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May 5, 2016

VIA E-FILING AND U.S. MAIL

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

**Re: In the Matter of the Investigation into Environmental and Socioeconomic Costs
Under Minn. Stat. § 216B.2422, Subd. 3
Docket No. E-999/CI-14-643
OAH Docket No. 80-2500-31888**

Dear Mr. Wolf:

Enclosed for filing please find the following on behalf of the Minnesota Large Industrial Group ("MLIG"):

1.   Exceptions to the Findings of Fact, Conclusions, and Recommendations of the Administrative Law Judge Regarding Phase I (CO_2 Track).

Very truly yours,

Stoel Rives LLP

Marc A. Al

MAA/tma
Enclosure
cc: Service List (via e-filing) (with encl.)

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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
EXCEPTIONS TO THE FINDINGS OF FACT, CONCLUSIONS, AND
RECOMMENDATIONS OF THE ADMINISTRATIVE LAW JUDGE
REGARDING PHASE I (CO$_2$ TRACK)**

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The Minnesota Large Industrial Group ("MLIG") hereby respectfully submits the following exceptions to the Findings of Fact, Conclusions, and Recommendation (the "Recommendations") of the Administrative Law Judge ("ALJ") in this matter regarding Phase I (CO_2) dated April 15, 2016, based upon which it submits that the Recommendations must be rejected and modified as set forth below and as set forth in the Appendix hereto.

INTRODUCTION

In its Order referring this matter to the Office of Administrative Hearings, the Commission directed that it believed "that a contested case proceeding is necessary to fully consider the Agencies' proposed CO_2 cost values. The Commission will therefore not act at this time on the Agencies' proposal to adopt the federal SCC values immediately. But, in light of the record so far, the Commission will ask the Administrative Law Judge to determine whether the Federal Social Cost of Carbon is reasonable and the best available measure to determine the environmental cost of CO_2 and, if not, what measure is better supported by the evidence."[1] None of the parties supporting a new environmental cost value for CO_2 has submitted any evidence other than the FSCC. Specifically, no other damages amounts have been identified.

As it relates to the CO_2 phase of this proceeding, the ALJ heard evidence in the form of pre-filed direct, rebuttal, and surrebuttal expert testimony and further heard five days of live expert testimony pursuant to the Commission's October 15, 2014, Notice and

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[1] Notice and Order for Hearing dated Oct. 15, 2014 at 4.

Order to determine whether the Federal Social Cost of Carbon ("FSCC") is reasonable and the best available measure to determine the environmental cost of CO_2 under Minn. Stat. § 216B.2422 and, if not, what measure is better supported by the evidence.[2] The ALJ further held one public hearing on August 26, 2015, at which public sentiments for and against adoption of the FSCC were aired but no expert testimony was submitted.

Because the Clean Energy Organizations ("CEOs"), later supported by the Minnesota Department of Commerce and the Minnesota Pollution Control Agency ("MPCA" and jointly with the Department the "Agencies"), Doctors for a Healthy Environment (the "Doctors"), and the Clean Energy Business Coalition ("CEBC" or the "Business Coalition") sought adoption of the FSCC as the environmental cost of CO_2 in Minnesota, they had the burden of establishing that the FSCC as adopted by the federal "Interagency Working Group" ("IWG") was reasonable and the best available measure to determine the environmental cost of CO_2 under Minn. Stat. § 216B.2422. *See* Minn. R. 1400.7300, Subp. 5. As set forth below, the ALJ instead considered evidence by the CEOs and the Agencies whether the IWG acted reasonably in 2010 in adopting the FSCC for its particular federal purposes limited to "cost-benefit analyses of regulatory actions that have small or 'marginal' impacts on cumulative global emissions."[3] Contrary to the Commission's charge to determine whether the FSCC is currently reasonable and the best

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[2]   Notice and Order for Hearing dated Oct. 15, 2014 at 4-5.

[3]   April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 62; Ex. 100 (Polasky Direct) at Schedule 2 (Feb. 2010 IWG Technical Support Document) at 1.

available measure to determine the environmental cost of CO_2, the ALJ further considered whether "it was reasonable for the IWG" to continue to rely on the 2007 Fourth Assessment Report ("AR4") published by the Intergovernmental Panel on Climate Change ("IPCC") when the IWG updated the FSCC in 2013, rather than the IPCC's subsequently published Fifth Assessment Report ("AR5")," overlooking that the AR5 was not published until after the IWG updated the FSCC in 2013.

As further set forth below, the ALJ erroneously imposed a burden of proof on FSCC opponents to show that climate change did not exist,[4] instead of considering witness testimony that the FSCC models do not adequately account for current data regarding actual current CO_2 levels and that the current reality is different from that predicted by the models, which "run hot," such that the data and the record invalidate a number of important assumptions within the FSCC, such as the equilibrium climate sensitivity ("ECS").

Bypassing these issues, the ALJ concluded that because it is the IWG's intention to update the FSCC "as appropriate in the future,"[5] the FSCC is reasonable and the best available measure to determine the environmental cost of CO_2 under Minn. Stat. § 216B.2422. This despite the ALJ's own conclusion that "the empirical evidence on which the IWG relied to calculate damage functions for the FSCC consisted of fewer than

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[4] *See, e.g.*, April 15, 2016, ALJ CO_2 Recommendations at 23.

[5] *Id.* at Conclusions 24-25.

fifty empirical studies, *which were neither up-to-date nor comprehensive*"[6] and the ALJ's conclusion that "more studies, using new approaches, have been published since the last update of the FSCC."[7] The MLIG respectfully submits that the ALJ's ultimate Conclusions and the ALJ's Recommendation to the Commission are not supported by the evidence, are contrary to the statutory scheme and its requirement of an empirical foundation and reliability, and must be rejected.

In the proceedings below, the MLIG has submitted affirmative evidence that the FSCC is based on erroneous assumptions. The IWG's various assumptions are, respectively, by themselves and in combination with others, far too uncertain and far too speculative to meet the applicable "practicability" test, or rely on outdated information, or are not supported by the total empirical evidence. The MLIG introduced affirmative evidence showing that the FSCC is not appropriate for adoption in the Minnesota regulatory environment, and the MLIG introduced evidence showing that if the Commission nevertheless desired to proceed along the lines of the FSCC, then six specific modifications were required to render the outcome relevant and within appropriate ranges of reliability.

The MLIG and the Utilities Group jointly retained Dr. Anne Smith, who was the only expert who obtained the models used by the IWG, tested those models, confirmed that she could achieve the same outcome as the IWG when using the IWG's data, and

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[6]   April 15, 2016, ALJ CO_2 Recommendations at Conclusions 9-10 (emphasis added).

[7]   *Id.* at Conclusions 9-10.

showed how corrections to the IWG's inputs impacted the outcome.[8] Thus, contrary to the ALJ,[9] Dr. Smith was able to provide exact social cost of carbon numbers resulting from her modifications and recommendations.

Specifically, the MLIG introduced evidence regarding modifications relating to:

(a)   the modeling time horizon: calculations beyond the year 2100 are too uncertain to rely on, and must replace the year 2300 used by the IWG;

(b)   the equilibrium climate sensitivity ("ECS"): the FSCC is based on grossly outdated information because it is based on the IPCC's 2007 Fourth Assessment Report ("AR4"), rather than the IPCC's most recent Fifth Assessment Report ("AR5") published in 2013, titled, *Climate Change 2013: The Physical Science Basis*;

(c)   the discount rate used to adjust the damage stream figures to present value: the MLIG introduced evidence regarding the use of 3%, 5%, and 7% discount rates or a weighted 5.66% discount rate (accounting for the fact that two-thirds of Minnesota's electricity consumption is by large industry and small, medium, and large companies, and about one-third of Minnesota's electric consumption is by households), rather than the 2.5%, 3%, 5%, and 95th percentile of damages at 3% discount rates relied on by

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[8]   Xcel Energy used the IWG's output, but did not use the models, such that Xcel is unable to calculate the effects of adjusting the inputs.

[9]   *See* April 15, 2016, ALJ CO$_2$ Recommendations at 123-124 (ALJ did not provide social cost of carbon numbers, as she was unable to make those calculations).

the IWG when it developed the FSCC for federal cost-benefit analysis of federal regulations specifically excluding relatively large CO_2 producers such as utilities;

(d)   the marginal ton to be regulated: the Commission should continue to rely on an "average" ton, rather than the "last" ton used by the IWG without discussion;

(e)   the applicable geographic scope: an appropriate geographic scope is Minnesota until such time as there is reciprocal recognition and action, rather than the global scope adopted by the IWG; and

(f)   expression of the social cost of carbon in "net tons" to account for the effects of leakage, as recognized by the IWG but not explicitly reflected in the FSCC value.

The ALJ has summarized much of the parties' positions and a good portion of the pre-filed testimony, but ignored most of the live testimony and did not actually make findings in the "Findings of Fact" portion of the Recommendations. For example, the ALJ did not weigh the evidence in her "Findings." Nor did the ALJ state in her "Findings of Fact" what she believed the evidence showed. Instead, the ALJ reached Conclusions, stating that one party or another had shown particular matters by a preponderance of the evidence, but those Conclusions are not supported by findings. If anything, the Conclusions find some support in the "Memorandum" the ALJ published with the Findings, Conclusions, and Recommendations, but the Memorandum shows that the ALJ has a fundamental personal disagreement with the statutory scheme that the

Commission is charged with carrying out. Specifically, the ALJ urges a new path for the Commission to take, which path improperly assumes the role of the Legislature and rewrites Minn. Stat. § 216B.2422.

The MLIG respectfully submits that the Commission has all the building blocks before it, including the pre-filed testimony, the evidentiary-hearing testimony, the exhibits, and the parties' positions as summarized in the issues matrix, the parties' briefs, and, to a degree, in the ALJ's "Findings of Fact." However, the MLIG also respectfully submits that the proponents of the FSCC did not meet their burden of proof that that the FSCC is reasonable and the best available measure to determine the environmental cost of CO_2 under Minn. Stat. § 216B.2422 and that numerous Findings of Fact and Conclusions as well as the Recommendations are not supported by the (preponderance of the) record, and should be rejected or modified as set forth below in detail.

As the Commission reviews this matter, the MLIG respectfully submits that it is further proper for the Commission to consider that the viability of the FSCC itself is highly uncertain because the National Academies of Sciences ("NAS") is currently undertaking an in-depth review of the FSCC, and has identified a number of the infirmities raised in this proceeding, including the overall uncertainty inherent in the values.[10] The committee commissioned by the NAS for this review has found that the

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[10] *Assessment of Approaches to Updating the Social Cost of Carbon: Phase 1 Report on a Near-Term Update* (Jan. 26, 2016). ("*NAS Report*") at 48 (noting *inter alia* that the IWG's FSCC estimates do "not yield a probability distribution that fully characterizes uncertainty about the SCC.")

current FSCC is fraught with uncertainty that the IWG has not sufficiently addressed (contrary to the ALJ's supposition that it has): "The committee notes that none of the three SCC-IAMs (nor any others of which the committee is aware) are sufficiently comprehensive to include all of the uncertainties in the inputs that are likely to be important in calculating the SCC."[11] The committee has found that the current social cost of carbon values do not "reflect the most recent scientific consensus on how global mean temperature is, in equilibrium, affected by CO_2 emissions."[12] The committee is evaluating the use of ECS within the integrated assessment models and is finding—much like experts who testified in this proceeding on behalf of opponents of adoption of the FSCC—that equilibrium climate sensitivity by itself does not sufficiently explain or estimate long-term future climate response. Accordingly the committee has recommended the development of a "common module" that better represents the relationship between CO_2 emissions and global temperature.[13]

This development is a relevant, independent, factor providing support for the exceptions set forth herein, which reject the FSCC as a viable, acceptable, current, reliable, and appropriate model for Minnesota resource-planning purposes.

ANALYSIS

I. THE LEGAL STANDARD

The Commission has broad authority to set rules, standards and practices

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11   *NAS Report* at 50.

12   *Id.* at 1.

13   *Id.* at 48.

governing service by public utilities.[14] But it bears emphasis that the Minnesota Supreme

Court has held:

> It is elementary that the Commission, being a creature of statute, has only those powers given to it by the legislature." Great Northern Railway Co. v. Public Service Comm'n, 284 Minn. 217, 220, 169 N.W.2d 732, 735 (1969). The legislature states what the agency is to do and how it is to do it. While express statutory authority need not be given a cramped reading, any enlargement of express powers by implication must be fairly drawn and fairly evident from the agency objectives and powers expressly given by the legislature.

Peoples Nat'l Gas Co. v. Minn. Pub. Utils. Comm'n, 369 N.W.2d 530, 534 (Minn. 1985).

Furthermore, "Neither agencies nor courts may under the guise of statutory interpretation

enlarge the agency's power beyond that which was contemplated by the legislative

body." Peoples, 369 N.W.2d at 534 (*quoting Waller v. Powers Dep't Store*, 343 N.W.2d

655, 657 (Minn. 1984)). When there is no ambiguous language to construe, courts will

look to the "necessity and logic" of the situation. *Id.* At the same time, the general rule

of a reviewing court is to "resolve any doubt about the existence of an agency's authority

against the exercise of such authority." *In re Qwest's Wholesale Service*, 702 N.W.2d

246, 258 (Minn. 2005) (emphasis added) (*citing In re N. States Power Co.*, 414 N.W.2d

383, 387 (Minn. 1987)).

It is axiomatic that the law cannot impose a liability, deprive citizens of resources,

or prohibit them from engaging in an otherwise lawful activity based upon speculation

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[14]   *See, e.g., Hoffman v. N. States Power Co.,* 764 N.W.2d 34, 44 (2009) ("The MPUC further enjoys broad power to 'ascertain and fix just and reasonable' policies for all public utilities.")

and admitted uncertainty as to whether or not the activity is in fact causing harm. Proof of causation of harm is a fundamental prerequisite to regulation. Causal uncertainty cannot be the basis for regulation. It may be the basis for theoretical modeling, but it cannot be the basis for a legal requirement. Fundamental notions of due process require more than guesswork, speculation, and regulation that lacks a current, actual empirical and factual basis. *Citizens Advocating Responsible Dev. v. Kandiyohi Cnty. Bd. of Comm'rs*, 713 N.W.2d 817, 834 (Minn. 2006). Consistent with those foundational legal principles regarding proof of harm and causation, the Commission set forth the legal standard in its January 3, 1997, Order Establishing Environmental Cost Values in Docket No. E-999/CI-93-583. That decision was affirmed by the Court of Appeals in *In re Quantification of Envt'l Costs Pursuant to Laws of Minn. 1993, Chap. 356, Sec. 3*, 578 N.W.2d 794 (Minn. Ct. App. 1998), and the Minnesota Supreme Court denied review on August 18, 1998. With the denial of review, the Commission's 1997 interpretation of Minn. Stat. § 216B.2422 became the law, which the Commission is now bound to apply.

Rooted in principles of due process, the Commission in the original 1996 proceeding adopted ALJ Klein's recommendation to not adopt high values that were based on speculation and not data.[15] Pursuant to the Commission's 1997 Order, it is not

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[15] Ex. 305 (March 22, 1996, Findings of Fact, Conclusions, Recommendation and Memorandum (ALJ Allan W. Klein), Docket 93-583) at ¶ 31 ("At some point, the degree of uncertainty associated with a proposed value becomes so great that there is insufficient evidence to meet the preponderance standard, and the value cannot be adopted."). The ALJ incorrectly states in her Memorandum that the Commission did not expressly adopt ALJ Klein's recommendation for conservatism in the face of uncertainty. This argument has no merit. This

(continued)

sufficient in this proceeding to simply make a "call for immediate action." In the original proceeding, the Commission held that "[h]owever enticing the MPCA's calls to immediate action may be, they do not add information that makes it any more practicable to quantify damages on the basis of this record nor do they alter the legislature's directive that the Commission is to quantify values only if (to the extent) it is feasible (practicable) to do so."[16] Instead, the ALJ was to consider, and the Commission must now consider that there are

> varying levels or depths of uncertainty, a continuum of uncertainty involved in the science underlying the valuation of externalities. At some levels of uncertainty it is still practicable (feasible) to quantify environmental values. . . However, there is also a point on the uncertainty continuum where it becomes infeasible to quantify environmental costs even though the Commission is convinced that such costs exist.[17]

The Commission in 1997 considered the following apt analogy:

> not all fogs are of the same thickness: in some fog, it is still possible to land an airplane without instrumentation while in thicker fog, this task becomes impossible despite the certainty that both land and airplane exist.[18]

(continued)
Commission recognized ALJ Klein's recommendation as "well-reasoned and firmly based in the record." January 3, 1997, Order Establishing Environmental Cost Values at 26 ("The Commission finds that the ALJ's calculation is well reasoned and firmly based in the record. See ALJ's Report, Findings 102 - 114.") & 34 ¶ 5 ("To the extent not separately addressed in this Order, the Commission adopts the decisions and analysis in ALJ's Report").

[16]   Order Establishing Environmental Cost Values dated January 3, 1997, at 31.

[17]   *Id.* at 30.

[18]   *Id.* at 30, n.17.

II.   BURDEN OF PROOF

The parties have been governed in this proceeding by a ruling that "no special burden of proof attaches to proceedings under Minn. Stat. § 216B.2422, and that any party advocating a position must support that position by a preponderance of the evidence."[19]   Accordingly, "[a] party or parties proposing that the Commission adopt a new environmental cost value for CO_2, including the Federal Social Cost of Carbon, bears the burden of showing, by a preponderance of the evidence, that the value being proposed is reasonable and the best available measure of the environmental cost of CO_2."[20]   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."[21]   "If the weight of the evidence [to determine whether a proposal is practicable[22]] 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."[23]

The MLIG takes exception to paragraph 3 of the Order Regarding Burdens of

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[19]   Order Regarding Burdens of Proof dated March 27, 2015 at 5 (*citing* Minn. Rules Part 1400.7300, subp. 5).

[20]   *Id.* at 2, ¶ 1.

[21]   *Id.* at 6 (emphasis added).

[22]   "Practicable" has been defined by the Commission in its January 3, 1997, Order Establishing Environmental Cost Values, to mean "feasible" or "capable of being accomplished."   Order Establishing Environmental Cost Values dated January 3, 1997, at 10-11.

[23]   Order Regarding Burdens of Proof dated March 27, 2015 at 6 (emphasis added).

Proof dated March 27, 2015 that requires that "[a] party or parties proposing that the Commission retain any environmental cost value as currently assigned by the Commission bears the burden of showing, by a preponderance of the evidence, that the current value is reasonable and the best available measure to determine the applicable environmental cost."[24] Imposing a burden of proof on a party seeking to establish a new value is in accord with Minn. R. 1400.7300, Subp. 5. Seeking to impose a burden of proof on a party who simply rejects values newly proposed by others, which then leaves the *status quo ante* is contrary to law. *See* Minn. R. 1400.7300, Subp. 5.

The ALJ's Memorandum suggests that the ALJ lost sight of the burden of proof and the Legislature's mandate. Minn. Stat. § 216B.2422 does not delegate to the Commission the power to set arbitrary social-cost-of-carbon values to minimize the environmental impact of society; the Commission's task instead is to quantify damages of CO_2 where the requisite level of certainty exists to establish those damages.[25]

A review of the ALJ's "Findings of Fact" and Conclusions shows that the ALJ placed an improper burden on opponents of the FSCC. The ALJ reports how parties disagree with the FSCC, and then provides the FSCC-proponents' response. The ALJ's Conclusions 52 through 56 show unambiguously that the ALJ put the cart before the horse, analyzing the alternatives to the FSCC before analyzing whether the FSCC proponents met their burden of proof. Conclusions 22 through 25 show that the ALJ did

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24   Order Regarding Burdens of Proof dated March 27, 2015 at 2-3, ¶ 3.

25   Order Establishing Environmental Cost Values dated January 3, 1997, at 30.

not even require the FSCC-proponents to defend critical aspects of the FSCC, such as the equilibrium climate sensitivity input.

Although this proceeding started with the CEOs' argument to the Commission that the science had changed since the original 1996 proceeding,[26] the CEOs, the Agencies, the Doctors, and the Business Coalition have not put forth any independent scientific evidence to show that the FSCC is based on current, accurate, reliable information that is appropriate for use in Minnesota resource-planning proceedings, and that the FSCC provides the best available measure of the environmental cost of CO_2. This is a fundamental flaw in their respective cases. In fact, the evidence shows—and the ALJ concluded—that the IWG's FSCC is based on empirical studies which are not up to date, and reaches excessively speculative conclusions. Therefore, and based on the ALJ's Conclusions, proponents of the FSCC have failed to meet the applicable burden of proof, requiring rejection, rather than adoption, of the FSCC. Specific flaws in the Recommendations are detailed below.

III. THE FSCC IS NOT SCIENTIFICALLY OR ECONOMICALLY VIABLE

The MLIG take exception to Conclusions 52 through 56, in which the ALJ concluded that "the Agencies and the CEOs demonstrated by a preponderance of the evidence that the Federal Social Cost of Carbon is reasonable and the best available measure to determine the environmental cost of CO_2, with the exceptions described in

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[26] *See* October 9, 2013, Memorandum in Support of Clean Energy Organizations' Motion to Update Externality Values for Use in Resource Decisions in Commission Docket No. E-999/CI- 93-583 at 18-19.

these findings regarding the 95th percentile and the time modeling horizon," and concluded that all other parties "failed to demonstrate, by a preponderance of the evidence, that any of the CO_2 environmental cost values they proposed are reasonable and the best available measure of CO_2 cost values."

The MLIG submits that the preponderance of the evidence shows that the FSCC is neither current, nor correct. The evidence instead shows that the sensitivity of the IAMs to unverified and non-scientific assumptions made by modelers, as well as by model users, throws into question the reasonableness of using any social cost of carbon value that the IAMs may produce, and that the social-cost-of-carbon values lack reasonableness for national-level as well as state-level policy-making.

Even the Clean Energy Organizations in this case expressly conceded the inherent uncertainty in the climate-emissions relationship at the heart of the FSCC calculation: "The exact relationship between concentrations and temperature is unknown and 'likely to remain unknown for the foreseeable future' because it involves complicated feedback loops, the strength of which are not currently measureable."[27] This is an explicit admission that there is not a preponderance of evidence to support the FSCC.

The ALJ did not assess the credentials of the experts. Peabody, for example, proffered Dr. Richard Tol, one of the foremost experts in the world and an IPCC lead

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[27] *See* Agencies November 24, 2015, Initial CO_2 Brief at 14. Additionally, Dr. Dessler, an expert for the CEOs, testified as to increases in uncertainty between 2007 and 2013: "I think there were additional studies that came out. I don't think that improved our understanding, it added to the range. In fact, if anything, it added some uncertainty." Tr. Vol. 3A at 49:12-16.)

author, who is the creator of the FUND model; one of the models upon which the very FSCC is based. He testified that the FSCC does not appear to be "scientifically or economically reliable."[28] Dr. Tol also testified that the FSCC models wholly fail to account for naturally occurring variability.[29] When a leading author and scientist of Professor Tol's caliber so testifies, it is untenable to ignore it and not give it substantial weight. Indeed, the CEOs and Agencies' decision to not cross examine Professor Tol amounts to a tacit admission that his credibility is superior and that they risked undermining their position had they attempted to cross examine him. The adverse inference to which the opponents of the FSCC are entitled in the face of this startling decision to not cross-examine Professor Tol is that the CEOs' and the Agencies' position is comparatively weaker.

Dr. Smith testified similarly,[30] but no person with actual knowledge of the intricacies of the adoption of the FSCC by the IWG has testified in this proceeding. The Agencies and CEOs instead proffered only the opinions—not actual damage-cost modeling work—of their retained experts, who had no direct involvement in IWG's proceedings, and who were not otherwise involved in the IWG's non-peer reviewed work in developing the FSCC.

On this basis alone the Commission should find that the proponents of the FSCC

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[28]   Ex. 238 (Tol Rebuttal) Ex. 2 (Report) at 7:131-133.

[29]   *Id.* at 9:187-188 ("current models do not disaggregate the effects of human-induced warming and natural variability.").

[30]   *See, e.g.*, Ex. 300 at 17.

have failed to meet their burden of proof, and should reject adoption of the FSCC for

Minnesota resource-planning purposes, leaving the current values.

However, if the Commission rejects this evidence, then the MLIG submits that

there are at least five modifications that must be made to the input assumptions for the

FSCC to "obtain relatively more appropriate estimates of damage costs from IAMs than

the IWG has produced.[31]

IV. THE ALJ'S MODELING TIME HORIZON OF THE YEAR 2200 IS UNREASONABLE AND MUST BE REDUCED TO THE YEAR 2100

A. Modeling time horizons through the years 2200 and 2300 are unreasonable

Under the January 3, 1997, Order Establishing Environmental Cost Values, the

Commission adopted Mr. Ciborowski's use of the year 2100 as the end of its modeling

horizon. The ALJ here has recommended extending that modeling horizon to the year

2200, although no witness recommended this year, although there is no factual basis for a

year-2200 modeling horizon, and notwithstanding the fact that the ALJ has admitted that

the "evidentiary underpinning is no greater for this extrapolation than it would be to

extend the model to the year 2300," which the ALJ rejected as "not reasonably supported

by adequate evidence."[32] Absent evidentiary support, the ALJ's Recommendation to use

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[31]   *See, e.g.*, Ex. 300 at 17.

[32]   *See* April 15, 2016, ALJ CO$_2$ Recommendations at Conclusions 34 and 35. *See also* Conclusion 9 ("…the empirical evidence on which the IWG relied to calculate damage functions for the FSCC consisted of fewer than fifty empirical studies, which were neither up-to-date nor comprehensive, adding to the uncertainty of the FSCC estimates, particularly in the areas of catastrophic damages and the treatment of the distant future.").

a new year 2200 modeling time horizon must be rejected.

It is undisputed that the IWG based the FSCC on a modeling time horizon stretching to the year 2300 based on the fact that CO_2 remains in the atmosphere for up to 200 years.[33] It is also undisputed that the IWG based its calculations for the FSCC on three different Integrated Assessment Models ("IAMs") which rely on certain scenarios from the Stanford Energy Modeling Forum ("EMF") exercise, EMF-22.[34] EMF-22 uses ten well-recognized scenarios to evaluate global action to meet specific global stabilization targets. The EMF-22 scenarios provide GDP, population, and greenhouse gas ("GHG") emission trajectories that are internally consistent for each model. The EMF-22 scenarios have been peer-reviewed, published, and are publically available.[35] But because the EMF-22 scenarios are not constructed to allow calculations beyond the year 2100,[36] the IWG extrapolated the EMF-22 data with another 200 years to be able to calculate damages through the year 2300, none of which is based on a peer-reviewed process.[37]

The FSCC modeling horizon is a brew of the IWG's own making, which "lack[s] a coherent, viable, and intuitive storyline (or set of storylines) that drive all of the

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[33]   *See* April 15, 2016, ALJ CO_2 Recommendations at Findings of Fact 255-267.

[34]   *See id.* at Finding of Fact 107.

[35]   *Id.*

[36]   *Id.* at Finding of Fact 255.

[37]   *Id.* at Conclusion 32.

extensions from 2100 to 2300."[38] According to a recent study by the Electric Power Research Institute (EPRI, 2014) which is part of the record, the FSCC contains major inconsistencies such as the assumption that the world will emit many more times the CO_2 than the total available carbon available in the world.[39] The EPRI found that:

· The forecasts are not self-consistent. The IWG extrapolates land-use CO_2 emissions, non-CO_2 radiative forcing, population, GDP, and fossil and industrial CO_2 emissions. But these extrapolations are done in isolation without considering the effect of one forecast on all other forecasts. Therefore, the set of extensions lack internal consistency.[40]

· The forecasts are inconsistent regarding physical facts. EPRI finds *all the IWG's extensions except the 5th Scenario result in an amount of CO_2 emissions that greatly exceed the CO_2 emissions that could come about from the combustion of all current estimates of global fossil fuel reserves*. Current estimates of total CO_2 embodied in reserves of fossil fuel fall between 3,700 and 7,100 Gt CO2. All IWG scenarios except the 5th Scenario forecasts total cumulative emissions in excess of 8,100 Gt CO_2 in 2200 and above 10,900 Gt CO_2 by 2300. The MERGE scenario's cumulative 2300 emissions exceed the emissions from reserves by 4.5 to 8.5 times. None of these relationships invalidate the IWG scenarios because new technologies could be developed or resources found that would greatly increase the level of reserves, but this would likely mean a significant increase in fossil fuel

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[38]   Ex. 302 (Smith Direct report) at 68 (citations omitted).

[39]   *See* Ex. 302 (Smith Direct report) at 68-69.

[40]   Population growth rate declines linearly, reaching zero in the year 2200. GDP/per capita growth rate declines linearly, reaching zero in the year 2300. The decline in the fossil and industrial carbon intensity (CO_2/GDP) growth rate over 2090-2100 is maintained from 2100 through 2300. Net land use CO_2 emissions decline linearly, reaching zero in the year 2200; and non-CO_2 radiative forcing remains constant after 2100. (Ex. 302 (Smith Direct report) at 68 (citations omitted).)

prices. However, none of the IWG extensions consider the feedback that the high demand for fossil fuels could have on the prices of fossil fuels. EPRI notes this relationship between current reserves and the amount of fossil energy that the IWG's extensions imply will be needed "further illustrates the need to consider socioeconomic structure and its uncertainty in the development of socioeconomic and emissions assumptions."

· There is a lack of diversity among the forecasts. The possible ways in which the world will evolve over the next three hundred years is much greater than five. But in some ways, the five scenarios represent only two regulatory outcomes. The four EMF scenarios represent a [business-as-usual] situation where no action is taken to reduce GHG emissions, and the 5th scenario represents a scenario in which the world strives to be on a 550 ppm CO_2 concentration.

· Furthermore, the formulas to project the post 2100 forecasts for population, GDP per capita, carbon intensity, net land use CO_2 emissions, and non-CO_2 radiative forcing are the same for all scenarios. Therefore, the IWG fails to consider a broad range of ways in which the market could evolve as required in the OMB's guidelines for regulatory analysis.[41]

The ALJ has implicitly recognized that the IAMs' damage functions are based on a limited number of studies of the economic impact of warming of 3°C or less.[42] The IAMs, however, are used to predict the damage to the economy of much greater changes

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[41] Ex. 302 (Smith Direct report) at 68-69 (citations omitted).

[42] *See* April 15, 2016, ALJ CO_2 Recommendations at Findings of Fact 255-260. *See also* Ex. 300 at 18:17-19:2. Dr. Polasky agrees with Dr. Smith and with the IWG that "there is currently a limited amount of research linking climate impacts to economic damages." (Tr. Vol. 1 at 83:7-85:3 (Polasky); Ex. 100 (Polasky Direct) at Schedule 2 (Feb. 2010 IWG Technical Support Document) at 5.)

in temperature.[43] The ALJ concluded that up to a temperature increase of about 3°C, "there is some limited empirical evidence about how climate change will impact the economy. By extending the time horizon of the scenarios, significant numbers of the IAMs' runs project very high temperature increases. Because there is no data to support the amount of damages that will result from temperature increases over about 4 degrees centigrade, … much of the FSCC estimate is speculative."[44]

Lacking any foundational data for the greater range, the modelers have had to extrapolate the shape of a damages curve above 3°C without being able to validate the shape with empirical data.[45] Despite the absence of an empirical foundation, the ALJ accepted without questioning that the higher damage levels at higher projected temperatures in the modeled damages curve elevate the IWG's FSCC estimates.[46] Quoting Professor Pindyck, Dr. Smith testified that

> [IAMs] can say nothing meaningful about the kinds of damages we should expect for temperature increases of 5°C or more. ….Thus we are left in the dark; IAMs cannot tell us anything useful about catastrophic outcomes, and thus cannot provide meaningful estimates of the SCC.[47]

In addition, the FSCC estimates are speculative because of the lack of specificity of the

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[43]   *See* April 15, 2016, ALJ CO$_2$ Recommendations at Findings of Fact 255-260.

[44]   *Id.* at Finding of Fact 256.

[45]   *Id.*

[46]   Ex. 300 (Smith Direct) at 18:17-19:2.

[47]   Ex. 304 (Smith Surrebuttal) at 10:22-11:6 (citations omitted).

dose-response relationships that are implicit in the IAMs' extrapolations.[48]

The current estimates of CO_2 environmental cost values for Minnesota were based on estimates of loss in GDP due to projected temperature changes through the year 2100, with an assumption that temperature will have increased 4°C above pre-industrial levels by that time.[49] "Mr. Ciborowski (the witness who prepared those estimates) relied upon projections that either ended by or before 2100, or addressed only temperature changes of 2.5°C or 3°C, which were being projected to occur well before 2100."[50] Like the Commission's fog analogy in its January 3, 1997, Order Establishing Environmental Cost Values,[51] Dr. Smith pointed out that "[t]hese researchers' decisions to limit their analytic horizons (observed in both Mr. Ciborowski's references and also in the EMF 22 scenarios) are not because they fail to understand that damages from greenhouse gas emissions in the near term will last beyond 2100."[52] "Rather, modelers know that the uncertainty in any projections they can make expands as those projections go further in time, until at some point the projections are not useful or meaningful. When the projections depend strongly on assumptions about technologies and/or consumer preferences, analysts feel that horizons much beyond 80 to 100 years is where uncertainty

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[48]   Ex. 300 (Smith Direct) at 19:21-20:1.

[49]   Ex. 302 (Smith Direct report) at 69.

[50]   *Id.*

[51]   *See* Order Establishing Environmental Cost Values dated January 3, 1997, at 30, n.17.

[52]   Ex. 302 at 69.

reaches that overly speculative point."[53]

Dr. Smith testified in her pre-filed testimony that "Cline (1992) is the one source that Mr. Ciborowski relied on that considers the role of potential damages in the far future (2250), at much higher temperatures (10°C), and even he presented his calculations as a "conceptual" exercise. He concluded:

> [P]erhaps the single most important need for research on greenhouse policy is to identify the prospective damages over the very-long-term, on the order of 250-300 years. The scientific community simply has not made these estimates… The furthest out the scientific community has yet been prepared to venture is to the year 2100.

In making this statement, Cline makes it clear that projections of damages beyond about 2100 are simply thought experiments that cannot be treated as credibly as the estimates for the period up through 2100."[54] Dr. Smith has accordingly unambiguously expressed that the IWG's values beyond the year 2100 are "driven more by the speculative portions of the IAMs' damages functions than by the portions that have at least some evidentiary basis."[55]

Ignoring this testimony, the ALJ recommends extension of the modeling time horizon to the year 2200.[56] However, even the CEOs' and the Agencies' witnesses agree that the damages are inherently uncertain, and become more and more uncertain as the

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[53]   Ex. 302 at 69.

[54]   *Id.* at 69-70 (citations omitted).

[55]   Ex. 300 at 23:2-5.

[56]   April 15, 2016, ALJ CO_2 Recommendations at Conclusion 35; *id.* at Recommendation 1.a.

time horizon is extended.[57] Dr. Polasky admitted that there really isn't empirical data to support the estimation of damages above a 3°C degree increase in temperature from temperatures at pre-industrial times, and that we haven't even reached 2°C above pre-industrial (year 1900) levels.[58] Furthermore, Dr. Polasky agreed that "the further out you go the more difficult it is. The greater the range of uncertainty, that is correct.[59]

Challenged about his basis for believing that the IWG "got it right," Dr. Polasky testified that the IWG's multi-agency process "drew on the expertise of many experts,"[60] which description the ALJ appears to have accepted.[61] But the testimony has shown that due to the "deliberative process privilege,"[62] with the exception of three people, the names and even the positions of individuals who worked on the FSCC are not known, nor is it known which individuals did which things in the IWG, or what their educational and professional work experiences/backgrounds were, rendering blind reliance unreasonable.[63] In other words, there is no evidence in the record to support the finding

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[57]   *See, e.g.*, Tr. Vol. 1 at 114:16-17 (Polasky: "inherent uncertainty in predicting future damages"); Tr. Vol. 1 at 11:20-12:1; 81:6-12; 81:13-82:1; 82:24-83:6; 172:13-17 (Polasky); Tr. Vol. 5 at 63:19-20 (Reich) ("a lot of uncertainty.").

[58]   Tr. Vol. 1 at 124:7-13; 211:21-25 (Polasky).

[59]   Tr. Vol. 1 at 89:22-90:11 (Polasky).

[60]   Tr. Vol. 1 at 61:23-25 (Polasky).

[61]   April 15, 2016, ALJ CO$_2$ Recommendations at Finding of Fact 61.

[62]   This privilege protects "documents reflecting advisory opinions, recommendations and deliberations comprising part of a process by which governmental decisions and policies are formulated." *See Nat'l Labor Relations Bd. v. Sears, Roebuck & Co.*, 421 U.S. 132 (U.S. 1975).

[63]   *See, e.g.,* Tr. Vol. 1 at 87:19-88:1; 112:9-16; 113:4-9; 152:18-153:1; 156:5-9

(continued)

in Finding of Fact 61 that the IWG included scientific and economic experts, and that

Finding of Fact must accordingly be modified.

The ALJ recognized the unreasonable uncertainty, and concluded that "the CEOs

and Agencies failed to demonstrate that the IWG's prediction of damages from the year

2100 to the year 2300 meet the same standards of reliability as the IWG's predictions of

damages from the present to the year 2100. The IWG used the peer-reviewed EMF-22

emissions scenarios, which were constructed through the year 2100. The IWG

extrapolated the EMF inputs to the year 2300 based on limited data, without the benefit

of peer review."[64]

The CEOs and the Agencies supported the IWG's extrapolation despite their

experts' admissions that the extrapolation introduced great uncertainty into the modeling

results. But the ALJ explicitly concluded that "the Agencies and the CEOs failed to

demonstrate by a preponderance of the evidence that a modeling time horizon extending

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(continued)

(Polasky). It is thus also error for the ALJ to have found that "[t]he interagency group included scientific and economic *experts* from the White House and federal agencies…" (Finding of Fact 61, emphasis added.) Without any knowledge of the names or positions of the members of the IWG, there is no basis to find or conclude that a person is an "expert," and the second sentence of Finding of Fact 61 must be modified as follows: "The interagency group included ~~scientific and economic experts~~ representatives from the White House and federal agencies, including the Council of Economic Advisers, Council on Environmental Quality, National Economic Council, Office of Energy and Climate Change, Office of Science and Technology Policy, Office of Management and Budget, Environmental Protection Agency, and Departments of Agriculture, Commerce, Energy, Transportation, and Treasury."

[64] April 15, 2016, ALJ CO_2 Recommendations at Conclusion 32.

to the year 2300 is reasonable."[65]   Additionally, the ALJ concluded that "[a]n additional

two-hundred years will add increased numbers of cost values at lower interest rates and

accelerating rates of damages with the passage of time and increased temperature.

Therefore, the Administrative Law Judge finds that an extrapolation extending two-

hundred years beyond the year that the EMF-22 scenarios were constructed to end is a

degree of uncertainty that is not reasonably supported by adequate evidence."[66]

In the Memorandum, the ALJ recognized that there is "a significant drop-off in the

reliability of how to predict those damages after 2100. Predicting future damages is not

at all certain, even based on the peer-reviewed EMF-22 scenarios designed to project to

the year 2100. The IWG's extrapolation beyond that time frame with the scenarios is

more tenuous."[67]   The ALJ further recognized that "[t]he best evidence supports

recalculating the damages to the year 2100."[68] But the ALJ then abandoned this finding

as well as the statutory scheme and its "practicability" standard, and choosing instead to

adopt a modeling horizon of the year 2200, in an effort to allegedly balance the "certainty

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[65]   April 15, 2016, ALJ CO$_2$ Recommendations at Conclusion 34.

[66]   *Id.* at Conclusion 34.

[67]   *Id.* at p. 129 (Memorandum).

[68]   *Id.*; Ex. 304 (Smith Surrebuttal) at 19:3-20 ("Stated another way, the amount of speculation about societal risks and preferences using a 2100 horizon for [social cost of carbon] estimation would be similar to attempting to project societal values associated with today's medical procedures, devices, drugs and immunizations, our communication methods such as the internet and smartphones, our range of food sources, our uses of electricity and gasoline, our methods of electricity generation, and our household appliances as an extension of the mix of services consumed and technologies available in 1935.")

that damages will continue to occur after 2100" with the "significant drop-off in the reliability of how to predict those damages after 2100."[69]

The MLIG applauds the ALJ for forthrightly admitting that the recommended compromise lacks an evidentiary basis when she concluded that "the evidentiary underpinning is no greater for this extrapolation than it would be to extend the model to the year 2300."[70] However, the Commission's January 3, 1997, Order Establishing Environmental Cost Values, as affirmed by the Court of Appeals, recognized that there are "varying levels or depths of uncertainty, a continuum of uncertainty involved in the science underlying the valuation of externalities," and further recognized that at "some levels of uncertainty it is still practicable (feasible) to quantify environmental values," but that "there is also a point on the uncertainty continuum where it becomes infeasible to quantify environmental costs even though the Commission is convinced that such costs exist."[71] This is the evidentiary standard that must be met, and the ALJ's Conclusions and Memorandum show that there is no such support for a modeling time horizon through the year 2200.

B.   Conclusion: the modeling time horizon must be reduced to the year 2100

Because the ALJ's compromise does not conform to the required evidentiary standard, and because the ALJ has reasonably and based upon Dr. Smith's testimony

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[69]   April 15, 2016, ALJ CO_2 Recommendations at p. 129-130 (Memorandum).

[70]   *Id.* at p. 129 (Memorandum) & Conclusions 34, 35.

[71]   Order Establishing Environmental Cost Values dated January 3, 1997, at 30.

concluded that "[t]he best evidence supports recalculating the damages to the year 2100,"[72] Recommendation 1.a. must be modified to substitute the year 2100 for the year 2200, and Conclusions 34 and 35 should be modified to read:

> 34.   The Administrative Law Judge concludes that the Agencies and the CEOs failed to demonstrate by a preponderance of the evidence that a modeling time horizon extending to the year 2300 is reasonable. An additional two-hundred years will add increased numbers of cost values at lower interest rates and accelerating rates of damages with the passage of time and increased temperature. Therefore, the Administrative Law Judge finds that an extrapolation extending two-hundred years or even one-hundred years beyond the year that the EMF-22 scenarios were constructed to end is a degree of uncertainty that is not reasonably supported by adequate evidence.

> 35.   However, weighing the importance of accounting for the CO2 that will remain in the atmosphere beyond the year 2100, and the understated nature of the FSCC, the Administrative Law Judge concludes that it is reasonable to implement the IWG's extrapolation for 100 years, to the year 2200. While the evidentiary underpinning is no greater for this extrapolation than it would be to extend the model to the year 2300, this approach lessens the danger of multiplication of errors within the extrapolation while providing a response to the strong evidence of damage from CO2.

> 35.   Because there is no evidentiary underpinning for the IWG's extrapolation of the EMF-22 scenarios, the FSCC values should be recalculated to reflect a shortened time horizon extending to the year 2100.

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[72]   Order Establishing Environmental Cost Values dated January 3, 1997, at 30.

V. THE ALJ ERRONEOUSLY ACCEPTED AN EQUILIBRIUM CLIMATE SENSITIVITY ("ECS") BASED ON GROSSLY OUTDATED INFORMATION

A. The ECS is a "very important driver"

It is undisputed that the equilibrium climate sensitivity ("ECS") is a "very important driver" in the damages calculations made by the PAGE, DICE, and FUND models.[73] As the ALJ recognized, ECS is the "long-term increase in the annual global average surface temperature resulting from a doubling of atmospheric CO_2 concentration relative to preindustrial levels (or stabilization at a concentration of approximately 550 ppm)."[74] An ECS of 2 means that a doubling of the atmospheric concentration of CO_2 from preindustrial levels results in an equilibrium temperature increase of 2°C, while an ECS of 1 implies that a doubling of CO_2 concentration ultimately leads to an increase in temperature of 1°C.[75] In other words, the ECS is the relationship between emissions and warming.[76] The ALJ further recognized that the ECS parameter is subject to considerable uncertainty.[77] Empirical observations about ECS, particularly in the higher temperature ranges, are very limited.[78]

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[73] Tr. Vol. 1 at 166:12-167:4 (Polasky).

[74] April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 111 (*citing* Ex. 800, WMH-2 at 12 (Hanemann Direct)). *See also* Tr. Vol. 2A at 16:5-7 (Lindzen); Ex. 405 (IPCC's 2013 Fifth Assessment Report) part 36 at 1110.

[75] April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 111 (*citing* Ex. 200 at 6-7 (Happer Direct)).

[76] *Id.*

[77] *Id.* (*citing* Ex. 800, WMH-2 at 12).

[78] *Id.* (*citing* Ex. 302, AES-D-2 at 28-29 (Smith Direct)).

The IWG dealt with this uncertainty by applying a statistical Roe & Baker probability distribution for the potential range of ECS values, but this range was based only on a "theoretical understanding of the response of the climate system to increased greenhouse gas concentrations."[79] In other words, there is no actual data supporting the IWG's ECS input into the FSCC models. Had the IWG relied on actual data, instead of theory, it would have had to confront the reality that global surface temperatures have not to date risen along with greenhouse gas emissions at the rates assumed in the FSCC models; Peabody's witnesses and evidence showed that the current temperature data calls into question the assumptions relied upon by the IWG.

The sensitivity of the IAM's damages calculations was demonstrated by Dr. Smith's rebuttal testimony. Dr. Smith ran the DICE 2010 model with the IMAGE socioeconomic scenario and a fixed ECS value of 1.5°C at discount rates of 3% and 5%. That study produced social cost of carbon estimates 57 percent to 60 percent lower than the IWG's estimates,[80] as shown in Table 1 on page 15 of Exhibit 303 (Smith Rebuttal):

Table 1. Sensitivity of 2020 SCC Estimates Using DICE 2010 and the IMAGE Socioeconomic Scenario ($/tonne CO_2, 2007$)

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[79] April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 113 (emphasis added).

[80] 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.

	3% discount rate	5% discount rate
No changes from IWG assumptions (i.e., replicating IWG's result for IMAGE scenario)	$48	$15
Using fixed value of equilibrium climate sensitivity = 3 (i.e., median value of IWG's probability distribution)	$43	$14
Using fixed value of equilibrium climate sensitivity = 1.5	$17	$6

(*See* Ex. 303 at 13:2-15:3.) For each row, Dr. Smith identified the specific changes she made from the IWG's analysis using the DICE 2010 model and the IWG's socioeconomic "IMAGE" scenario. These are social cost of carbon values for emissions in the year 2020, and are stated in 2007$, which is the dollar-year used in the IWG's reports.[81]

B. The IWG and the ALJ relied on an erroneous ECS

1. The ECS relied on by the IWG and adopted by the ALJ is out of date by more than 6 years

It is undisputed that the IWG did not use the climate sensitivity numbers provided by the IAMs, and instead relied on its own estimates on climate sensitivity.[82] The IWG

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[81] To convert to 2014$, multiply the values by 1.11. (Ex. 303 (Smith Rebuttal) at 14:12-13.)

[82] Tr. Vol. 1 at 97:18-21 (Polasky).

based its ECS on the IPCC's 2007 Fourth Assessment Report (AR4).[83] The ALJ concluded that "the IPCC ranges are representative of a comprehensive, peer-reviewed body of scientific study based on multiple lines of evidence."[84]

Although the IWG relied on the IPCC's 2007 AR4, it did not rely on one fixed sensitivity, instead applying a Roe & Baker distribution[85] within a range of climate sensitivities contained in AR4.[86] The 2007 AR4 advocated a new, higher, likely-range ECS from 2°C to 4.5°C and a "central estimate" of 3°C compared to the IPCC's 2001 Third Assessment Report ("AR3"), which had found a likely range of 1.5°C to 4.5°C and did not contain a central estimate.[87]

The IPCC expressly abandoned both the higher ECS and the central estimate of 3°C in 2013 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"[88] — in other words, better science. In fact, the IPCC expressly found in its 2013 Fifth Assessment Report (AR5) that the new

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[83] *See* Ex. 101 at Schedule 1 (July 2015 IWG Response to Comments) at 12.

[84] April 15, 2016, ALJ CO$_2$ Recommendations at Conclusion 23.

[85] Ex. 100 (Polasky Direct) at Schedule 2 (Feb. 2010 IWG Technical Support Document) at 13-14 (IWG "selected Roe and Baker distribution").

[86] *See* Ex. 101 at Schedule 1 (July 2015 IWG Response to Comments) at 12.

[87] 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.

[88] 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.

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."[89] This lower part translates to an ECS range from 1.5°C to 3°C.

According to Dr. Polasky, testifying for the CEOs, the AR4 ECS is outdated, and the "measure of central tendency" first and last found in AR4 has been abandoned.[90] Reliance on AR4 in this proceeding is thus inappropriate. Agreeing, the Agencies recognized expressly 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."[91]

> ### 2. The IWG misapplied the Roe & Baker distribution, leading to erroneous ECS input into the IAM models

As stated above, the IWG dealt with uncertainty by applying a statistical Roe & Baker probability distribution for the potential range of ECS values. The IWG's use of a Roe & Baker distribution and how it used that distribution are important for two reasons. First, as Dr. Lindzen testified, Roe & Baker distributions give special emphasis to high values.[92] Secondly, even assuming that the AR4 data was the appropriate data upon which to apply a Roe & Baker distribution, *quod non*, the IWG misapplied the Roe & Baker distributions, causing an overstatement of the social cost of carbon.

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

[90] Tr. Vol. 1 at 165:10-15 (Polasky).

[91] Agencies November 24, 2015, Initial CO_2 Brief at 34.

[92] Tr. Vol. 2A at 38:6-7 (Lindzen).

While the IWG centered its Roe & Baker distribution on AR4's "best estimate" of 3°C,[93] and focused two-thirds of the probabilities between 2°C and 4.5°C,[94] the IWG included far fewer probabilities below 1.5°C than it should have based on AR4. Instead of 10 percent of probabilities falling at 1.5°C and below, only 1.3 percent did.[95] In fact, the 10th percentile was nearly at 2°C (10th percentile = 1.91).[96] The IWG thus misapplied the Roe & Baker distribution, leading to an erroneous input into the IAMs, causing them to produce higher temperatures and higher damages values.

3.   <u>Applying a Roe & Baker distribution to the correct ECS range lowers the social cost of carbon</u>

It has been argued that under AR5, two-thirds of the Roe & Baker distribution should have fallen between 1.5°C and 4.5°C, rather than the IWG's 2.0°C to 4.5°C range.[97] However, given the IPCC's finding in AR5 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,"[98] it would be much more appropriate to find that two-thirds of the Roe & Baker distribution should have fallen between 1.5°C and 3°C, rather than the IWG's 2.0°C to 4.5°C ECS range. A very

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[93]   Ex. 100 (Polasky Direct) at Schedule 2 (Feb. 2010 IWG Technical Support Document) at 13.

[94]   *Id.*

[95]   *Id.*

[96]   *Id.*

[97]   Peabody November 24, 2015, Initial CO_2 Brief at 76-78 (*comparing* Ex. 405 (IPCC AR5) part 1 at 16 with Ex. 100 (Polasky Direct) at Schedule 2 (Feb. 2010 IWG Technical Support Document) at 13).

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

conservative mid-point would be an ECS of 2.5°C,[99] which would lead to significant reductions in the social cost of carbon as compared to the IWG's Roe & Baker distribution.

The lowest bound and upper bound for the Roe & Baker distributions also should have changed. Under AR5, five percent of the values should have fallen at 1.0°C and below. But the IWG placed the 5th percentile of the ECS at 1.72°C.[100] 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,"[101] AR5 now provides that "Equilibrium climate sensitivity is … very unlikely greater than 6°C.[102] 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:[103]

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[99]   The midpoint between 1.5°C and 3°C is 2.25°C.

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

[101]   Ex. 268 at 38.

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

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

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
5th percentile	1.72	1.49	1.37	1.13
10th percentile	1.91	1.74	1.65	1.48
Mode	2.34	2.52	2.65	2.90
Median (50th percentile)	3.00	3.00	3.00	3.00
Mean	3.50	3.28	3.19	3.07
90th percentile	5.86	5.14	4.93	4.69
95th percentile	7.14	5.97	5.59	5.17

Because the IWG has not updated its climate sensitivity probability distribution to the IPCC's current scientific projections, and because the IWG misapplied the Roe & Baker distributions, the FSCC estimates are both out-of-date and erroneous. Because even proponents of the FSCC recognize 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,"[104] reliance on an uncorrected version of the IWG's FSCC in this proceeding lacks an empirical basis and is inappropriate as a matter of law.[105]

> 4. The ALJ erred in accepting use of the outdated AR4 data for this proceeding and allowing an incorrect Roe & Baker distribution to be used

The ALJ has accepted the use of an erroneously applied Roe & Baker distribution, and erroneously concluded that it was reasonable for the IWG to continue using an ECS

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[104] Agencies November 24, 2015, Initial CO_2 Brief at 34; Tr. Vol. 1 at 115:16-24 (Polasky) ("the evaluation that needs to be undertaken by the Commission in setting the environmental cost value should include a hard look at the framing assumptions that were used to generate the federal social cost of carbon").

[105] *See* Order Establishing Environmental Cost Values dated January 3, 1997, at 30 & n.17.

range of 2°C to 4.5°C, because the ALJ's Conclusions overlook her own factual findings

and the order of events. The ALJ concluded:

> 24.　The Administrative Law Judge concludes that the preponderance of the evidence demonstrates the IWG had a reasoned basis to refrain from adopting the IPCC AR5 ECS values in the IWG's 2013 FSCC update. While the IWG could have chosen to adopt the updated values at that time, it stated that it viewed that IPCC AR4 ECS values as the most authoritative at the time of the 2013 update and affirmed its intention to update the ECS values as appropriate in the future, based on the latest science and external expert advice.
>
> 25.　The Administrative Law Judge concludes that the preponderance of the evidence demonstrates that it was reasonable for the IWG to adopt the ECS range of 2.0-4.5°C as stated in the IPCC AR4.[106]

In these conclusions the ALJ overlooked an import part of the record, as summarized in

her own Finding of Fact 241, which shows that at the time the IWG updated the FSCC in

2013, the IPCC had not yet released its Fifth Assessment Report (AR5).[107] Thus, the

ALJ's apparent conclusion that the IWG made a deliberate choice for the IPCC's 2007

Fourth Assessment Report (AR4) over the Fifth Assessment Report (AR5) is not

supported by the record or the ALJ's own findings.

　　The ALJ's conclusion that "it was reasonable for the IWG to adopt the ECS range

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[106]　April 15, 2016, ALJ CO$_2$ Recommendations at Conclusions 24 and 25.

[107]　*See id.* at Findings of Fact 241 ("At the time the 2013 SCC update was released, the most recent authoritative statement about ECS appeared in the IPCC's AR4. Since that time, as several commenters noted, the IPCC issued a Fifth Assessment Report that updated its discussion of the likely range of climate sensitivity compared to AR4.").

of 2.0-4.5°C as stated in the IPCC AR4"[108] further shows that the ALJ did not follow the Commission's instructions as to the issue to be determined in this proceeding. While the reasonableness of the IWG's adoption of the FSCC for its purposes in 2010 and the reasonableness of the IWG's actions in updating the FSCC in 2013 are important parameters, the issue to be decided is whether the FSCC values are now reasonable and the best available measure to determine the environmental cost of CO_2 under Minn. Stat. § 216B.2422 and, if not, what measure is better supported by the evidence.[109] Because the IPCC had not yet released AR5, one cannot blame the IWG for not using it in conjunction with its 2013 update to the FSCC. But the question in this proceeding is whether the Commission in 2016 should rely on the IPCC's 2007 AR4 ECS values in setting the Minnesota social cost of carbon under Minn. Stat. § 216B.2422, as advocated by the CEOs, the Agencies, the Doctors, and the Business Coalition and now recommended by the ALJ, rather than the IPCC's 2013 AR5 ECS values. The MLIG submits that AR4 is grossly outdated and that there is no excuse for using a 2007 report when an updated 2013 report reaching different conclusions based on new data is available, especially since the 2013 AR5 report (the lower part of the range of 1.5°C to 4.5°C) reverts in part back to AR3 (1.5°C to 4.5°C), such that AR4 can be deemed an aberration.

It is important in this regard to remember that the 2007 AR4 does not consist of

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[108]   *See* April 15, 2016, ALJ CO_2 Recommendations at Conclusion 25.

[109]   Notice and Order for Hearing dated Oct. 15, 2014 at 4-5.

year-2007 data. Instead, AR4 summarized peer-reviewed information published since publication of the IPCC's Third Assessment Report (AR3) in 2001. The ALJ thus based her Recommendations on data that is between 9 and 15 years old and rejected every single study published between 2007 and 2013, thereby expressly rejecting the acknowledged preponderance of the evidence favoring a lower ECS range.[110]

The ALJ noted in Finding of Fact 242 that Dr. Dessler testified that it is his belief that "if the IPCC ECS estimate were to be reassessed today, the lower bound would likely again be 2 degrees instead of the 1.5 degrees published in AR5." The ALJ does not assign any particular credibility to this testimony, and that testimony directly conflicts with all other testimony relating to the ECS, such as the testimony of Drs. Spencer, Happer, Lindzen, Mendelsohn, and Bezdek.[111] The ALJ appears to have resolved this matter by relying on the IPCC, rather than any of Drs. Dessler, Spencer, Happer, Lindzen, Mendelsohn, or Bezdek's testimony.[112] Because Dr. Dessler's testimony is furthermore not based on any peer-reviewed data, but is instead based on his personal conversations with a number of attendees at a conference,[113] because he has admitted that he may well change his mind but would need data regarding the next 5 to 20 years,[114] and

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[110]   Tellingly, this is the only IPCC AR5 finding that the ALJ chose to reject (again, with no explanation or justification); the ALJ otherwise used the IPCC's AR5 to support a number of other findings in the Recommendations.

[111]   *See* April 15, 2016, ALJ CO_2 Recommendations at Findings 230-236.

[112]   *Id.* at Conclusion 23.

[113]   Tr. Vol. 3A at 112.

[114]   Tr. Vol. 3B (Bezdek) at 24:17-25:17 ("But I mean, you know, I don't see anything
(continued)

because since the IPCC issued AR5 in September of 2013 it has not issued any statements to indicate any change in the ECS,[115] it is inappropriate to rely on this one witness's statement.

The importance of the IPCC's AR5 has been urged forcefully by the Agencies:

· "[Dr. Gurney] discussed the importance of the IPCC 5th Assessment Report"[116]

· 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"[117]

· "the synthesis supplied by the IPCC is the best comprehensive review of global temperature records"[118]

· "The most authoritative contemporary source is the IPCC's 5th Assessment Report…"[119]

· "Dr. Gurney reiterated that the IPCC 5th Assessment Report, which is the most comprehensive assessment of research on the issue of CO_2 fertilization and the role of CO_2 fertilization within climate change …"[120]

· "The most reliable evidence on this topic is the IPCC 5th Assessment Report…"[121]

(continued)
right now to cause me to change my opinion, but they could change. I don't know if it will be five years or ten years or 20 years. I mean, I don't know.").

[115]   Tr. Vol. 3B (Bezdek) at 25:18-23.

[116]   Agencies November 24, 2015, Initial CO_2 Brief at 8.

[117]   *Id.*

[118]   *Id.* at 24.

[119]   *Id.* at 50.

[120]   *Id.* at 55

[121]   *Id.* at 56; *see also* April 15, 2016, ALJ CO_2 Recommendations at Findings of Fact 240 (Agencies' reliance on AR5).

· "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:"
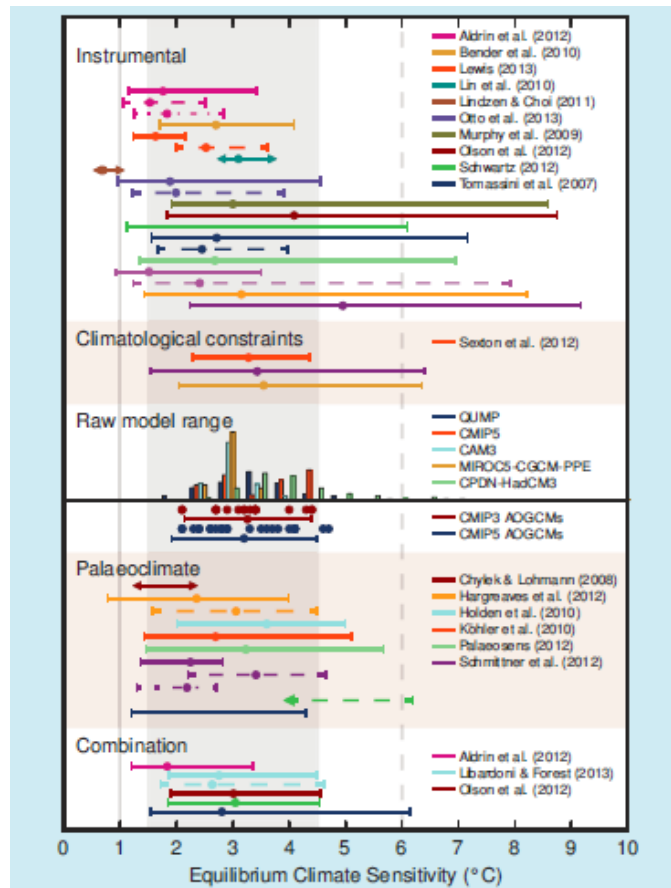
Box 12.2, Figure 1 | Probability density functions, distributions and ranges for equilibrium climate sensitivity, based on Figure 10.20b plus climatological constraints shown in IPCC AR4 (Meehl et al, 2007b; Box 10.2, Figure 1), and results from CMIP5 (Table 9.5). The grey shaded range marks the *likely* 1.5°C to 4.5°C range, and the grey solid line the *extremely unlikely* less than 1°C, the grey dashed line the *very unlikely* greater than 6°C. See Figure 10.20b and Chapter 10 Supplementary Material for full caption and details. Labels refer to studies since AR4. Full references are given in Section 10.8.

(Agencies November 24, 2015, Initial CO₂ Brief at 91, *citing* Ex. 405 (AR5), pt. 36 at 1110.) Remarkably absent from the Agency's submissions was reliance on the IPCC's AR4, on which the ALJ's Conclusions and Recommendations are based.

On the basis of all of the above, Conclusions 24 and 25 cannot be sustained or

adopted by the Commission. Combining the ALJ's reliance on grossly out-of-date IPCC AR4 information and the ALJ's unsupported rejection of all current scientific information with the IWG's misapplication of the Roe & Baker distribution renders Conclusions 24 and 25 not only unsustainable but also arbitrary and capricious (it should furthermore be noted that the ALJ made no conclusions that the proponents of adoption of the FSCC met their burden of proof with respect to the ECS,[122] rendering the adoption of the FSCC invalid as a matter of law).

5. In the original proceeding the Commission also rejected reliance on out-of-date information

The Commission's precedent is to demand the most current data upon which to base its decisions, and to rejected out-of-date information. Thus, in the original 1996 proceeding, the Commission rejected reliance on out-of-date U.S. Environmental Protection Agency National Ambient Air Quality Standards ("NAAQS") and relied instead on current data, holding that

> Some parties argued that there can be no damages/costs to the environment as long as emissions do not cause ambient air concentrations to exceed the NAAQS. *However, the EPA has not been able to keep the NAAQS updated. They do not reflect the latest scientific knowledge.* Based on the record established in this matter, it is clear that the NAAQS currently are not necessarily set at no-cost levels. The Commission finds the Minnesota-specific state of the art damage cost study sponsored by NSP, the Triangle Economic Research (TER) Study, more dependably reflects environmental costs in Minnesota.[123]

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[122]   *See* April 15, 2016, ALJ CO_2 Recommendations at Conclusions 22-25.

[123]   Order Establishing Environmental Cost Values at 16-17 (emphasis added).

In light of the admissions by proponents of the FSCC, the undisputed fact that the ECS adopted by the IWG is now grossly out of date, the IWG's unambiguous misapplication of the Roe & Baker calculations, the burden of proof that the proponents must meet and which has not been addressed by the ALJ in her Conclusions, and because the basis for this entire proceeding was to make the science current,[124] the MLIG respectfully submits that the ALJ's Conclusions 24 and 25, which are based on the IPCC's Fourth Assessment Report (AR4), are not supported by the record and must be rejected.

6. The ALJ appears to have improperly credited Freeman's analysis that the lowering of the ECS increased the social cost of carbon

In Findings of Fact 237 and 320, the ALJ summarized the Agencies' citations to Mark C. Freeman et al., *Climate Sensitivity Uncertainty: When is Good News Bad?*, Harvard Kennedy School, Faculty Research Working Paper Series (2015), in which Professor Freeman calls the lowering of the bottom of the ECS range in AR5 from AR4's 2°C-4.5°C range to 1.5°C-4.5°C "good news," but then explains that the willingness to pay would increase ("bad news") because the estimate of its standard deviation would have increased.[125] The Agencies concluded that the economic implication is an increase

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[124] *See* October 9, 2013, Memorandum in Support of Clean Energy Organizations' Motion to Update Externality Values for Use in Resource Decisions in Commission Docket No. E-999/CI- 93-583 at 18-19.

[125] 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).

in the social cost of carbon.[126]

The ALJ attached significance to whether evidence submitted in the case was peer reviewed.[127] However, Freeman *et al.* is not peer-reviewed[128] and the article authors overlook, possibly because of that fact, that contrary to Freeman's assumption that the uncertainty ranged has widened,[129] the uncertainty range actually decreased.[130] Because the ALJ made no actual findings of fact, it is difficult to determine to what extent she considered the Freeman arguments. But because the ALJ cites to the article without acknowledging the error in its analysis (although that error was briefed), it is reasonable to assume that the article played a role in the ALJ's erroneous conclusion that "the FSCC underestimates the full environmental cost of CO_2."[131]

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[126] *See* April 15, 2016, ALJ CO_2 Recommendations at Findings of Fact 237 and 320.

[127] *See id.* at Findings of Fact 31, 32, 39, 107, 181, 227, 239, 348, footnote 680, Findings of Fact 351, 352, 353, 354, 355, 356, 358, 359, 360, 362; Conclusions 23, 32, 47, 48; and Memorandum at 129.

[128] Freeman (2015), cover disclaimer.

[129] Freeman (2015) at 2.

[130] At the same time that the IPCC announced the lowering of the bottom of the range, it 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," (*see* Ex. 405 part 36 at 1111, first full paragraph (italics in original)), effectively reducing the emphasized range by 1°C (the lower half of 1.5°C to 3°C is a difference of 1.5°C, while the difference between 2°C and 4.5°C is 2.5°C).

[131] *See, e.g.*, April 15, 2016, ALJ CO_2 Recommendations at Conclusion 13.

C. Conclusion: the likely ECS is in "the lower part of the range from 1.5°C to 4.5°C," which translates to a conservative average or central ECS of 2.5°C if one were to use one number for computational purposes

Requiring a damages-cost approach serves to protect fundamental notions of due process and traditional legal and procedural requirements governing causation and legal liability. But here, the FSCC is divorced from "estimates about the future based on current experience and evidence" and "best accounting for future uncertainties."[132] The "current experience and evidence" shows that temperatures have not risen as much as the models predicted. A proper analysis must calibrate the current remedy to the current actual evidence of harm—not speculation. Given that it is undisputed that the average global temperatures are below 1.0°C above pre-industrial levels—and are below the level the models had predicted would occur as a result of the current level of CO_2[133]—the

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[132]   *See* April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 7.

[133]   *See* Ex. 405 (AR5), part 29, at 895, which shows that even though backcasting is a much simpler exercise than predictions, in fact the models have not been able to accurately simulate the 20th century historical record. Figure FAQ10.1 from the IPCC AR5 shows that climate model simulations (CMIP3, CMIP5) fail to track the strong warming trend from 1910-1945, the cooling from 1945-1970, or the flat temperature trend in the 21st century. The only feature that the climate models accurately simulate is the warming in the last quarter of the 20th century — and as the edge of the graph shows, that accord is falling apart:

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burden of proof is on the proponents of the FSCC, not on the opponents, to prove that the FSCC is reliably predictive in the face of this past failure. The minimal temperature increase to date has not resulted in damages that are quantified in the FSCC and the FSCC doesn't comport with the applicable legal standards.

The MLIG respectfully submits that Conclusions 24 and 25 must be rejected, and replaced as follows:

> 24. ~~The Administrative Law Judge concludes that the preponderance of the evidence demonstrates the IWG had a reasoned basis to refrain from adopting the IPCC AR5 ECS values in the IWG's 2013 FSCC update. While the IWG could have chosen to adopt the updated values at that time, it stated that it viewed that IPCC AR4 ECS values as the most authoritative at the time of the 2013 update and affirmed its intention to update the ECS values as appropriate in the future, based on the latest science and external expert advice.~~

> 25. ~~The Administrative Law Judge concludes that the preponderance of the evidence demonstrates that it was~~

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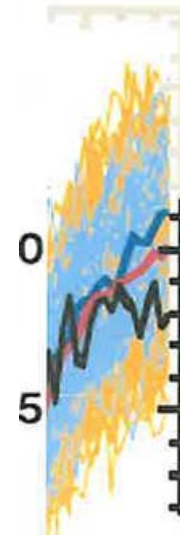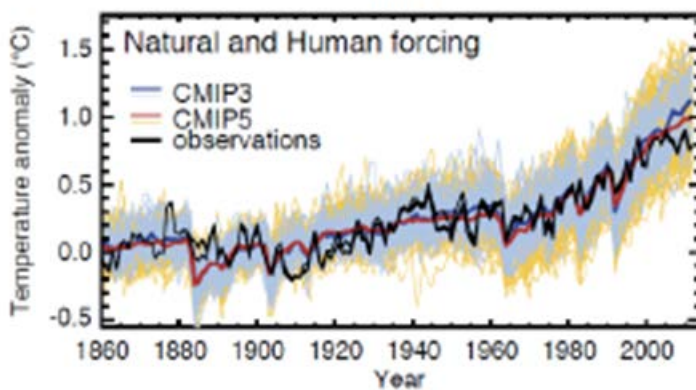
~~reasonable for the IWG to adopt the ECS range of 2.0-4.5 °C as stated in the IPCC AR4.~~

24.   The preponderance of the evidence shows that the likely ECS is in "the lower part of the range from 1.5°C to 4.5°C,"[134] which would equate to a conservative average or central ECS of 2.5°C if one were to use one number for computational purposes.

The MLIG accordingly also respectfully submits that the portion of Conclusion 22 where the ALJ rejects an ECS of 1.5°C is incorrect *per se*, and that an ECS of 1°C would fall within the 5th percentile of a Roe & Baker distribution, such that the ALJ's complete rejection of that value is also incorrect and not supported by the record.

The MLIG finally submits that the ALJ's reliance on the IPCC's AR4 ECS range of 2°C-4.5°C in Conclusion 23 is based on data that is admitted to be outdated, and must be stricken from that Conclusion, leaving solely reliance on AR5.

With these corrections, the Recommendations would provide either (1) that the FSCC should be recalculated by applying a central ECS of 2.5°C or (2) that the FSCC should be recalculated by applying an ECS in the lower part of the range from 1.5°C to 4.5°C, pursuant to the IPCC's 2013 AR5.

VI.   THE ALJ ERRONEOUSLY REJECTED A DISCOUNT RATE OF 7% AND ERRONEOUSLY ACCEPTED A DISCOUNT RATE OF 2.5%

A.   The ALJ erroneously summarized the MLIG's position with respect to discount rates

The IWG presented the FSCC valued at three different discount rates: 2.5%, 3%, and 5%. Quoting selectively, the ALJ found that "[t]he Utilities and the MLIG agreed

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[134]   Ex. 405 part 36 at 1111, first full paragraph.

that is was reasonable for the IWG to base its discount rates on the 'consumption rate of interest' and supported the 3% and 5% discount rates."[135]   The ALJ further held that "[t]he Utilities and the MLIG hinted that the OMB's suggested discount rate of 7% would be 'a reasonable estimate of the before-tax market rate of interest as an appropriate upper bound, but ultimately did not endorse a specific percentage for the upper limit."[136]   The first finding is only partially correct, while the cited portion of the Finding 184 is erroneous.

As recognized by the ALJ, the MLIG found application of both the 3% and the 5% discount rates reasonable for regulations affecting only private consumption. However, the MLIG has at all times been clear that a discount rate of 7% is appropriate when a regulation will affect private sector capital spending, as recognized by the federal Office of Management and Budget ("OMB").[137]   The MLIG has further been clear that two-

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[135]   *See* April 15, 2016, ALJ CO$_2$ Recommendations at Finding of Fact 182 (*citing* Ex. 300 (Smith Direct) at 23).

[136]   *Id.* at Finding of Fact 184 (*citing* Ex. 304 (Smith Surrebuttal) at 26-27).

[137]   *See* MLIG November 24, 2015, Initial CO$_2$ Post-Hearing Brief at 46-52, 77-78, 86; MLIG December 15, 2015, CO$_2$ Post-Hearing Reply Brief at 20-23, 40. Dr. Smith testified in her pre-filed direct testimony (Ex. 300 at 23:13-24:6) that:

> Two of the discount rates used by the IWG, 3% and 5%, are reasonable. The IWG based those discount rate estimates on empirical evidence of how people actually make trade-offs between consumption today and in the future, called the "consumption rate of interest." … The Federal guidance and the IWG note the social rate of time preference and consumption rate of interest are to be used when a regulation will affect only private consumption. The Federal guidance identifies 3% as a lower bound for approximating the social rate of time preference, but actually requires use of a 7% rate

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thirds of Minnesota's electricity consumption is by large industry and small, medium, and large companies and only about one-third of Minnesota's electric consumption is by households.[138] On the basis of this record, the MLIG has respectfully submitted, and maintains here, that it is appropriate to consider a discount rate of 5.66%, which consists of a usage-averaged discount rate based on the 3% consumption rate of interest identified by the IWG[139] (33.3%) and a conservative 7%[140] average before-tax real rate of return to private capital in the U.S. Economy (66.6%).[141] Findings of Fact 182 and 184 should be corrected and Conclusions 16 through 18 are not supported by the record, are erroneous, and should be rejected as set forth in detail below.

B. The discount rate is critical

As the CEOs' witness Dr. Polasky has remarked, "what one assumes about the

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> when a regulation will affect private sector capital spending because 7% approximates the opportunity cost of displaced private sector investment. The IWG's range of 3% to 5% is intended to reflect only uncertainty in the consumption rate of interest, and for that particular concept, falls within the Federal guidance.

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[138] Tr. Vol. 4 at 89:4-14 (Martin).

[139] *See* Ex. 102 (Polasky Rebuttal) at Schedule 1 (July 2015 IWG Response to Comments) at 22.

[140] As set forth above, the Commission has as recently as May 8, 2015, approved 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.)

[141] *Id.* at 21.

discount rate matters hugely."[142] The FSCC for the year 2020 at a 3% discount is \$42.14

(in 2007\$/net tonne[143]), while the FSCC for that same year at a 5% discount rate is

\$12.03 (in 2007\$/net tonne), thus reflecting a difference factor greater than 3.5.

(*Compare* Ex. 307 (Table 4A) line 1 (FSCC value at 3% discount rate) with line 4 (FSCC

value at 5% discount rate)).

> **C.** **The IWG's rejection of a 7% discount rate for the FSCC should not dictate the discount rates in this proceeding because the FSCC was not designed to make policy decisions nor for state resource planning regulating industrial electric utilities**
>
>> 1. The ALJ has failed to incorporate into the Conclusions and Recommendations that the FSCC was not designed to make specific policy decisions or for state resource planning regulating industrial electric utilities

The IWG and the ALJ appropriately recognized that the FSCC has a limited

purpose, namely "to allow agencies to incorporate the social benefits of reducing carbon

dioxide (CO_2) emissions into cost-benefit analyses of regulatory actions that have small,

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[142] Ex. 100 (Polasky Direct) at 11. *See also id.* at Schedule 2 (July 2010 IWG Technical Support Document) at 17; CEOs November 24, 2015 Initial CO_2 Brief at 18 and 27; Agencies November 24, 2015, Initial CO_2 Brief at 30 ("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."

[143] The term "tonne" refers to a metric ton. A metric ton is about 10% larger than a short ton. The current Minnesota environmental 1 cost values are stated in \$/short ton, while the IWG's SCC values (and all other estimates that are derived from runs of the IAMs that the IWG used) are in \$/metric ton, i.e., "\$/tonne." (Ex. 300 at 34:20-35:3.)

or 'marginal,' impacts on cumulative global emissions."[144] The ALJ erroneously held

that the difference between this federal purpose and the Minnesota application is merely

"a question about process," which is now "cured through this proceeding."[145]

Contrary to the ALJ's understanding, the intended purpose of the FSCC is only to

help identify, among the vast array of possible regulations to reduce greenhouse gas

emissions, those regulations that have positive net benefits. The FSCC was not designed

to develop the content of the regulation or influence the choice of options to comply.[146]

In contrast, if used in integrated resource planning and other Commission decisions in the

Minnesota context, "the imprecise SCC [social cost of carbon] would not help determine

whether to regulate, but rather *how* to make individual resource allocation decisions.

These decisions – such as whether to operate or retire a power plant, what type of

generation capacity to invest in, how to set solar tariffs, how to evaluate Conservation

Improvement Program (CIP) benefits – are sometimes binary, difficult to reverse, and

often have large and long-term implications for electricity rates, environmental impacts,

and reliability."[147]

In an effort to avoid rejection of the FSCC on this basis, Dr. Hanemann (testifying

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[144]   April 15, 2016, ALJ CO$_2$ Recommendations at Finding of Fact 62. *See also* Ex.
         302 (Smith Direct report) at 32 (*citing* Ex. 100 (Polasky Direct) at Schedule 2
         (Feb. 2010 IWG Technical Support Document) at 1).

[145]   April 15, 2016, ALJ CO$_2$ Recommendations at 130-131.

[146]   Ex. 600, pt. 1 (Martin Direct) at 12:22-13:11; Ex. 601, Martin Rebuttal at 19-22;
         Ex. 602 (Martin Surrebuttal) at 7-9, 19-22.

[147]   Ex. 600, pt. 1 (Martin Direct) at 13:13-20. *See also id.* at 13:22-14:9; Ex. 601,
         Martin Rebuttal at 19:23-20:22:4; Ex. 302 (Smith Direct, Ex. 2) at 32, Para. 1.

for the Agencies) argued for adoption of the FSCC notwithstanding this distinction, and commented that "[t]he IWG's SCC estimates have also been used in analysis and discussions outside of the United States."[148] Dr. Hanemann testified that "[f]or example, Canada used a social cost of carbon based on the IWG's SCC in their regulatory impact analysis for the 2013 Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations" and "on April 22, 2014, Montgomery County, Maryland, revised its County Code 18A on environmental sustainability to require the SCC to be incorporated into return on investment for efficiency and sustainability decisions."[149]

The MLIG respectfully submitted that these two references are misleading, and that no other government has used the IWG's FSCC for the purpose for which it is being proposed in this proceeding. Specifically, as Mr. Martin has testified, to the extent the Canadian government "copied" the IWG's FSCC, "[t]his is an example of using the SCC precisely as intended – for cost-benefit analysis of [proposed] federal regulations."[150] Accordingly, Mr. Martin testified, and the MLIG agrees, the Canadian reference does not provide any rationale for using the IWG's FSCC for Minnesota Public Utility

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[148]   Ex. 800, pt. 1 (Hanemann Direct) at 62:13-21.

[149]   *Id.*

[150]   Ex. 601, Martin Rebuttal at 20:12-21. It should further be noted that the automobile industries in the United States and Canada are integrated and that the alignment of the Canadian Regulations with the U.S. EPA standards was deemed important, so that the same U.S. EPA-estimated vehicle technology choices and adoption rates were used in the Canadian analysis. "This leads to the same proportional costs per vehicle, adjusted for exchange rates, as those that were used in the U.S. EPA analysis." *See* http://canadagazette.gc.ca/ rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng. html (cited in Ex. 800, pt. 1 (Hanemann Direct) at 62, n.41) at section 7.5.1.

Commission decisions.[151] Similarly, as to the Montgomery County, Maryland, Code, Mr. Martin testified that this regulation, like the federal FSCC, "also is more akin to deciding whether or not to regulate, than to making resource planning decisions."[152]

Second, no showing has been made that either government entity held a contested hearing or even that public comments were filed and considered. On the contrary, the Canadian announcement as cited by Dr. Hanemann suggests that no Board of Review was established.[153]

Dr. Hanemann has next suggested that the Commission should consider using the FSCC for integrated resource planning because four utilities have already done so.[154] As Mr. Martin has noted, Dr. Hanemann has provided no details about how the FSCC was used.[155] Instead, Dr. Hanemann's discussion abruptly shifted to the use of an "internal price of carbon for planning purposes," for which he cited a Carbon Disclosure Project (CDP) publication finding that 29 companies, including Xcel Energy, use such a price.[156] But according to Xcel's Mr. Martin, "[Dr. Hanemann] here confuses a regulatory cost proxy with a CO_2 damage cost value" and "the regulatory cost range does not estimate

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[151] Ex. 601, Martin Rebuttal at 20:12-21.

[152] *Id.* at 20:1-21.

[153] *See* http://canadagazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng. html at first paragraph (cited in Ex. 800, pt. 1 (Hanemann Direct) at 62, n.41).

[154] Ex. 800, pt. 1 (Hanemann Direct) at 63.

[155] Ex. 601, Martin Rebuttal at 20:23-21:12.

[156] Ex. 800, pt. 1 (Hanemann Direct) at 63.

damages and therefore cannot serve as the basis for a CO_2 externality value."[157] "The

Commission's regulatory cost range is derived from estimates of the cost of achieving

compliance with future CO_2 regulations, and makes no attempt to estimate climate

damages from CO_2 emissions."[158] Thus, neither the Canadian example, nor the

Montgomery County example or the "utility integrated resource plan" example set forth

on page 63 of Dr. Hanemann's pre-filed direct testimony can support the application of

the FSCC in the current context.

>2. <u>Use of a 7% discount rate is appropriate and required in the
>Minnesota resource-planning context</u>

The ALJ concluded that (1) OMB Circular A-4 does not require the IWG to use a

7% discount rate because the circular is advisory and not mandatory in nature; (2) "the

OMB participated in the IWG's development of the FSCC and there was no evidence that

the OMB objected to the IWG's choice not to use a 7 percent discount rate in calculating

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[157] See for example the October 9, 2013, Memorandum in Support of Clean Energy Organizations' Motion to Update Externality Values for Use in Resource Decisions in Commission Docket No. E-999/CI- 93-583 at 14, noting that "Pursuant to §216H.06, the Commission is required to apply projected likely carbon regulatory costs in resource acquisition proceedings. Regulatory costs are not the same as externalities and to compare them would be an apples-to-oranges comparison..." See also *Comments of the Minnesota Department of Commerce, Division of Energy Resources and the Minnesota Pollution Control Agency* in Docket No. E999/CI-00-1636. June 10, 2014, page 15 and 17, recommending the Commission require that any CO2 externality values be damage values, not compliance costs, willingness-to-pay/accept, or other value types. The "internal price of carbon" cited by Dr. Hanemann from the CDP report is a proxy for regulatory compliance costs, not damage values.

[158] Ex. 601 (Martin Rebuttal) at 20:23-21:12.

the FSCC;"[159] and (3) inclusion of a 7% discount rate would be a "cost-of-control" approach, contrary to the Commission's required damage-cost approach.[160] Each of these Conclusions is erroneous.

> ### a. The ALJ's first Conclusion rejecting a 7% discount rate is contradicted by the Findings of Fact and OMB Circulars A-4 and A-94

The ALJ's first conclusion is contradicted by Finding of Fact 117:

117. OMB Circular A-4 directs agencies to use discount rates of 3 and 7 percent, where 3 is the consumption discount rate and 7 is the discount rate appropriate for private capital.[247] That is, when a regulation is anticipated to affect primarily private consumption "for instance, via higher prices for goods and services," OMB Circular A-4 advises the use of a 3 percent discount rate "to reflect how private individuals trade-off current and future consumption."[248] When a regulation is expected to primarily affect how capital is allocated in the private sector, the higher rate of 7 percent is appropriate as it better reflects the opportunity cost of capital.[249] Observed returns on invested capital are much higher than the 3 percent consumption rate of time preference (also called the risk free interest rate), at least in part because investments involve risk for which investors must be compensated; and investors pay taxes on income from their investments.[250]

(April 15, 2016, ALJ CO_2 Recommendations at 37 (highlighting added).)

The ALJ's conclusion also conflicts with OMB Circulars A-4 and A-94 which provide that the 7 percent discount rate is the appropriate discount rate to use whenever, such as here, the main effect of a regulation is to displace or alter the use of capital in the private sector.[161] Specifically, Circular A-4 provides that

> As a default position, OMB Circular A-94 states that a real discount rate of 7 percent should be used as a base-case for regulatory analysis. The 7 percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy. It is a broad measure that reflects the returns to

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[159]   April 15, 2016, ALJ CO_2 Recommendations at Conclusion 16.

[160]   *Id.* at Conclusion 17.

[161]   Ex. 417 (OMB Circular A-4) at 33.

real estate and small business capital as well as corporate capital. It approximates the opportunity cost of capital, and it is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector.[162]

While the OMB's Circulars A-4 and A-94, as federal documents, are not binding on the Commission, the inclusion of a 7% discount rate is warranted in Minnesota resource planning for the same reasons it is a required modeling discount rate in the federal context when it "affects how capital is allocated in the private sector":[163] it "better reflects the opportunity cost of capital"[164] and "is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector."[165] Accordingly, the first sentence of the ALJ's Conclusion 16 must be rejected.

b. The ALJ's second Conclusion rejecting a 7% discount rate is contradicted by the IWG

The ALJ's second conclusion, that "the OMB participated in the IWG's development of the FSCC and there was no evidence that the OMB objected to the IWG's choice not to use a 7 percent discount rate in calculating the FSCC," overlooks that the FSCC was designed for purposes *other* than private capital allocation, as the ALJ recognized in Finding of Fact 62. Thus, application of the 7% discount rate was inappropriate in the IWG's consumer context focusing on "cost-benefit analyses of regulatory actions that have small, or 'marginal,' impacts on cumulative global

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[162]   Ex. 417 (OMB Circular A-4) at 33.

[163]   Ex. 800, WMH-2 at 19-20.

[164]   *Id.*

[165]   Ex. 417 (OMB Circular A-4) at 33.

emissions."[166]   Thus, the OMB had no reason to seek, and every reason to oppose, application of a 7% discount rate with respect to the FSCC.   But these considerations govern neither this proceeding nor the context of Minn. Stat. Minn. Stat. § 216B.2422, subd. 3.   Given those very different purposes, as set forth above, application of a 7% discount rate is appropriate and contextually required here.   As the IWG recognized in July 2015,

> *The 7 percent rate is an estimate of the average before-tax real rate of return to private capital in the U.S. economy*.   It is a broad measure that reflects the returns to real estate and small business and corporate capital and is meant to approximate the opportunity cost of capital in the United States. *The 3 percent rate is an estimate of the real rate at which consumers discount future consumption flows to their present value*, often referred to as the social rate of time preference or the consumption rate of interest.

> The IWG examined the economics literature and concluded that the consumption rate of interest is the correct concept to use in evaluating the net social costs of a marginal change in CO_2 emissions, as the impacts of climate change are measured in consumption-equivalent units in the three IAMs used to estimate the SCC.   This 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 to reflect how private individuals trade-off current and future consumption.[167]

Although the issue was extensively briefed, the ALJ did not address the distinction

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[166]   Ex. 100 (Polasky Direct) at Schedule 2 (Feb. 2010 IWG Technical Support Document) at 1.

[167]   Ex. 101, Ex. 1 at 21-22 (emphasis added).

between an after-the-fact benefit analysis that financially burdens consumers only in relatively small ways (such as CO_2 regulations that affect a $30,000 by $0.93), and a major-cost input into capital-intensive, large-scale electric-generating units, which shows why the FSCC cannot be used in this proceeding without—at a minimum— modifications: the model designed by the IWG expressly includes a discount rate deemed appropriate to that analysis, but not appropriate to Minnesota resource planning and other resource-selection proceedings under Minn. Stat. § 216B.2422. Here, the undeniable purpose of the environmental-cost statute is to influence capital-investment decisions and resource choices pursued by public utilities and ultimately approved by the Commission which necessarily impact electric rates for electricity-intensive large-scale customers, medium-scale customers, and consumers alike. Accordingly, the second sentence of the ALJ's Conclusion 16 must also be rejected.

To place the 7 percent discount rate in context, the Commission has as recently as May 8, 2015, approved 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.[168] This is important to note, because these figures are

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[168]   *See* May 8, 2015, Findings of Fact, Conclusions, and Order in Docket No. E-002/GR-13-868 at 61-62:

XXVII.   Capital Structure and Overall Cost of Capital

The Company and the Department agreed on the Company's capital structure for both the 2014 test year and the 2015 Step. The ICI Group initially argued that the equity component of the Company's capital structure should be the same as the equity component of its parent company, Xcel Energy, Inc., but it did not ultimately include that claim among the modifications it recommended to the ALJ's recommendations.[68]

The Company and the Department agreed on the cost of long- and short-term debt for both the 2014 test year and the 2015 Step; no other party commented. The Administrative Law Judge concurred in the Department and the Company's joint recommendation on both capital structure and the cost of debt, as does the Commission.

The Company, the Department, the ICI Group, the Commercial Group, and AARP disagreed on the cost of common equity. As explained above, the Commission has set the cost of equity at 9.72%.

The resulting overall capital structure and cost of capital are set forth below, rounded to the second decimal place:

2014 Test Year

Component	Component Ratio	Cost	Weighted Cost
Long-term Debt	45.6%	4.90%	2.23%
Short-term Debt	1.9%	0.62%	0.01%
Common Equity	52.5%	9.72%	5.10%
Total	100%		7.35%

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[68] ICI Exceptions at 41–42.

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2015 Step

Component	Component Ratio	Cost	Weighted Cost
Long-term Debt	45.61%	4.94%	2.25%
Short-term Debt	1.89%	1.12%	0.02%
Common Equity	52.5%	9.72%	5.10%
Total	100%		7.38%

used by Xcel as a discount rate in integrated resource planning. For example, in its most recent integrated resource plan dated January 2015, Xcel Energy assumed a before-tax weighted discount rate of 7.58% (after-tax discount rate of 6.62%) to determine the present value of revenue requirements:[169]

C. Modeling Assumptions – Detail

1. Capital Structure and Discount Rate

The rates shown in Table 1 were calculated by taking a weighted average of Minnesota (85 percent) and Wisconsin (15 percent) information from the January 2014 Corporate Assumptions Memo. The after tax weighted average cost of capital of 6.62 percent is used to calculate the capital revenue requirements of generic resources. It is also used as the discount rate to determine the present value of revenue requirements.

Table 1: Capital Structure

	Capital Structure	Allowed Return	Before tax Elec. WACC	After tax Elec. WACC
L-T Debt	45.24%	5.12%	2.33%	1.37%
Common Equity	52.56%	9.89%	5.24%	5.24%
S-T Debt	2.20%	0.64%	0.01%	0.01%
Total			7.58%	6.62%

It would be entirely inconsistent for the Commission to approve a CO_2 environmental cost value that assumes a low discount rate for an extended investment horizon (150-200 years), which value would be used in resource planning where a higher discount rate is assumed over a shorter time horizon (15-30 years).

c. The ALJ's third Conclusion rejecting a 7% discount rate is contradicted by the OMB

The ALJ held in Conclusion 17 that "the proposal advanced by the Utilities and MLIG to increase the upper end of the discount rate range to incorporate the opportunity

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[169] Tr. Vol. 4 at 94:1-95:17 (Martin); Ex. 436 at 6.

cost of emissions reductions in the IWG's IAMs would be a "cost-of-control" approach, contrary to the Commission's required damage-cost approach." There is no factual finding to support this conclusion, and the conclusion is contradicted by the OMB's Circular A-4 and Finding of Fact 118.

Circular A-4 recognizes that "[w]hen a regulation is expected to primarily affect how capital is allocated in the private sector, the higher rate of 7 percent is appropriate as it better reflects the opportunity cost of capital. Observed returns on invested capital are much higher than the 3 percent consumption rate of time preference (also called the risk free interest rate), at least in part because investments involve risk for which investors must be compensated; and investors pay taxes on income from their investments."[170] The veracity of the statements in Circular A-4 is borne out by the immediately preceding section, showing that this Commission approved 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.[171] Circular A-4 has no relationship to a cost-of-control, and Conclusion 17 must be rejected.

Conclusion 17 must further be rejected because it conflicts with Finding of Fact 118. The Agencies argued, and the ALJ appears to have accepted, that the 7% interest rate is a "market rate" and is only appropriate when it is identical to a "consumption rate"

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[170]   *See* April 15, 2016, ALJ CO$_2$ Recommendations at Finding of Fact 117 (*citing* Ex. 800, WMH-2 at 19-20 (Hanemann Direct)).

[171]   *See supra* at p. 58-60.

of capital.[172] But as Dr. Smith's uncontested testimony shows, "the IAMs used by the IWG consider only the change in damages from an incremental ton of reduction, yet the spending to achieve that reduction will somewhat reduce the levels of future societal consumption on which the IWG's damage estimates are based. This reduction in future consumption comes from the diversion of scarce capital to reduce emissions in order to produce those benefits and the amount of this lost opportunity will accumulate at the before-tax market rate of interest, which is higher than the consumption rate of interest."[173]

Although Dr. Hanemann has not contested Dr. Smith's testimony, the ALJ has overlooked it, as the ALJ has overlooked in her Conclusions that the purpose of the FSCC is different from the social cost of carbon in this public utilities resource planning setting. This is particularly clear from Conclusion 46, where the ALJ states that "[t]here was no evidence offered in this proceeding to demonstrate that the IWG's FSCC values are different than they would have been had the IWG developed an SCC specifically for the purpose of complying with Minn. Stat. § 216B.2422, subd. 3."[174] In so concluding, the ALJ overlooked the testimony of Mr. Martin[175] and the testimony of Dr. Smith, whose entire testimony revolved around showing why and how modifications to the

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[172]   April 15, 2016, ALJ CO$_2$ Recommendations at Findings of Fact 214-216 and Conclusions 15 and 17.

[173]   Ex. 304 (Smith Surrebuttal) at 27.

[174]   April 15, 2016, ALJ CO$_2$ Recommendations at Conclusion 46.

[175]   *See, e.g.*, Ex. 600 at 3, 6, 10, 11-14, (Martin Direct)

FSCC were necessary if it was to be used in Minnesota, including modifications to the discount rate[176] because the Minnesota regulatory process is directed to capital-intensive, large-scale public utilities, two-thirds of whose customers are large industry and small, medium, and large companies, rather than consumers.[177] The ALJ further overlooked the OMB's Circulars A-4 and A-94, requiring modeling at a 7% discount rate when a proposed regulation impacts primarily industry,[178] and the related arguments by the MLIG (and others). The second sentence of Conclusion 46 must accordingly be rejected as contradicted by the evidence.

The 7 percent discount rate that is appropriate for regulatory action impacting private capital investment is no more a "cost-of-control" than the 5 percent discount rate adopted by the ALJ and expressly approved by the IWG because it is "positively correlated with market returns."[179] In fact, as recognized by the IWG and the OMB, the 7% (discount) interest rate is the before-tax real rate of return on private capital, which is a market return.[180] The 3% (risk-free consumer interest rate) discount rate, 5% (risky

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[176]   *See, e.g.*, Exs. 300 at 24-26 (Smith Direct); Ex. 304 (Smith Surrebuttal) at 25-30.

[177]   Tr. Vol. 4 at 89:4-14 (Martin).

[178]   The Commission should in this regard keep in mind that regulations impacting, for example, automobiles, may be directed at manufacturers, but are felt directly by consumers who purchase the everwhelming number of those automobiles. That is not the case in the Minnesota regulatory setting.

[179]   *See* April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 118. *See also* Agencies November 24, 2015, Initial CO_2 Brief at 121 (acknowledging that the 3% and 5% discount rates are respectively risk-free and risky-investment consumer interest rates).

[180]   Ex. 101, Ex. 1 at 21-22; Ex. 417 (OMB Circular A-4) at 33 ("In a recent analysis,
(continued)

investment consumer interest) discount rate, and 7% (pre-tax private capital) discount rate thus are all market rates and rates of interest that affected individuals and entities are willing to pay to shift consumption into the present."[181]

Because Conclusion 17 is contradicted by the preponderance of the record and contradicted by the Findings of Fact, it must be rejected.

D. The use of a 2.5% discount rate is inappropriate, particularly in the absence of a 7% discount rate

In Conclusion 18, the ALJ concluded that "the Agencies and the CEOs demonstrated, by a preponderance of the evidence, that the IWG's choice of a 2.5 percent rate of discount is within the existing bounds of rates used in other climate change models." The ALJ further concluded that "[t]he 2.5 percent rate of discount is a reasonable approach to account for the multigenerational scope of the FSCC and to address the concern that interest rates are uncertain over time."[182] The MLIG respectfully submits that the use of a 2.5% discount rate is inappropriate in this proceeding and for Minnesota public utilities resource planning, and must be rejected,

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(continued)

OMB found that the average rate of return to capital remains near the 7 percent rate estimated in 1992.").

[181] *See* April 15, 2016, ALJ CO$_2$ Recommendations at Finding of Fact 118. *See also* Agencies November 24, 2015, Initial CO$_2$ Brief at 121 (acknowledging that the 3% and 5% discount rates are respectively risk-free and risky-investment consumer interest rates); Ex. 417 (OMB Circular A-4) at 33 ("If we take the rate that the average saver uses to discount future consumption as our measure of the social rate of time preference, then the real rate of return on long-term government debt may provide a fair approximation. Over the last thirty years, this rate has averaged around 3 percent in real terms on a pre-tax basis.").

[182] April 15, 2016, ALJ CO$_2$ Recommendations at Conclusion 18.

particularly in the absence of application of a 7% before-tax-real-rate-of-return-on-private-capital discount rate. Rejection of the ALJ's 2.5% discount-rate conclusions is appropriate under the Commission's January 3, 1997, Order Establishing Environmental Cost Values in Docket No. E-999/CI-93-583, in which the Commission previously rejected low discount rates proposed by the MPCA, and held that the discount rate should be "at least 3 - 5 percent for reducing future environmental damages to present value."[183]

> The IWG has acknowledged that
>
> > The choice of a discount rate, especially over long periods of time, raises highly contested and exceedingly difficult questions of science, economics, philosophy, and law. Although it is well understood that the discount rate has a large influence on the current value of future damages, there is no consensus about what rates to use in this [climate change] context.[184]

As Dr. Smith has credibly and cogently testified, many of the values recommended in the literature and in this proceeding are driven more by moral philosophy than informed by empirical analysis.[185] Recommendations for the right discount rate can be categorized as either (1) descriptive of observed human behavior, consistent with market evidence that reveals human preferences, or (2) prescriptive or normative in nature, reflecting subjective moral judgments without evidentiary basis.[186] Dr. Smith testified that the use

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[183]   January 3, 1997, Order Establishing Environmental Cost Values in Docket No. E-999/CI-93-583 at 27.

[184]   Ex. 100 at Schedule 2 (July 2010 IWG Technical Support Document) at 17.

[185]   Ex. 302 (Smith Direct report) at 80.

[186]   *Id.*

of a 2.5% rate is not supported by empirical evidence, does not meet the criteria that Minnesota used in the prior proceeding, and noted that an element of the IWG's decision to adopt this rate as one of three discount rates was to insert a subjective view and ethical considerations among some policy analysts that people living today should not discount the consumption of future generations in the manner in which they discount their own within-generation consumption choices.[187]   The ALJ has unambiguously chosen to advocate for this prescriptive or normative approach in the ALJ's Memorandum.[188]

The ALJ's approach is not uncommon, although it lacks an empirical basis. Dr. Smith testified that the "prescriptive approach for setting lower-than-observed discount rates when conducting a [benefit cost analysis] for a policy that affects multiple generations often starts with an appeal to the ethical notion that it is inappropriate for present generations to give less weight to the consumption that entirely different generations will enjoy than we give to our own current generation's consumption."[189]

The MLIG respectfully submits that in accepting the 2.5% discount rate the ALJ has improperly ignored the purpose of this proceeding. While one cannot necessarily

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[187]   Ex. 302 (Smith Direct report) at 80-82; 87-89.

[188]   *See* April 15, 2016, ALJ CO$_2$ Recommendations at p. 127 ("In establishing cost values in this proceeding, the Administrative Law Judge respectfully recommends that the Commission consider applying conservative values to the well-being of future generations and the planet needed to sustain them, rather than primarily to the financial cost of providing that wellbeing."). The ALJ also wrote that "there is now undeniable evidence that CO2 emissions are already having a dramatic impact on the Earth and its climate," *id.*, but neither made Findings of Fact along these lines nor was a record citation provided.

[189]   *Id.* at 87.

express in monetary terms access or lack of access to a stream of fresh, clean, water,[190] the purpose of this proceeding is exclusively to determine monetary damages, which is an economic enterprise. Of course, the statement that the consumption ("welfare") of future generations should be given fair consideration when society makes decisions today that may have very long-term consequences is easy to accept. However, the ALJ ignored that the use of a discount rate that is lower than, and inconsistent with, empirical evidence of current societies' consumption rate of interest is not the only approach that economists/philosophers have suggested for ethically accounting for future generations.[191]

Dr. Smith pointed out that inter-generational welfare and growth models, as well as theories of intra-generational welfare, have been analyzed to assess economic criteria for inter-generational comparisons. Any number of possible inter-generational distributions can be derived from the models, but Prof. Mishan of the London School of Economics wrote that "no economic criterion can produce acceptable answers to the distribution problem – whether at a point of time or over time – since the problem is basically an ethical one."[192] Recognizing the ethical issue is one of personal opinion,

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[190] *See* April 15, 2016, ALJ CO_2 Recommendations at p. 127 (Memorandum) (The ALJ wrote that "[a] modern proverb graphically illustrates the dichotomy of conservatism in the face of climate change: 'When the last tree is cut down, the last fish eaten, and the last stream poisoned, you will realize that you cannot eat money.'").

[191] Ex. 302 (Smith Direct report) at 87-88.

[192] Ex. 302 (Smith Direct report) at 87 (*citing* Ezra J. Mishan, *Economic Criteria for Intergenerational Comparisons*, Journal of Economics 37(3-4):281-306 (1977) at (continued)

Prof. Mishan suggests he believes most people would agree that an equal per capita real

consumption[193] for all generations is ethically fair:

> For whatever be our view of the fundamental factors
> explaining differences in existing incomes, we are likely to
> agree that an equal per capita real consumption for all
> generations is an eminently fair arrangement … In sum, the
> ethical appeal of equality of per capita consumption over
> generational time is independent of a belief in the justice of
> an equal division of the product in any existing society, and is
> far more compelling.[194]

This eloquent observation caused Dr. Smith to testify that "economic analysis offers no

way to sort among prescriptive formulas. It is thus false to view the common prescription

of adjusting the discount rate to lower levels than is descriptive of existing society's

consumption rate of time preference as the only ethical way to handle the question of

fairness to future generations. In fact, studies have shown that the approach of addressing

this concern through lowered discount rates creates analytic problems. Two such

problems were noted by Farrow and Viscusi: time inconsistency and infinite benefits.

Nordhaus (2007) further demonstrates that an overly low discount rate in an IAM model

such as his DICE model results in nonsensical implications for savings rates."[195] The

ALJ erroneously does not address any of these arguments.

Dr. Smith has noted that while "prescriptive discounting adjustments are to be

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(continued)

304).

[193]   "Real consumption" adjusts for inflation.

[194]   Mishan (1997) at 300-301.

[195]   Ex. 302 (Smith Direct report) at 88 (citations omitted).

avoided, the quote from Mishan suggests alternative ways to give consideration to the welfare of future generations. If he is correct that most would agree that we should manage existing societal decisions so that future generations will have at least our level of real consumption, then we can look to the IAMs' projected consumption to determine how well different emissions regulations meet that objective."[196]

Table 12 in Dr. Smith's report, Exhibit 302 (p.89) presents the real per capita consumption in each of the five IAM baseline scenarios in the current time (2020), and then in 2100, 2200, 2300. "These consumption paths are the endogenous ones that DICE calculates, given the climate impacts associated with each scenario's respective projection of emissions."[197] "In other words, the damage function in the model decreases the raw IWG projections of GDP in light of the emissions projected and their projected impact on temperature."[198]

Table 12. Real Undiscounted Consumption per Capita Over Time IAM Scenarios (Baseline Emissions)

	IMAGE	MERGE	MESSAGE	MiniCAM	5th scenario
Real global consumption per capita					
2020	$ 9,194	$ 7,427	$ 8,595	$ 7,613	$ 8,171
2100	$ 37,133	$ 22,892	$ 26,912	$ 36,671	$ 31,106
2200	$ 125,365	$ 43,798	$ 53,759	$ 134,827	$ 90,555
2300	$ 169,660	$ 49,239	$ 63,872	$ 187,494	$ 122,001
Consumption relative to 2020 consumption					
2100 relative to 2020	4	3	3	5	4
2200 relative to 2020	14	6	6	18	11
2300 relative to 2020	18	7	7	25	15

Source: NERA runs of DICE model using median equilibrium climate sensitivity (ECS=3)

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[196]   Ex. 302 (Smith Direct report) at 88.

[197]   *Id.*

[198]   Ex. 302 (Smith Direct report) at 88 n.132. These calculations used the median value of the ECS (*i.e.*, 3°C). (*Id.*)

Table 12 shows that "even after absorbing the impacts of temperature change, all of the IAM scenarios are predicting that future generations will be far wealthier and have far higher consumption than is the case in the present.[199] In fact, by 2100, they project that real consumption will be 3 to 5 times higher than we have today. By 2300, when the largest amount of climate impact (with unreduced business-as-usual emissions) will have occurred,[200] consumption will be between 7 and 25 times higher than we have today. Thus, the IAM scenarios that the IWG has used to compute the [social cost of carbon] of a ton of emission today are also implying that any cost we incur today will reduce our consumption in the present while adding to the vastly higher welfare of future generations."[201]

Given this significant increase in future generations' consumption despite temperature change and the effects thereof and given the very significant factor by which

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[199]   Although Dr. Hanemann disagreed with just about every expert in the proceeding before the ALJ, including non-testifying experts such as professor Dr. William D. Nordhaus, who has been described as "the world's foremost economist on climate change," (*see, e.g.,* http://chronicle.com/article/Cool-Head-on-Global-Warming-/142713/), but whose FUND-model discount rate Dr. Hanemann claimed was "too high," (Agencies November 24, 2015, CO_2 Brief at 121), Dr. Hanemann reluctantly agrees 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).

[200]   For four of the five IWG scenarios, the baseline emissions projection reflects a business-as-usual world. (Ex. 302 (Smith Direct report) at 53.) The "5th scenario" has a baseline that reflects global emissions being reduced to achieve atmospheric concentration stabilization at 550 ppm, but this scenario receives only 20% weight in the calculation of the IWG's SCC values, as it is only one of five scenarios that are averaged together. (*Id.*)

[201]   Ex. 302 (Smith Direct report) at 88.

the proponents of the FSCC seek to have resource-planning inputs increase to account for highly speculative damages over a very long time horizon, it is appropriate that the Commission continue to act conservatively, as it expressly held in its 1997 Order.[202] Contrary to feverish but unempirical pleas to preserve the welfare of future generations, the actual data in this proceeding shows that adoption of a reasonable and appropriate discount rate will not lead to the current generation taking advantage of future generations,[203] although, by definition, the current generation will be paying for the impacts of the values adopted as a result of this proceeding.[204]

It should be noted in this regard that Xcel Energy's position in briefing to the ALJ that "[t]here is simply no empirical evidence of the preferences and behaviors of distant future generations"[205] 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

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[202] Ex. 305 (March 22, 1996, Findings of Fact, Conclusions, Recommendation and Memorandum (ALJ Allan W. Klein), Docket 93-583) at Finding 36 ("The adopted values should be conservative."); January 3, 1997, Order Establishing Environmental Cost Values at 34, ¶ 5 (expressly adopting the decisions and analysis in ALJ Klein's Report except as separately addressed in the Order).

[203] Dr. Mendelsohn testified that the falling interest rate tied to slowing economic growth over time justifies a discount rate that falls over time, but does not justify a lower fixed rate. (Ex. 218 (Mendelsohn Rebuttal report) at 6:111-115.)

[204] The MLIG has expressed great concern for the impact on ratepayers in general, including household consumers of electricity, (Tr. Vol. 1 at 41:5-13), while Xcel, through Mr. Martin, has stated that "adoption of high CO_2 environmental cost values could result in increased energy costs, which could disproportionally affect lower-income rate payers, minorities, and the elderly." (Ex. 601, Martin Rebuttal at 35:18-22.)

[205] Xcel November 24, 2015, Initial CO_2 Brief at 27.

example of arbitrary conduct.

One way that the MLIG has suggested the Commission may approach the discount rate is to use a usage-averaged discount rate based on the 3% consumption rate of interest identified by the IWG[206] (33.3%) and a conservative 7%[207] average before-tax real rate of return to private capital in the U.S. Economy (66.6%).[208] The relative weight is based on the fact that two-thirds of Minnesota's electricity consumption is by large industry and small, medium, and large companies and only about one-third of Minnesota's electric consumption is by households.[209] Because this discount rate already includes a blend of "high" and "low" discount rates, the MLIG suggests that this one discount rate be used in calculating both the "high" and the "low" ends of the range of the environmental cost value of CO_2.[210]

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[206] *See* Ex. 102 (Polasky Rebuttal) at Schedule 1 (July 2015 IWG Response to Comments) at 22.

[207] As set forth above, the Commission has as recently as May 8, 2015, approved 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.)

[208] *Id.* at 21.

[209] Tr. Vol. 4 at 89:4-14 (Martin).

[210] Use of a usage-averaged 5.66% discount rate is more conservative than the use of a usage-averaged discount rate based on the 2.5%, 3%, 5%, and 7% discount rates, which would achieve a higher, 5.83%, discount rate (2.5% + 3% + 5% = 10.5% / 3 = 3.5% [⅓ weight] + 7% + 7% [⅔ weight] = 17.5% / 3 = 5.83%).

E. Conclusion: discount rates of 3%, 5%, and 7% are appropriately used in this proceeding or a usage-based average discount rate of 5.66% can be substituted

The MLIG respectfully submits that discount rates of 3%, 5%, and 7% are supported by the record, are appropriately used in this proceeding, and that an alternative usage-based average discount rate of 5.66% could be substituted. Accordingly, the following Findings of Fact and Conclusions should be modified as follows:

> Finding of Fact 182. The IWG presented the FSCC valued at three different discount rates: 2.5, 3, and 5 percent. The Utilities and MLIG agreed that it was reasonable for the IWG to base its discount rates on the "consumption rate of interest" and supported the 3 and 5 percent discount rates. The "consumption rate of interest," according to the Utilities and MLIG, is the same as what OMB calls the "social rate of time preference," with both terms in contrast to the "opportunity cost of capital." The Utilities and MLIG agreed that the consumption rate of interest was appropriate for the IWG to use because the IAMs model damages in "consumption-equivalent" units. Therefore, it was sensible to utilize the consumption rate of interest to discount damages to their present value. But because the FSCC has different, consumer, purposes, than the capital-intensive, large-scale public utility purpose of Minn. Stat. § 216B.2422, the Utilities and MLIG also argued that a 5 percent discount rate should not be the upper bound used for the SCC, and that the upper bound should be set at 7 percent.

> Finding of Fact 184. ~~The Utilities and MLIG also argued that a 5 percent discount rate should not be the upper bound used for the SCC. The Utilities and MLIG raised the concern that, once the damages are stated as a present value, they "will be compared to a cost of emissions control that will be paid for with private capital," that is, compared to utility resource investment costs.~~ The Utilities and MLIG objected that the FSCC fails to account for the opportunity costs of utility resource investments in its discounting. If the IWG accounted for the pre-tax market rate returns as provided for by OMB Circulars A-4 and A-94, applicable to private capital

investments and opportunity costs of utility resource investments, it would include discount rates higher than 5 percent, which would lower the FSCC. The IWG's discount rates have overstated the applicable cost by only using consumer ~~consumption~~ rates of interest. T~~he Utilities and MLIG acknowledged that it would be impracticable to incorporate the opportunity cost of emissions reductions in the IWG's IAMs, but instead suggested increasing the upper end of the discount range.~~ The Utilities and MLIG showed ~~hinted~~ by a preponderance of the evidence that the OMB's ~~suggested~~ mandatory modeling discount rate of 7 percent ~~would be "a reasonable estimate of the before tax market rate of interest" as an appropriate upper bound, but ultimately did not endorse a specific percentage for the upper limit.~~ should be a discount rate used in this proceeding and Minn. Stat. § 216B.2422, as it is in other aspects of Minnesota resource planning.

Conclusion 15. The Administrative Law Judge concludes that Peabody, and the Utilities and MLIG have ~~failed to~~ demonstrated by a preponderance of the evidence that a Ramsey rule discount rate that adjusts over time is reasonable to use in calculating the SCC. ~~That approach is not appropriate because it is based on the concept that climate policy can be viewed through the metaphor of a single, infinitely lived individual rather than the changing views of societies as they evolve over generations. The Administrative Law Judge concludes that the Ramsey rule fails to take into account the idea that priorities and preferences of people and societies will change over an extended period of time and does not address issues of equity between generations. Furthermore, the Administrative Law Judge concludes the Ramsey rule is not appropriate in this proceeding because it begins with a higher discount rate which declines with time. In addition to the intergenerational nature of the FSCC damage calculation, due to the uncertainties associated with the possibility of catastrophic damages from a "tipping point" event which may occur at an unknown time, and the understatement of impacts in the IAMs' damage functions, the Administrative Law Judge concludes that an approach that is designed to begin with a higher discount rate and gradually declines is neither reasonable nor the best approach to for the purpose of calculating an SCC.~~

Conclusion 16. ~~The Administrative Law Judge concludes that the preponderance of the evidence demonstrated that the OMB Circular A-4 does not require the IWG to use the seven percent discount rate to calculate the FSCC, because the Circular A-4 is advisory and not mandatory in nature. The Administrative Law Judge concludes that the OMB participated in the IWG's development of the FSCC and there was no evidence that the OMB objected to the IWG's choice not to use a seven percent discount rate in calculating the FSCC.~~

Conclusion 17. ~~The Administrative Law Judge concludes that the proposal advanced by the Utilities and MLIG to increase the upper end of the discount rate range to incorporate the opportunity cost of emissions reductions in the IWG's IAMs would be a "cost-of-control" approach, contrary to the Commission's required damage-cost approach.~~

Conclusion 18. The Administrative Law Judge concludes that the Agencies and the CEOs demonstrated, by a preponderance of the evidence, that the IWG's choice of a 2.5 percent rate of discount is within the existing bounds of rates used in other climate change models. ~~The 2.5 percent rate of discount is a reasonable approach to account for the multigenerational scope of the FSCC and to address the concern that interest rates are uncertain over time.~~

Recommendations [relating to discount rate]. The FSCC should be recalculated using discount rates of 3, 5, and 7 percent or using either a usage-averaged discount rate of 5.66%, based on the 3% consumption rate of interest identified by the IWG[211] (33.3%) and a conservative 7%[212] average before-tax real rate of return to private capital in the U.S. Economy (66.6%).

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[211] *See* Ex. 102 (Polasky Rebuttal) at Schedule 1 (July 2015 IWG Response to Comments) at 22.

[212] As set forth above, the Commission has as recently as May 8, 2015, approved 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.)

VII. THE ALJ ERRONEOUSLY REJECTED CONTINUATION OF AN AVERAGE MARGINAL TON CALCULATION

In Conclusion 28, the ALJ "concludes that the Utilities and MLIG failed to demonstrate that the Commission used an average ton approach in the first Externalities case."[213] This conclusion is contrary to the Commission's January 3, 1997, Order Establishing Environmental Cost Values in Docket No. E-999/CI-93-583, where the Commission expressly adopted Mr. Ciborowski's average cost per ton damages calculation testimony.[214]

The IWG used, and the ALJ here adopted, a "last ton" approach to the calculation of the FSCC. Dr. Smith testified that it is inappropriate to assume that a particular ton of CO_2 emitted in the near future would be the last ton to be decided on as part of a 300-year "business as usual" baseline of otherwise unconstrained future emissions,[215] since many of the tons emitted that contribute to the FSCC value will not be emitted until much later than the Minnesota tons in question and by others than Minnesota, while the carbon emitted in Minnesota is no more or less harmful than carbon emitted elsewhere and is

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[213]   April 15, 2016, ALJ CO_2 Recommendations at Conclusion 28.

[214]   January 3, 1997, Order Establishing Environmental Cost Values in Docket No. E-999/CI-93-583 at 27.

[215]   For four of the five IWG scenarios, the baseline emissions projection reflects a business-as-usual world. Thus, each 2020 ton is valued against a future baseline projection in which no other reductions are ever made. However, if there is to be any actual climate benefit in reducing CO_2 emissions in Minnesota, those actions *have* to be part of a comprehensive policy. (Ex. 302 (Smith Direct report) at 53 (emphasis in original).) The "5th scenario" has a baseline that reflects global emissions being reduced to achieve atmospheric concentration stabilization at 550 ppm, but this scenario receives only 20% weight in the calculation of the IWG's SCC values, as it is only one of five scenarios that are averaged together. (*Id.*)

also no more or less harmful than any of the tons assumed to be emitted in the future.[216]

Dr. Smith testified that, for example, the FSCC value for 2020 depends on the concentration of greenhouse gasses projected to already exist by 2020, all emissions produced in 2020, and all emissions produced from 2020 into the far future.[217] Dr. Smith further testified that in the case of greenhouse gases, the marginal damage estimate varies with the baseline projection of greenhouse gas emissions and is higher if it is calculated against a baseline reflecting a world in which no greenhouse gas control policies are in place, compared to a world that includes global greenhouse gas control policies.[218] Dr. Smith thus concluded that a more appropriate marginal value than used in the FSCC should be calculated using a projection of CO_2 and other greenhouse gas emissions consistent with the global target that is considered appropriate to address climate change concerns, which the IWG did not do.[219]

Dr. Mendelsohn agrees with this critique, noting that the IWG calculated the SCC "assuming zero abatement not only today but forever. Not only in the United States but everywhere."[220] In Dr. Mendelsohn's words, "[t]he IWG made a conceptual error by measuring the wrong SCC." Even the Agencies agreed that some adaptation and

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[216]   Ex. 300 at 20:7-21:1.

[217]   Ex. 300 at 20:18-21.

[218]   Ex. 300 at 21:16-21.

[219]   Ex. 300 at 21:21-22:5.

[220]   Ex. 214 (Mendelsohn Direct) at 15:21-16:2; Exhibit 216 (Mendelsohn Direct report) at 9, 10.

technological change will occur in the future to mitigate losses and reduce emissions.[221] The ALJ did not reject this evidence. The integrated assessment models are actually designed to account for future adaptation, but for the FSCC the IWG modified the damage functions in the models to eliminate consideration of adaptation. Not accounting for adaptation caused the IWG to vastly overestimate the social cost of carbon. As the ALJ found, the IWG itself acknowledged that "the IAMs do not provide compelling treatments of adaptation and technological change."[222] Accordingly, the MLIG takes exception to Conclusion 44 that there is a preponderance of evidence that the IWG accounted for adaptation and mitigation in the FSCC.

The MLIG also takes exception to Conclusion 45, in which the ALJ implicitly rejected Dr. Mendelsohn's testimony that a key problem with the IWG's use of the IAMs is that they eliminated the models' own inherent accounting for society's future reaction to observed climate damages by taking mitigative action.[223] Dr. Mendelsohn's testimony was not challenged by any other witness, and the ALJ's Conclusion is contrary to accepted environmental economic thought and contrary to the way that the DICE model was originally constructed (*i.e.,* the DICE model's approach as originally constructed by

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[221] April 15, 2016, ALJ CO$_2$ Recommendations at Recommendation at 89, *id.* at Finding of Fact 332. The State Agencies admit that the IAMs exclude adaptation and technological change, which causes them to overestimate damages. (*See* Agencies November 24, 2015, Initial CO$_2$ Brief at 134.)

[222] April 15, 2016, ALJ CO$_2$ Recommendations at Recommendation at 44, *id.* at Finding of Fact 143.

[223] *See* Peabody November 24, 2015, Initial CO$_2$ Brief at 64-65.

its creator, Yale professor Dr. William D. Nordhaus).[224] The way the IWG ran the models, the world is assumed to have no reaction whatsoever to damages from climate change and will do nothing to reduce future emissions. This increases the externality values by compounding the damages further.

To correct this significant flaw, Dr. Mendelsohn ran the DICE model to account for adaptation as the model was originally intended, using the "optimization" mode instead of the "standardized" mode that the IWG used. Dr. Mendelsohn explained that a damages model for determining the externality value of carbon should measure the marginal damage associated with each policy choice. This is a familiar procedure that environmental economists use for all pollutants, not just carbon dioxide.[225] The IWG, however, measured the social cost of carbon at the highest possible level of emissions, which assumes there is no mitigation – even though the purpose of the SCC is to encourage mitigation. (Ex. 220 (Mendelsohn Surrebuttal) at 24.)

The ALJ noted Dr. Mendelsohn's testimony,[226] but summarily rejected it without citing any evidence and without explanation, stating simply in Conclusion 45 that his running of the DICE model using the "optimization" function is "not consistent with the cost-damage approach required by the Commission." Yet there is no evidence, much less a preponderance of evidence, to support this conclusion. Moreover, this conclusion is

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[224]   Tr. Vol. 3A 35:18-36-7 (Mendelsohn).

[225]   Ex. 220 (Mendelsohn Surrebuttal) at 23; *see generally* Peabody December 15, 2015, CO_2 Post-Hearing Reply Brief at 81-84.

[226]   April 15, 2016, ALJ CO_2 Recommendations at Recommendation at 48, *id.* at Finding of Fact 159.

incorrect. Running the DICE model using the "optimization" function is entirely

consistent with a damages cost approach because a damages cost approach requires focus

on "actual" damages. The optimization model is predicated on predictions about what

people "actually" do, not on unrealistic assumptions that no mitigation will occur at all.

In the face of prior mitigation efforts in Minnesota alone, which adopted a SCC in 1997,

and the recent Paris Climate Change Accord, the conclusion that no mitigation will occur

is untenable and inconsistent with a damage cost approach. Therefore, the

Recommendation is internally inconsistent in its logic, misunderstands the proper

application of a damage cost approach, and must be rejected. Instead of contending with

this acknowledged limitation of the FSCC which results in significant overvaluation of

damages, the ALJ chose to look the other way. The MLIG respectfully requests that the

Commission acknowledge that the preponderance of the evidence supports the

consideration of adaptation and mitigation in the damage functions of the models.

Mr. Martin also agrees with Dr. Smith and testified that the IWG's calculation of

damages by using the "last ton" as the marginal use creates excessive damages, and that

an "average ton" should be used instead of the "last ton."[227]

To understand the sensitivity of the estimated SCC value to the question of which

emissions levels should be the point at which the marginal damages should be computed,

Dr. Smith considered that the marginal benefit is if the Minnesota tons in question are

viewed as the first increment to all future anthropogenic tons, rather than the last

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[227]   Tr. Vol. 4 at 46:3-47:14 (Martin).

increment to a business-as-usual baseline.[228] To estimate the marginal value of the first

ton, which is the lowest possible marginal value that the IWG's IAMs will produce, Dr.

Smith modified the IAMs so that the baseline scenario represents no anthropogenic

emissions occurring after 2020.[229] Dr. Smith explained several times, and testified

extensively at trial,[230] that this was merely an analytical device that allows one to infer

the range of variation in the marginal damage estimate when using alternative future

emissions projections.[231] The first ton analysis creates a lower bound for the Minnesota

CO_2 environmental cost value and informs the Commission about how much of the

IWG's marginal value estimate is due to emissions yet to be emitted, and not due to

historical and present greenhouse gas emissions.[232] The first ton analysis also allowed

Dr. Smith to calculate the average marginal value by averaging first and last ton

estimates.[233]

Dr. Smith's "first ton calculation" has been criticized by a number of witnesses

and by the ALJ, who claim that Dr. Smith seeks to pretend there are no emissions after

2020, which obviously is not a realistic prediction of future emissions.[234] Dr. Hanemann,

the Agencies' witness, testified that "Dr. Smith's suggested first ton analysis is

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[228]   Ex. 302 at 62.

[229]   *Id.*

[230]   *See* Tr. Vol. 2A at 124:21-126:23.

[231]   Ex. 304 at 22:8-23:4.

[232]   *Id.*

[233]   *Id.*

[234]   *See*, e.g., April 15, 2016, ALJ CO_2 Recommendations at Finding of Fact 27.

unexceptional for a flow pollutant [such as criteria pollutants]. It is unreasonable with a stock pollutant, it is a category error."[235]

In her surrebuttal, Dr. Smith addressed such criticism. She testified that

> Dr. Hanemann is wrong, and it is surprising that he does not recognize what I did as a standard analytical method for backing out a marginal benefit curve from a complex bottom-up damage function model such as an IAM.[236] *The emissions projection I used to estimate the marginal damage of the "first ton" was never intended to be an accurate projection of total actual future outcome*, but only to understand the sensitivity (i.e., range of variation) of the SCC estimate to different levels of projected future emissions. That analytical device allows me to inform the Commission on how much of the IWG's SCC estimates are due to emissions yet to be emitted, as opposed to due to historical GHG emissions. Knowing that degree of sensitivity of the IAMs' SCC values is essential to understanding how much the marginal damage will vary when using alternative (realistic) future emissions projections other than just those five projections that the IWG used. For example, knowing the sensitivity allowed me to estimate the SCC value associated with a baseline that has a very large amount of global emissions control effort, as contrasted to the IWG scenarios that assume no incremental regulation of GHGs for the next 285 years (which I called the "last ton" approach). By knowing this sensitivity, it is also possible to make a rough approximation of the average cost per ton, which I explained in my testimony could be an appropriate estimate under a perspective that the Minnesota environmental cost values are intended to represent an estimate of compensatory damages rather than externality pricing.[237]

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

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[235] Tr. Vol. 2B at 33:15-18 (Hanemann).

[236] In live testimony, Dr. Haneman, as set forth above, acknowledged that the analytical concept is valid. (*See* Tr. Vol. 2B at 33:15-17.)

[237] Ex. 304 (Smith Rebuttal) at 22:8-23:4 (emphasis added). *See also id.* at 22:1-6.

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."[238] Dr. Smith's work allows the Commission to determine how to actually calculate the "average marginal ton" that as a concept has been used since 1997 as the Commission sets the environmental cost value of CO_2.

It is appropriate to value damages from Minnesota emissions in a range between the first and the last ton: the average ton. To approximate these damages assuming use of IAMs, the upper bound should be set as the average of the marginal damage estimates for the first and last ton in the IWG projections.[239] It is accordingly also appropriate to reject Conclusions 26 through 29, and to order the recalculation of the FSCC using the average ton approach.

VIII. THE COMMISSION SHOULD REEVALUATE THE GEOGRAPHIC SCOPE OF DAMAGES CALCULATIONS AND CALCULATE DAMAGES BASED ON A LOCAL DAMAGES SCOPE

The ALJ concluded, in line with the Commission's January 3, 1997, Order Establishing Environmental Cost Values in Docket No. E-999/CI-93-583, that "Minn.

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

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

Stat. § 216B.2442, subd. 3, and the Commission's requirement that the parties use a damage-cost analysis compel that the question of the geographic scope of damages be viewed in terms of the source of the CO_2 emissions and all their damaging impacts, wherever they are experienced. Therefore, the Administrative Law Judge concludes that this proceeding requires a global scope for damages."[240] At first blush, this conclusion makes sense. However, the MLIG take exception to the ALJ's summary rejection of the MLIG's arguments and the supporting testimony that a worldwide geographic scope is inappropriate in the absence of reciprocity; an issue that was not addressed in detail in the prior proceedings and that is more complex than the ALJ's summary rejection suggest. The MLIG accordingly urges the Commission to review the issue anew.

In 1997, the Commission considered that

> Parties further objected that it would be "impracticable" for Minnesota to adopt CO_2 values because CO_2 (and any associated global warming) could not be addressed with any appreciable impact by Minnesota alone. It is true that CO_2 emissions in Minnesota (approximately 33 million tons per year) constitutes approximately 0.1 percent of global CO_2 emissions (approximately 60 billion tons per year). The objectors' argument, however, does not really challenge the

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[240] April 15, 2016, ALJ CO_2 Recommendations at Conclusion 39.

The ALJ also concluded that "The Administrative Law Judge concludes that the Utilities and MLIG failed to demonstrate, by a preponderance of the evidence, that limiting damages to the United States or Minnesota will capture all of the damage caused by CO_2 emissions released from electric power generating facilities within Minnesota." *Id.* at Conclusion 37. However, the Utilities and the MLIG never claimed that "limiting damages to the United States or Minnesota will capture all of the damage caused by CO_2 emissions released from electric power generating facilities within Minnesota." This Conclusion is accordingly not based on the record and should be rejected.

practicability (feasibility) of setting CO_2 values, but instead questions the wisdom of doing so in view of what they view as the inconsequential impact of such an effort. Their argument that nothing should be done because nothing "significant" (in the eyes of the objectors) can be done is a political argument not appropriately before the Commission. The legislature has made the appropriate political decision that the Commission should value CO_2 to the extent that this is feasible and, after rejecting some proposed ranges for CO_2 the Commission has done so.[241]

To be sure, Minnesota's contribution to the world-wide CO_2 emissions is increasingly insignificant. It is unfathomable why the State and this Commission would want to increase the environmental cost value of CO_2 and potentially jeopardize the State's economy for no environmental benefit.[242] It is for this reason that conservative values must be set, as recognized in the January 3, 1997, Order Establishing Environmental Cost Values.[243] Furthermore, reciprocity plays a role in the quantity of the value to be assigned to the environmental cost value of CO_2 and the absence of reciprocity on both a national and international level means that a global geographic damages scope leads to an

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[241] Order Establishing Environmental Cost Values at 26.

[242] *See, e.g.*, Tr. Vol. 4 at 100:21-23 (Martin) (other states and countries are likely to make CO_2 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); Tr. Vol. 3A at 99:2-24; 100:20-23 (Dessler) (China will not act in response to Minnesota's actions).

[243] *See* Ex. 305 (March 22, 1996, Findings of Fact, Conclusions, Recommendation and Memorandum (ALJ Allan W. Klein), Docket 93-583) at ¶ 31 ("At some point, the degree of uncertainty associated with a proposed value becomes so great that there is insufficient evidence to meet the preponderance standard, and the value cannot be adopted."); Order Establishing Environmental Cost Values at 26 ("The Commission finds that the ALJ's calculation is well reasoned and firmly based in the record. See ALJ's Report, Findings 102 - 114.") & 34 ¶ 5.

overstatement of damages caused by Minnesota-produced CO_2.

Dr. Smith, Dr. Gayer, Mr. Martin, and Dr. Mendelsohn all agree that the value to be set should be impacted by reciprocity. In this regard, it is important to note that no witness suggests that reciprocal action would result from Minnesota's unilateral action.[244]

It is undisputed that CO_2 travels globally. In fact, it takes about one month for CO_2 to circulate around the Northern Hemisphere, such that if the CO_2 above Minnesota were to suddenly vanish, other CO_2 from the rest of the world would take its place in about a one-month period.[245] Accordingly, and as the IWG has noted, addressing global greenhouse gas emissions in a meaningful way requires all major emitting nations to reduce their emissions significantly, not just the U.S. emitters.[246] Importantly, this fact "leads to exactly the *opposite* conclusion about inclusion of global benefits in the SCC

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[244]   *See, e.g.*, Tr. Vol. 4 at 100:21-23 (Martin) (other states and countries are likely to make CO_2 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 CO_2 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).

[245]   Tr. Vol. 4 at 151:20-152:3 (Gurney).

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

value from what the IWG concluded."[247] The reason is that IAMs "compute a high \$/ton

value for a ton of U.S. emission not because the U.S.'s emissions are causing such high

damages, but rather the SCC estimate is driven upwards by the effect of all of the other

nations' uncontrolled CO_2 emissions."[248] Otherwise stated, if no other nation emitted

greenhouse gasses, then the SCC estimate would be entirely due to U.S. emissions;

however, that SCC estimate would be lower than what the IWG has computed."[249] Thus,

in the absence of other nations' CO_2 emissions, it would be entirely appropriate to

employ a global geographic damages scope. But given those other nations' emissions

and in the absence of reciprocity, it is inappropriate for Minnesota to do so.[250] Imposing

the higher SCC estimate made by the IWG on U.S. entities pushes U.S. entities to make

an unfairly large amount of emissions reductions, but without global benefit given the

small portion of Minnesota's contribution to global emissions.[251] Alternatively, if other

countries imposed a SCC value on their own emissions equivalent to the SCC value the

U.S. imposes, then their emissions would be lowered too, which would lower the global

SCC.

As stated above, this analysis does not suggest that Minnesota should not compute

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[247] Ex. 302 (Smith Direct report) at 96 (citations omitted; emphasis in original).

[248] Ex. 302 (Smith Direct report) at 95-96 (emphasis in original).

[249] *Id.* at 96 (citations omitted).

[250] *Id.*

[251] Ex. 302 (Smith Direct report) at 96. The Commission recognized Minnesota's small contribution in 1997. Order Establishing Environmental Cost Values (January 3, 1997) at 26 (at the time approximately 0.1 percent of global CO2 emissions).

an environmental cost value for CO_2. However, the value should be computed with a local geographic scope. Doing so is a standard part of a benefit-cost analysis, which sums the benefits across people within the political jurisdiction whose citizens are choosing to undertake a policy and thereby be the ones to bear its costs.[252] This is consistent with defining "economic standing" based on legal rights.

Both Dr. Smith and Dr. Gayer have testified that because Minnesota's environmental cost values policy imposes potential costs on generators in Minnesota and near Minnesota, and the costs from such actions will then be passed to electricity customers residing only within Minnesota, economic standing should only be assigned to Minnesotans.[253] Dr. Gayer testified that since Minnesotans will accrue all costs, absent explicit reciprocity, it would be outside of the typical practice of benefit-cost analysis for Minnesota to consider the environmental benefits to the entire global population.[254]

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. He testified 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. If applied broadly, such a policy

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[252]   Ex. 302 (Smith Direct report) at 95 (citations omitted).

[253]   *Id.*; Ex. 400 (Gayer Direct) at 9.

[254]   Ex. 400 at 9; Ex. 401 at 3:2-4:21.

would demand a dramatic shift in all state policies, including state poverty programs.[255]

Similarly, broad application of global cost and benefits would suggest that a policy that incurs costs that leads to the relocation of people or businesses from Minnesota to other states or countries should not be considered a cost of the policy, and in all likelihood (depending on which state or country the activity is shifted to) should be considered a benefit of the policy. Demonstrative feelings of altruism could justify considering benefits outside of Minnesota, but any reasonable estimate of the magnitude of altruism would suggest only partial consideration of non-Minnesotans, with greater weight given in proportion to proximity. Even considering altruistic motivations, a national estimate would still over-estimate the benefits to Minnesotans of reducing CO_2.[256]

A local geographic scope is also supported by Prof. Pindyck, whose article, "Climate Change Policy: What Do Models Tell Us?" (2013a) *Journal of Economic Literature* 51(3), 860-872, has been cited for every possible proposition.[257] Professor Pindyck has been endorsed by the Agencies and their witness, Dr. Hanemann, as "an

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[255]   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.

[256]   Ex. 400 (Gayer Direct) at 9.

[257]   *See, e.g.*, Doctors November 24, 2015, Initial CO_2 Brief at 22; CEOs November 24, 2015, Initial CO_2 Brief at 23; Agencies November 24, 2015, Initial CO_2 Brief 62-63 and 106-107; Peabody November 24, 2015, Initial CO_2 Brief at 30, 105-106, 112; MLIG November 24, 2015, Initial CO_2 Brief at 38 (*citing* Ex. 304 (Smith Surrebuttal) at 10:22-11:6).

eminent economic theorist."[258] Prof. Pindyck has shown that "these [IAM] models have

crucial flaws that make them 'close to useless' as tools for policy analysis."[259] 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 by the

Agencies:

> 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 the true size of the SCC, the carbon tax could be increased or decreased accordingly.[260]

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

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[258]   Agencies November 24, 2015, Initial CO_2 Brief 61 (*citing* Ex. 801 (Hanemann Rebuttal) at 36).

[259]   *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).

[260]   Agencies November 24, 2015, Initial CO_2 Brief at 62 (*citing* Robert S. Pindyck, "Climate Change Policy: What Do Models Tell Us?" (2013a) *Journal of Economic Literature* 51(3), 860-872 at 870 (emphasis added)).

U.S. Congress, rather than the Commission.[261] 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,[262] and as a statewide elected body is better suited to make such social cost-benefit policy determinations.

Relevant in the context of the present 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 CO_2 emissions, the revenue is collected in Minnesota. It is not

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[261] *See, e.g.*, Agencies November 24, 2015, Initial CO_2 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).

[262] 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 Board (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.

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. 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.[263] As Dr. Smith and Dr. Gayer have testified, there is no good reason to adopt a global rule here, notwithstanding the fact that "we've done it this way for the past 19 years."

Dr. Gayer testified that in the absence of even national reciprocity, the IWG's estimates should be adjusted to the State level. Doing so would result in estimates that are approximately 0.4 percent of the global value in magnitude, suggesting extremely small damage estimates, with a high-end estimate of $0.37 per metric ton of CO_2 (2010 damage value in 2007 dollars), as set out in detail in his report (Ex. 400, Appendix 2). Lacking a modeling component inherent in the IAMs that will calculate Minnesota-only damages, Dr. Smith recommended calculating only U.S. damages, and made this alternative framing assumption in her modeling. Although this change still significantly overstates Minnesota-specific damages, Dr. Smith argued it is more appropriate than using global damages and provides 100 percent altruistic weight to all other U.S.

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[263] *See, e.g.*, http://www.lcv.org/media/press-releases/LCV-Statement-on-Secretary-Kerry-s-Announcement-to-Double-Climate-Investments.html. The fact that over time the world will, in fact, adapt and mitigate is inescapable.

states.[264]

The MLIG respectfully submits that the above testimony, data, and analysis shows that the global geographic scope for damages calculations leads to an improper overstatement of damages in the absence of reciprocity. 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 CO_2 environmental cost value. Accordingly, unless and until there is a national and international reciprocal system in force, the MLIG respectfully submits that the calculation of the environmental cost value of CO_2 is appropriate based on a local, *i.e.*, Minnesota, damages assessment, and that Conclusion 39 should be rejected and the FSCC recalculated accordingly.

IX. THE ALJ APPROPRIATELY RECOMMENDED THAT THE COMMISSION OPEN AN INVESTIGATION INTO LEAKAGE, BUT THE COMMISSION SHOULD MEANWHILE EXPRESS THE SOCIAL COST OF CARBON IN NET TONS

The ALJ has correctly recognized in Conclusion 40 that "calculating leakage of increased CO_2 emissions is not properly a part of this proceeding" and has further correctly included a Recommendation "that the Commission open an investigation into the questions of how to best measure leakage, and whether and how to take leakage into account in other proceedings."[265] However, the MLIG respectfully submits that

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[264] Ex. 302 at 99; Tr. Vol. 2A at 62:20-63:2. Dr. Smith also provided U.S. and non-U.S. components to her calculated values, so that the Commission can determine whether and to what extent it wants to give weight to non-U.S. damages in the environmental cost values to reflect altruism of Minnesotans.

[265] April 15, 2016, ALJ CO_2 Recommendations at Conclusion 40; *id.* at Recommendation 2.

regardless of the calculation methodology, the Commission should at this time express the social cost of carbon as a net value.

As the environmental cost value of CO_2 increases, the problem of leakage increases, especially if one is acting in a leadership mode and the surrounding parties, like an electricity system in the surrounding states that are interconnected, don't take on any dollar per ton or take a lower one on.[266] In its extreme, leakage can, in fact, lead to a net increase in CO_2, thus doing more harm than good.[267]

In its July 2015 Response to Comments, the IWG recognized this problem, and directed that the federal calculation of the benefit of any CO_2 regulation include leakage:

> The 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, and not the SCC, that any leakage should be accounted for.[268]

As repeatedly stated above, the FSCC has a different use than the Minnesota social cost of carbon, which the above quote reflects. But similar to the calculation of net benefits in the federal context, the Commission in this context should apply any social cost of carbon value to the net tons affected, as neither the mere movement of worldwide CO_2 production nor increasing worldwide CO_2 production is the purpose of Minnesota's statutory scheme.[269] In light of the importance of the issue of leakage, and to ensure that

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266   *Id.* at 103:14-23.

267   *Id.* at 103:24-104:1; Ex. 401 (Gayer Surrebuttal) at 9:7-10:3.

268   Ex. 101 at 33.

269   *See* Tr. Vol. 2A at 102:9-103:13 (Smith).

the appropriate tons are considered for application of the environmental cost value of CO_2 to be set with the benefit of this proceeding, the MLIG accordingly respectfully asks that the Commission express its Order in dollars per (short or metric) *net* ton. This direction can then be used in resource planning proceedings.

CONCLUSION

The MLIG respectfully submits that the law requires application of conservative principles and not to adopt high values based on speculation rather than empirical data. The MLIG further respectfully submits that the ALJ lost sight of the burden of proof and the mission she was tasked with: to quantify values only if (to the extent) it is feasible (practicable) to do so.[270]

The MLIG has addressed the two questions posed by the Commission, answering both why the FSCC is neither reasonable nor the best available measure of the environmental cost value for CO_2 and what alternative framing-assumption adjustments to the damages horizon would be required if the Commission were to desire to adopt a form of the FSCC: a modeling time horizon extending no further than the year 2100; application of a correct equilibrium climate sensitivity, based on the IPCC's Fifth Assessment Report (AR5), in the lower part of the likely range of 1.5°C to 4.5°C, which translates to an ECS range from 1.5°C to 3°C or a conservative averaged ECS of 2.5°C; the use of only discount rates of 3%, 5%, and 7%, or an alternative usage-averaged

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[270]   Order Establishing Environmental Cost Values dated January 3, 1997, at 31.

discount rate of 5.66%; calculation of damages using the correct marginal ton, the average ton; and calculation of damages using 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). The MLIG has further shown why the Commission should express the environmental cost value of CO_2 in net tons to account for leakage.

As applied, the MLIG respectfully submits that the Commission should adopt a range for the environmental cost value of CO_2 of \$0.37 to \$5.14 per net metric ton (in 2014 dollars).[271]

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Respectfully submitted,

STOEL RIVES LLP

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Dated: May 5, 2016   *s/ Marc A. Al*

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[271] 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 \$0.90 to \$5.14 (in 2014 dollars per net metric ton) *See* Ex. 307 at lines 32 and 42.

APPENDIX

Should be

Finding of Fact 61

In 2009, the United States' Council of Economic Advisers and the federal Office of Management and Budget (OMB) convened a working group of federal agencies to develop estimates of the FSCC. The interagency group included ~~scientific and economic experts~~ representatives from the White House and federal agencies, including the Council of Economic Advisers, Council on Environmental Quality, National Economic Council, Office of Energy and Climate Change, Office of Science and Technology Policy, Office of Management and Budget, Environmental Protection Agency, and Departments of Agriculture, Commerce, Energy, Transportation, and Treasury.

Finding of Fact 182

The IWG presented the FSCC valued at three different discount rates: 2.5, 3, and 5 percent. The Utilities and MLIG agreed that it was reasonable for the IWG to base its discount rates on the "consumption rate of interest" and supported the 3 and 5 percent discount rates. The "consumption rate of interest," according to the Utilities and MLIG, is the same as what OMB calls the "social rate of time preference," with both terms in contrast to the "opportunity cost of capital." The Utilities and MLIG agreed that the consumption rate of interest was appropriate for the IWG to use because the IAMs model damages in "consumption-equivalent" units. Therefore, it was sensible to utilize the consumption rate of interest to discount damages to their present value. But because the FSCC has different, consumer, purposes, than the large-industry electric utility purpose of Minn. Stat.

Should be

§ 216B.2422, the Utilities and MLIG also argued that a 5 percent discount rate should not be the upper bound used for the SCC, and that the upper bound should be set at 7 percent.

Finding of Fact 184

~~The Utilities and MLIG also argued that a 5 percent discount rate should not be the upper bound used for the SCC. The Utilities and MLIG raised the concern that, once the damages are stated as a present value, they "will be compared to a cost of emissions control that will be paid for with private capital," that is, compared to utility resource investment costs.~~ The Utilities and MLIG objected that the FSCC fails to account for the opportunity costs of utility resource investments in its discounting. If the IWG accounted for the pre-tax market rate returns as provided for by OMB Circulars A-4 and A-94, applicable to private capital investments and opportunity costs of utility resource investments, it would include discount rates higher than 5 percent, which would lower the FSCC. The IWG's discount rates have overstated the applicable cost by only using consumer ~~consumption~~ rates of interest. T~~he Utilities and MLIG acknowledged that it would be impracticable to incorporate the opportunity cost of emissions reductions in the IWG's IAMs, but instead suggested increasing the upper end of the discount range.~~ The Utilities and MLIG showed ~~hinted~~ by a preponderance of the evidence that the OMB's ~~suggested~~ mandatory modeling discount rate of 7 percent ~~would be "a reasonable estimate of the before-tax market rate of interest" as an appropriate upper bound, but ultimately did not endorse a specific percentage for the upper limit.~~

should be a discount rate used in this proceeding and Minn. Stat. § 216B.2422, as it is in other aspects of Minnesota resource planning.

Finding of Fact 237

The Agencies noted the observation that, while a decrease in the minimum possible climate sensitivity "is undoubtedly good news for the planet," it also implied a widening of the range of uncertainty. The Agencies explained that, as the uncertainty surrounding damages related to climate change increases, one is willing to pay a higher premium to avoid exposure to that increasingly uncertain risk. The Agencies also asserted that Freeman *et al.* demonstrated that reducing the "peakedness" of the climate sensitivity distribution by eliminating the "best estimate" for climate sensitivity increased the willingness to pay value for avoiding climate change. Therefore, the Agencies concluded, the economic implication of the increase in the uncertainty regarding climate sensitivitay is that it raises the SCC in the Pindyck economic model of climate change. These arguments must be rejected, however, as the non-peer-reviewed Freeman *et al.* article is based on a fundamental error, namely the assumption that the uncertainty *range* widened between the IPCC's AR4 and the IPCC's AR5, when the uncertainty *range* actually decreased, from 2°C-4.5°C (a difference of 2°C) to *the lower part of* the range of 1.5°C-4.5°C (a difference of 1.5°C).

Finding of Fact 320

The Agencies acknowledged that the Pindyck quotation cited by Xcel (see paragraph 314, above) was accurate in that uncertainty over climate sensitivity has

increased. However, the Agencies argued that Dr. Pindyck's concerns are not a persuasive argument against the Commission's adoption of the FSCC. Asserting that Xcel failed to point out the implication that Freeman, Wagner, and Zeckhauser drew from this increase in uncertainty, the Agencies explained that the economic implication of the increase in the uncertainty regarding climate sensitivity is that it raises the SCC in Pindyck's economic model of climate change. As also stated with respect to Finding of Fact 237,these arguments must be rejected, as the non-peer-reviewed Freeman *et al.* article is based on a fundamental error, namely the assumption that the uncertainty *range* widened between the IPCC's AR4 and the IPCC's AR5, when the uncertainty *range* actually decreased, from 2°C-4.5°C (a difference of 2°C) to *the lower part of* the range of 1.5°C-4.5°C (a difference of 1.5°C).

Conclusion 3.b.

~~A party or parties proposing that the Commission retain any environmental cost value as currently assigned by the Commission bears the burden of showing by a preponderance of the evidence that the current value is reasonable and the best available measure to determine the applicable environmental cost.~~

Conclusion 10

The Administrative Law Judge concludes that more studies, using new approaches, have been published since the last update of the FSCC and that the IWG has expressed a commitment to continuing to pursue the most current research and to incorporate it as appropriate into future FSCC updates. ~~The Administrative Law Judge concludes~~

~~that, if the Commission adopted the FSCC, the Commission could update its CO₂ environmental cost values in the future as the IWG revised the FSCC based on more current research~~.

Conclusion 11	~~The Administrative Law Judge concludes that a preponderance of the evidence demonstrates that the FSCC underestimates the negative effects that increased warming will have on human health.~~
Conclusion 13	The Administrative Law Judge concludes that, based on unreported and underreported health and environmental impacts, along with the IWG's acknowledgement that the FSCC is not based on the most current research<u>, an overstatement of the equilibrium climate sensitivity, the erroneous inclusion of a 2.5 percent discount rate, the erroneous exclusion of a 7 percent discount rate, the use of a time-modeling horizon that is entirely unreliable and not supportable by any empirical evidence, and reliance on an incorrect marginal ton,</u> the preponderance of the evidence demonstrates that the FSCC <u>misstates</u> ~~understates~~ the ~~full~~ environmental cost of CO₂ <u>even at a global geographic scope</u>.
Conclusion 15	The Administrative Law Judge concludes that Peabody~~, and the Utilities and MLIG~~ <u>has</u> ~~failed to~~ demonstrate<u>d</u> by a preponderance of the evidence that a Ramsey rule discount rate that adjusts over time is <u>also</u> reasonable to use in calculating the SCC. ~~That approach is not appropriate because it is based on the concept that climate policy can be viewed through the metaphor of a single, infinitely-lived individual rather than the changing views~~

<u>Should be</u>

~~of societies as they evolve over generations. The Administrative Law Judge concludes that the Ramsey rule fails to take into account the idea that priorities and preferences of people and societies will change over an extended period of time and does not address issues of equity between generations. Furthermore, the Administrative Law Judge concludes the Ramsey rule is not appropriate in this proceeding because it begins with a higher discount rate which declines with time. In addition to the intergenerational nature of the FSCC damage calculation, due to the uncertainties associated with the possibility of catastrophic damages from a "tipping point" event which may occur at an unknown time, and the understatement of impacts in the IAMs' damage functions, the Administrative Law Judge concludes that an approach that is designed to begin with a higher discount rate and gradually declines is neither reasonable nor the best approach to for the purpose of calculating an SCC.~~ <u>The Ramsey rule takes into consideration that some countries that have high rates of growth also have low incomes, and that the appropriate discount rate for them should be higher than the discount rate for slower growing but wealthier countries. The propriety of application of the Ramsey rule is explained in Finding of Fact 189.</u>

Conclusion 16

~~The Administrative Law Judge concludes that the preponderance of the evidence demonstrated that the OMB Circular A-4 does not require the IWG to use the seven percent discount rate to calculate the FSCC, because the Circular A-4 is advisory and not mandatory in nature. The Administrative Law Judge concludes that~~

the OMB participated in the IWG's development of the FSCC and there was no evidence that the OMB objected to the IWG's choice not to use a seven percent discount rate in calculating the FSCC.

Conclusion 17

The Administrative Law Judge concludes that the proposal advanced by the Utilities and MLIG to increase the upper end of the discount rate range to incorporate the opportunity cost of emissions reductions in the IWG's IAMs would be a "cost-of-control" approach, contrary to the Commission's required damage-cost approach.

Conclusion 18

The Administrative Law Judge concludes that the Agencies and the CEOs demonstrated, by a preponderance of the evidence, that the IWG's choice of a 2.5 percent rate of discount is within the existing bounds of rates used in other climate change models. The 2.5 percent rate of discount is a reasonable approach to account for the multigenerational scope of the FSCC and to address the concern that interest rates are uncertain over time.

Conclusion 20

The Administrative Law Judge concludes that the CEOs and the Agencies demonstrated by a preponderance of the evidence that the FSCC likely understates damages and that the risk of a "tipping point" is not well-represented within the scope of the 2.5, 3.0, and 5.0, and 7.0 percent rates of discount.

Conclusion 22

The Administrative Law Judge concludes that Peabody failed to demonstrate, by a preponderance of the evidence, that an ECS value of 1 or 1.5 degrees centigrade is correct and that an ECS of more than 2

degrees centigrade is "extremely unlikely."

Conclusion 23	The Administrative Law Judge concludes that the preponderance of the evidence demonstrates that the ECS doubling range~~s~~ as reported by the IPCC in ~~the IPCC AR4 (2.0-4.5 °C) and t~~he IPCC AR5 (the lower part of the 1.5°C-4.5-°C range) is ~~are~~ a more accurate ECS range~~s~~ than the range advanced by Peabody because the IPCC range~~s~~ is ~~are~~ representative of a comprehensive, peer-reviewed body of scientific study based on multiple lines of evidence.
Conclusions 24 and 25	24. ~~The Administrative Law Judge concludes that the preponderance of the evidence demonstrates the IWG had a reasoned basis to refrain from adopting the IPCC AR5 ECS values in the IWG's 2013 FSCC update. While the IWG could have chosen to adopt the updated values at that time, it stated that it viewed that IPCC AR4 ECS values as the most authoritative at the time of the 2013 update and affirmed its intention to update the ECS values as appropriate in the future, based on the latest science and external expert advice.~~
	25. ~~The Administrative Law Judge concludes that the preponderance of the evidence demonstrates that it was reasonable for the IWG to adopt the ECS range of 2.0-4.5 °C as stated in the IPCC AR4.~~
	24. The preponderance of the evidence shows that the likely ECS is in "the lower part of the range from 1.5°C to 4.5°C," which would equate to a conservative average or central ECS of 2.5°C if one were to use one number for computational

purposes.

Conclusion 26

The Commission used an average ton approach in the first Externalities case. The Administrative Law Judge concludes that the Utilities and MLIG ~~failed to~~ demonstrate~~d~~, by a preponderance of the evidence, that the proposal to value CO_2 emissions by using an average ton approach is warranted because use of the last marginal ton incorrectly assumes that a particular ton of CO_2 emitted in the near future would be the last ton to be decided on as part of a 300-year "business as usual" baseline of otherwise unconstrained future emissions. Many of the tons emitted that contribute to the FSCC value will not be emitted until much later than the Minnesota tons in question and by others than Minnesota, while the carbon emitted in Minnesota is no more or less harmful than carbon emitted elsewhere and is also no more or less harmful than any of the tons assumed to be emitted in the future. Further, the use of a "last ton" approach assumes zero abatement, ever, by any country. All parties agreed that some adaptation and technological change will occur in the future to mitigate losses and reduce emissions, and the IAMs are actually designed to account for future adaptation, but the IWG modified the damage functions in the models to eliminate consideration of adaptation for the FSCC. Not accounting for adaptation caused the IWG to overestimate the social cost of carbon. The IWG itself acknowledged that "the IAMs do not provide compelling treatments of adaptation and technological change."

using baselines in which there are no additional emissions of CO_2 after the incremental emission is a reasonable approach to measuring damages in this proceeding. The Utilities and MLIG based this approach on the idea that incremental emissions reduction costs should be balanced with societal damage costs in calculating the SCC. This approach is contrary to the Commission's understanding of a damage-cost approach because, by incorporating the cost of emissions reductions, the Utilities' and MLIG's proposal incorporates a "cost-of-control" approach.

Conclusion 27

The Administrative Law Judge concludes that the Utilities and MLIG failed to demonstrate, by a preponderance of the evidence, that the proposal to value CO_2 emissions by using baselines in which there are no additional emissions of CO_2 after the incremental emission is a reasonable approach because this approach presumes an effective global emissions reduction program will be in effect. The Utilities and MLIG failed to present any evidence of such a program.

Conclusion 28

The Administrative Law Judge concludes that the Utilities and MLIG failed to demonstrated, by a preponderance of the evidence, that the proposal to value CO_2 emissions by using an average ton approach is a reasonable approach in this proceeding, and continues the Commission's practice since the first Externalities case. The Administrative Law Judge concludes that by averaging the first and last tons to calculate the average ton, the Utilities' and MLIG's average ton

~~incorporates the cost of emissions reductions. Therefore, the Utilities' and MLIG's proposal incorporates a "cost-of-control" approach. In addition, the Administrative Law Judge concludes that the Utilities and MLIG failed to demonstrate that the Commission~~ to use~~d~~ an average ton approach ~~in the first Externalities case~~.

Conclusion 29

The Administrative Law Judge concludes that the Agencies and the CEOs failed to demonstrate~~d~~, by a preponderance of the evidence, that the FSCC's approach to counting the last ton of CO_2 emitted as the marginal ton is reasonable and the best approach to calculate damages. ~~This is the best and most reasonable approach because it most closely matches the scientific understanding of what is known about the nature of CO$_2$, which is that each ton of CO$_2$ emitted has a cumulative impact, both with respect to the CO$_2$ emitted in the past and the CO$_2$ emitted in the future, as long as that ton of CO$_2$ remains in the atmosphere.~~

Conclusion 34

The Administrative Law Judge concludes that the Agencies and the CEOs failed to demonstrate by a preponderance of the evidence that a modeling time horizon extending to the year 2300 is reasonable. An additional two-hundred years will add increased numbers of cost values at lower interest rates and accelerating rates of damages with the passage of time and increased temperature. Because, as concluded above, the IWG's prediction of damages for the year 2100 to the year 2300 does not meet the same standards of reliability as the IWG's predictions of

damages from the present to the year 2100 Therefore, the Administrative Law Judge finds that an extrapolation extending two-hundred years or even one-hundred years beyond the year that the EMF-22 scenarios were constructed to end is a degree of uncertainty that is not reasonably supported by adequate evidence.

Conclusion 35	However, weighing the importance of accounting for the CO2 that will remain in the atmosphere beyond the year 2100, and the understated nature of the FSCC, the Administrative Law Judge concludes that it is reasonable to implement the IWG's extrapolation for 100 years, to the year 2200. While the evidentiary underpinning is no greater for this extrapolation than it would be to extend the model to the year 2300, this approach lessens the danger of multiplication of errors within the extrapolation while providing a response to the strong evidence of damage from CO2.
	Because there is no evidentiary underpinning for the IWG's extrapolation of the EMF-22 scenarios, the FSCC values should be recalculated to reflect a shortened time horizon extending to the year 2100.
Conclusion 37 (the Utilities and the MLIG never took the claimed position)	The Administrative Law Judge concludes that the Utilities and MLIG failed to demonstrate, by a preponderance of the evidence, that limiting damages to the United States or Minnesota will not capture all of the damage caused by CO_2 emissions released from electric power generating facilities within Minnesota.
Conclusion 38	The Administrative Law Judge concludes that MLIG improperly framed the

~~calculation of the environmental cost value of CO_2 as a question of economic standing by stating the question in terms of who pays the costs of the policy and who receives the benefits.~~

Conclusion 39

~~The Administrative Law Judge concludes that Minn. Stat. § 216B.2442, subd. 3, and the Commission's requirement that the parties use a damage-cost analysis compel that the question of the geographic scope of damages be viewed in terms of the source of the CO_2 emissions and all their damaging impacts, wherever they are experienced. Therefore, the Administrative Law Judge concludes that this proceeding requires a global scope for damages.~~

The question of geographic scope a worldwide geographic scope is complex in the absence of reciprocity and was not addressed in detail in the original 1996 proceedings. Reciprocity plays a role in the quantity of the value to be assigned to the environmental cost value of CO_2 and the absence of reciprocity on both a national and international level means that a global geographic damages scope leads to an overstatement of damages caused by Minnesota-produced CO_2. Addressing global greenhouse gas emissions in a meaningful way requires all major emitting nations to reduce their emissions significantly, not just the U.S. emitters. Importantly, this fact leads to exactly the opposite conclusion about inclusion of global benefits in the SCC value from what the IWG concluded. The IAMs compute a high $/ton value for a ton of U.S. emission not because the U.S.'s emissions are causing such high damages, but rather the

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SCC estimate is driven upwards by the effect of all of the other nations' uncontrolled CO_2 emissions. Otherwise stated, if no other nation emitted greenhouse gasses, then the SCC estimate would be entirely due to U.S. emissions; however, that SCC estimate would be lower than what the IWG has computed. The ALJ accordingly concludes that unless and until there is a national and international reciprocal system in force, the calculation of the environmental cost value of CO_2 should be made on a local, *i.e.*, Minnesota, damages assessment.

Conclusion 43

~~The Administrative Law Judge concludes that the Agencies and CEOs demonstrated by a preponderance of the evidence that, given the increased scientific certainty of the link between CO_2 emissions and climate change, uncertainties such as the potential danger of a "tipping point" catastrophe reasonably require an initially high SCC until more is known about such uncertainties.~~

Conclusion 44

The Administrative Law Judge concludes that the Agencies and CEOs failed to demonstrate~~d~~, by a preponderance of the evidence, that the IWG adequately accounted for adaptation and mitigation in the FSCC. In fact, the record shows that the IWG removed the adaptation and mitigation elements from the IAMs. The MLIG, Peabody, and others ~~No other party~~ demonstrated, by a preponderance of the evidence, that it is reasonable and necessary to account for adaptation or mitigation ~~to any extent~~ beyond that included in the FSCC. While t~~T~~here was no specific evidence presented regarding the

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efficacy of any specific mode of adaptation or mitigation, the Utilities and the MLIG showed that future generations will be far wealthier and have far higher consumption than is the case in the present. In fact, by 2100, real consumption will be 3 to 5 times higher than we have today. By 2300, when the largest amount of climate impact (with unreduced business-as-usual emissions) will have occurred, consumption will be between 7 and 25 times higher than today. Thus, the IAM scenarios that the IWG has used to compute the SCC of a ton of emission today are also implying that any cost incurred today will reduce present consumption while adding to the vastly higher welfare of future generations.

Conclusion 45 — The Administrative Law Judge concludes that approaching the damage calculation to achieve an "optimal mitigation level" such as Peabody recommended is not consistent with the cost-damage approach required by the Commission.

Conclusion 46 — The Administrative Law Judge concludes that the preponderance of the evidence demonstrates that the IWG has not taken a position regarding whether it is appropriate for a state to adopt the FSCC for purposes such as those outlined in Minn. Stat. § 216B.2422, subd. 3. The Administrative Law Judge concludes that the FSCC could provide the Commission with the information it requires to implement Minn. Stat. § 216B.2422, subd.3. There was no evidence offered in this proceeding to demonstrate that the IWG's FSCC values are different than they would have been had the IWG developed an SCC specifically for the purpose of complying with Minn. Stat.

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~~§ 216B.2422, subd.3.~~

Conclusion 47

The Administrative Law Judge concludes that Peabody ~~failed to~~ demonstrate<u>d,</u> by a preponderance of the evidence<u>,</u> that the IWG is neither peer-reviewed nor transparent. <u>Nevertheless,</u> ~~W~~while the FSCC itself is not peer-reviewed, a preponderance of the evidence demonstrated that the IWG relied primarily on peer-reviewed literature, particularly the work of the IPCC, which is recognized by the Commission, the Minnesota Court of Appeals and the United States Supreme Court as a credible source of expertise in the area of climate change. The experts in this proceeding reviewed the FSCC process exhaustively, providing extensive analysis and critique. While technically not a peer review, this contested case process has provided a thorough level of scrutiny of the FSCC and the IWG's process in developing the FSCC<u>, which has showed that the FSCC is both out-of-date and erroneous</u>. The IWG's Technical Support Documents are all part of the record in this proceeding, along with numerous commentaries regarding the IWG's process and the FSCC.

Conclusion 53

The Administrative Law Judge concludes that MLIG ~~failed to~~ demonstrate<u>d</u>, by a preponderance of the evidence, that ~~any of~~ the CO_2 environmental cost values it proposed are reasonable and the best available measure of CO_2 cost values.

Conclusion 54

The Administrative Law Judge concludes that the Utilities and MLIG ~~failed to~~ demonstrate<u>d</u>, by a preponderance of the evidence, that ~~any of~~ the CO_2 environmental cost values they proposed

are reasonable and the best available measure of CO_2 cost values.

Conclusion 56	The Administrative Law Judge concludes that the Agencies and the CEOs ~~failed to~~ demonstrate~~d~~, by a preponderance of the evidence, that the Federal Social Cost of Carbon is reasonable and the best available measure to determine the environmental cost of CO_2~~, with the exceptions described in these findings regarding the 95th percentile and the time modeling horizon~~.
Recommendation 1	The Administrative Law Judge respectfully recommends that the Commission reject the Federal Social Cost of Carbon as reasonable and the best available measure to determine the environmental cost of CO_2.

In the alternative, the Administrative Law Judge respectfully recommends that the Commission ~~adopt~~ modify the Federal Social Cost of Carbon as follows to reach approximately ~~reasonable and~~ the best available measure to determine the environmental cost of CO_2~~, establishing a range of values including the 2.5 percent, 3.0 percent, and 5 percent discount rates, with the following amendments~~:

a. The FSCC values will be re-calculated to reflect a shortened time horizon extending to the year ~~2200~~2100.

b. The FSCC values will be re-calculated using an equilibrium climate sensitivity in "the lower part of the range from 1.5°C to 4.5°C" pursuant to the IPCC's Fifth Assessment Report, which would equate to a conservative average or central ECS of 2.5°C if one were to use one number for

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computational purposes.

c. The FSCC will be re-calculated using using either discount rates of 3, 5, and 7 percent or using a usage-averaged discount rate of 5.66%, based on the 3% consumption rate of interest identified by the IWG[272] (33.3%) and a conservative 7%[273] average before-tax real rate of return to private capital in the U.S. Economy (66.6%). The Commission will exclude the value derived from the 95th percentile at a 3 percent discount rate value from the range of values.

d. The FSCC will be re-calculated using the average ton.

e. The FSCC will be re-calculated using a local, *i.e.*, Minnesota, damages assessment.

Recommendation 2

The Administrative Law Judge respectfully recommends that the Commission open an investigation into the questions of how to best measure leakage, and whether and how to take leakage into account in other proceedings, as suggested by the Utilities, the MLIG, and Xcel in this proceeding, and that the Commission meanwhile express its Order in dollars per (short or metric) *net* ton.

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[272] *See* Ex. 102 (Polasky Rebuttal) at Schedule 1 (July 2015 IWG Response to Comments) at 22.

[273] As set forth above, the Commission has as recently as May 8, 2015, approved 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.)