PF.CEOs
https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={6B656271-449B-4CCF-A79E-B23151A8B0A8}&documentTitle=201512-116529-01
.
Summary:Adopt FSCC, which of course is moving target.
$11 $36 $56 $105, specified as $2007 / Metric ton, but with GDP deflator and conversion to Short tons MN uses
the numbers happen to be almost identical., especially for the first 3.
ALJ recommended against the 4th number (3%-95th), wanted end date reduced from 2300 to 2200, but also agreed that the FSCC was likely an underestimate. **BUT, in effect, the ALJ recommended most of the FSCC.**

STATE OF MINNESOTA

OFFICE OF ADMINISTRATIVE HEARINGS

FOR THE MINNESOTA PUBLIC UTILITIES COMMISSION

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

MPUC Docket No. E-999/CI-14-643, E-999/CI-00-1636

OAH Docket No. 80-2500-31888

PROPOSED FINDINGS OF FACT

OF

CLEAN ENERGY ORGANIZATIONS

DECEMBER 15, 2015

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INTRODUCTION

Minnesota Center for Environmental Advocacy, Sierra Club, and Fresh Energy (collectively, "Clean Energy Organizations" or "CEO") submit the following Proposed Findings of Fact based on their Initial and Reply Briefs in this matter. CEO maintain that the preponderance of the evidence shows that the Interagency Working Group's Federal Social Cost of Carbon is a reasonable measure and the best available measure of the external costs of carbon dioxide emissions. Based on all the evidence, the Administrative Law Judges ("ALJs") should recommend that the Public Utilities Commission adopt the Federal Social Cost of Carbon for use in Minnesota utility proceedings pursuant to Minnesota Statute § 216B.2422, subdivision 3.

PROCEDURAL HISTORY

1. In 1993, the Minnesota Legislature enacted Minnesota Statute § 216B.2422, subdivision 3, which required the Public Utilities Commission to "quantify and establish" environmental costs of electricity generation.[1] Pursuant to this statute, the Commission established interim cost values in 1994.[2]

2. In 1997, the Commission established permanent values for the external costs of air pollutants Sulfur Dioxide ("SO_2"), coarse particulate matter ("PM_{10}"), Carbon Monoxide ("CO"), Nitrogen Oxides ("NO_x"), Lead ("Pb"), and Carbon Dioxide ("CO_2"). *Id.* at 33. It adopted a range of $0.30 to $3.10 for the external cost of CO_2, based on damage figures assessed by the Pollution Control Agency's expert.[3]

3. In 2001, the Commission began to update external cost values to account for inflation,[4] but declined to establish an external cost for fine particulate matter ("$PM_{2.5}$") or Mercury.[5] The Commission continues to use the values established in 1997 today, adjusted only for inflation.[6]

4. On October 9, 2013, CEO filed a Motion requesting that the Commission re-open the externalities docket to update externality values for CO_2 and NO_x and to establish values for

[1] Minn. Stat. § 216B.2422 (2014).
[2] Ex. 306.
[3] *Id.* at 25-27, 33.
[4] Order Updating Externality Values, Pub. Util. Comm'n Docket No. E-999/CI-00-1636 at 10 (May 3, 2001).
[5] Order Deferring Further Action, Pub. Util. Comm'n Docket No. E-999/CI-00-1636 at 4 (Oct. 5, 2001).
[6] *See* Notice of Updated Environmental Externality Values, Pub. Util. Comm'n Docket No. E-999/CI-00-1636 (May 27, 2015).

SO_2 and $PM_{2.5}$. CEO argued that the earlier adopted values were no longer supported by scientific evidence.[7]

5. On February 10, 2014, the Commission reopened the docket to investigate the environmental and socioeconomic costs of electricity generation for SO_2, $PM_{2.5}$, NO_x, and CO_2.[8] It also directed the Department of Commerce and the Pollution Control Agency to convene a stakeholder group to help the Commission determine the scope of that investigation.[9]

6. On June 10, 2014, as a result of the stakeholder process, the agencies recommended that the Commission adopt the federal Office of Management and Budget's Social Cost of Carbon ("Federal SCC") summary value at a 3% discount rate as the value for CO_2. [10]

7. On October 15, 2014, the Commission declined to adopt the Federal SCC immediately and referred two issues to the Office of Administrative Hearings ("OAH") for contested case hearings: what appropriate values are for SO_2, $PM_{2.5}$, and NO_x, and:

> Whether the Federal Social Cost of Carbon 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.[11]

8. The Clean Energy Organizations, the Minnesota Department of Commerce, and Peabody Energy Corporation were parties to the Public Utilities Commission proceeding and maintained party status when the matter was submitted to the Office of Administrative Hearings.

9. On December 9, 2014, the ALJs granted intervention to Otter Tail Power, Minnesota Power, Northern States Power doing business as Xcel Energy, Minnesota Large Industrial Group, Great River Energy, and Minnesota Chamber of Commerce.[12]

10. On March 19, 2015, the ALJs granted intervention to the Minnesota Pollution Control Agency.

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[7] Notice of Motion and Motion to Update Externality Values, Pub. Util. Comm'n Docket No. E-999/CI-93-583 (October 9, 2013).

[8] Order Reopening Investigation and Convening Stakeholder Group to Provide Recommendations for Contested Case Proceeding, Subd. 3, Pub. Util. Comm'n Dockets No. E-999/CI-00-1636 & E-999/CI-14-643, at 5 (Feb. 10, 2014).

[9] *Id.* at 6.

[10] Dep't of Commerce & Pollution Control Agency, Comments of the Minnesota Dep't of Commerce and the Minn. Pollution Control Agency, Pub. Util. Comm'n Docket No. E-999/CI-00-1636 (June 10, 2014).

[11] Notice and Order for Hearing, Pub. Util. Comm'n Dockets No. E-999/CI-00-1636 & E-999/CI-14-643/ at 8 (Oct. 15, 2014). The Honorable LaraSue Schlatter on behalf of the OAH bifurcated the hearings and testimony on CO_2 from those for the criteria pollutants SO_2, $PM_{2.5}$, and NO_x. First Prehearing Order, Office of Admin. Hearings, Docket No. 80-2500-31888, Pub. Util. Comm'n Docket No. E-999/CI-14-643 at 12 (Dec. 9, 2014).

[12] *Id.* at 2, 4.

11. On April 16, 2015, the ALJs granted intervention to Doctors for a Healthy Environment and the Clean Energy Business Coalition.

12. The parties pre-filed direct, rebuttal, and surrebuttal testimony on June 1, August 12, and September 10, 2015, respectively.

13. A hearing was held September 24 - 29, 2015, at which time opportunity was provided for cross-examination of all witnesses.

LEGAL FRAMEWORK

14. The Commission has asked the parties to address and the Administrative Law Judges to make a recommendation on the following question:

> Whether the Federal Social Cost of Carbon 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.[13]

Burden Of Proof

15. On March 27, 2015, the ALJs issued an Order establishing that:

> [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.[14]

The Order further states that "[a] party or parties, opposing a proposed environmental cost value must demonstrate, at a minimum, that the evidence offered in support of the proposed values is insufficient to amount to a preponderance of the evidence."[15] Parties supporting "retention of an existing cost value … must introduce any evidence on which it intends to rely in this docket[.]"[16]

Parties

The following parties participated in this contested case proceeding:

16. The Minnesota Department of Commerce is an executive agency and, among other things, the chief regulator for the energy industry.

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[13] Notice and Order for Hearing, Pub. Util. Comm'n Docket Nos. E-999/CI-00-1636, E-999/CI-14-643/ at 8 (Oct. 15, 2014).
[14] Order Regarding Burdens of Proof, Pub. Util. Comm'n Docket No. E-999/CI-14-643/Office of Admin. Hearings Docket No. at 2 (Mar. 27, 2015).
[15] *Id.* at 3.
[16] *Id.*

17. The Minnesota Pollution Control Agency is an executive agency responsible for acting in the public interest in Minnesota regarding air pollution, and has been charged by the legislature with improving air quality "by promoting, in the most practicable way possible, the use of energy sources . . . which produce or emit the least air contaminants consistent with the agency's overall goal of reducing all forms of pollution."[17]

18. The Clean Energy Organizations are the Minnesota Center for Environmental Advocacy, the Sierra Club, and Fresh Energy. The Minnesota Center for Environmental Advocacy, founded in 1974, is a nonprofit organization that uses law, science, and research to protect Minnesota's natural resources, wildlife, and the health of its people. Sierra Club is a national nonprofit environmental organization whose Beyond Coal Campaign advocates for a nationwide transition from coal to clean energy in the electric sector and supports efforts by federal and state regulators to address the causes and impacts of climate change. Fresh Energy is a nonprofit organization that works in the public interest to catalyze state and regional policy and regulation that will stimulate the technological advancements necessary for an energy system that sustains the economy, people, and the planet.

19. Doctors for a Healthy Environment is comprised of the Twin Cities Medical Society, a member organization of 6,000 physicians living and working in the Twin Cities metro area with a mission to improve the public health through physician engagement in clinical practice, policy development, and public health initiatives. Their participation in this docket is regarded as a professional and moral obligation by their membership.

20. The Clean Energy Business Coalition consists of Midwest Renewable Energy Association, Solar Energy Industries Association, and Wind on the Wires. Midwest Renewable Energy Association seeks to promote renewable energy, energy efficiency, and sustainable living through education and demonstration and has 23 business members in Minnesota. Solar Energy Industries Association is the national trade association of the U.S. solar industry and has 18 active member companies in Minnesota. Wind on the Wires is a policy organization that advocates for wind energy in the Upper Midwest.

21. Northern State Power, doing business as Xcel Energy, is Minnesota's largest private utility holding company.

22. Peabody Energy Corporation is the world's largest private sector coal company and sells coal to five power plants in Minnesota.

23. Minnesota Large Industrial Group is comprised of large industrial companies located in Minnesota including mining companies, paper mills, manufacturing facilities, and a pipeline company. By their count, electricity makes up 25-30 percent of their individual operating costs.

24. Great River Energy, Minnesota Power, and Otter Tail Power intervened as a single party. Great River Energy ("GRE") provides wholesale electricity to distribution coops in Minnesota. Minnesota Power ("MP") is an energy utility company based in Duluth, Minnesota,

[17] Minn. Stat. § 116.07, subd. 2 (2014).

that provides service in northeastern Minnesota. Otter Tail Power ("OTP") is an energy utility company based in Fergus Falls, Minnesota that provides service in Minnesota.

Positions Of The Parties

25. Four parties recommend adopting the Federal SCC values as reported in the 2013 update and future updates. Those include:

A. The Department of Commerce and the Pollution Control Agency (together, "Agencies").
B. The Minnesota Center for Environmental Advocacy, Fresh Energy, and Sierra Club (collectively, the "Clean Energy Organizations" or CEO)
C. Doctors for a Healthy Environment; and
D. The Clean Energy Business Coalition

26. Four parties oppose adoption of the Federal SCC:

A. Xcel Energy
B. Peabody Energy
C. Minnesota Large Industrial Group; and
D. The Coalition of Utilities, GRE/MP/OTP

27. Parties opposed to the Federal SCC have proposed alternative values. Specifically:

A. Xcel Energy proposes a range from $12.33 to $41.80.[18]
B. MLIG and GRE/MP/OTP propose a range from $1.62 to $5.14.[19]
C. Peabody Energy proposes three alternatives: (1) a zero value, (2) a negative value (-$17.97 - -$4.05), or (3) retaining the existing Commission values.[20]

28. Under the burden of proof adopted by the ALJs in this case, each party bears the burden to demonstrate, by a preponderance of the evidence, that its proposal is both reasonable and the best available value.

The Clean Energy Organizations' Witnesses:

29. Dr. Stephen Polasky has extensive experience and expertise in the area of damage-cost assessments and environmental economics, including on climate change economics and the Social Cost of Carbon.[21] He was senior staff economist for environmental and natural resources for the President's Council of Economic Advisers in 1998-1999 and, while there, focused on the costs and benefits of reducing CO_2 emissions in light of the recent Kyoto

[18] Ex. 600 at 8.
[19] Ex. 300 sched. 2 at 47.
[20] Peabody Initial Br. at 113-15.
[21] Ex. 100 at 1; ex. 100 sched. 2 at 1.

Protocol.Dr Polasky has worked directly on climate change issues in Minnesota, including as the sole economist on an expert committee that reviewed the impact of climate change on the Great Lakes region, and as a member of two working groups for the Minnesota Climate Change Advisory Group 2007-2008. He also testified before the Minnesota Legislature on cap-and-trade policy in 2008. Dr. Polasky has authored numerous peer-reviewed journal articles and textbooks, several of which deal with climate change economics. He has conducted extensive research and published research in numerous journals on the value of ecosystem services and natural capital, the full costs of biofuel and fossil-fuels, and decision-making under uncertainty, all of which has involved pricing CO_2 emissions using estimates of the social cost of carbon, the costs of adapting to climate change, as well as discounting and uncertainty. *Sustainability* 4(12): 3248-3259. Dr. Polasky also serves as an editor or reviewer for professional journals. Dr. Polasky is a member of the National Academy of Sciences. He also serves on a number of advisory boards that regularly deal with climate change issues, including:

A. Science Advisory Board for the U.S. Environmental Protection Agency

B. Science Advisory Board for the National Oceanic and Atmospheric Administration

C. Sustainability External Advisory Committee, Dow Chemical Company

D. Science Council and Board of Directors, The Nature Conservancy

E. Science Council, Program on Ecosystem Change and Society, International Council of Scientific Unions

F. Policy and Technical Expert Committee, Wealth Accounting for the Value of Ecosystem Services, World Bank, and

G. National Academies, Board on Environmental Change and Society

30. Dr. John P. Abraham is a professor of thermal sciences at the University of St. Thomas who specializes in the topics of heat transfer, fluid mechanics, climate change, and numerical modeling. He teaches these topics in formal courses and lectures, and also carries out both basic and applied research in these areas. His research includes climate change, ocean warming, climate sensitivity, numerical modeling, paleoclimate research, and renewable energy. In total, he has produced approximately 120 journal papers, over 100 conference presentations or major public lectures, and more than 20 books, edited works, book chapters, and patents.[22]

31. Dr. Andrew Dessler is a professor in the Department of Atmospheric Sciences at Texas A&M University. He earned his Ph.D." in chemistry from Harvard University, and spent two years doing postdoctoral research at NASA in Greenbelt, Maryland. Prior to his position at Texas A&M University in 2005, he was on the research faculty in the Department of Meteorology and the Earth System Science Interdisciplinary Center at the University of Maryland. His research for the past decade has focused on water vapor and clouds, both of which

[22] Ex. 102 at 1.

play an important role in regulating our climate. He spent a year as a Senior Policy Analyst in the White House Office of Science and Technology Policy, where he was the Office's staff atmospheric scientist. He has co-authored two books on climate change: "The Science and Politics of Global Climate Change: A Guide to the Debate" (Cambridge University Press, 2006, 2010); and "Introduction to Modern Climate Change" (Cambridge University Press, 2012, 2015).[23]

32. Minnesota's leading forest researcher, Dr. Peter Reich, is one of only a handful of scientist in the world able to authoritatively comment on Minnesota's forests. Dr. Reich is a Regents Professor (the highest award possible) at the University of Minnesota. He has published over 500 papers, including dozens in the leading journals such as Nature, Science, and the Proceedings of the National Academy of Sciences. During the past 15 years he has been among the 10 most cited researchers in the world in the field of environmental science and ecology. He was named the BBVA Foundation Frontiers of Knowledge Laureate in 2010 for Ecology and Conservation Biology. There is no Nobel Prize in ecology and the BBVA Award is considered one of a handful that most closely resembles the Nobel Prize.[24]

BACKGROUND

Global Climate Change

33. Fossil fuel combustion emits greenhouse gases including carbon dioxide ("CO_2") into the atmosphere. Anthropogenic sources of CO_2 emissions have increased and are increasing the concentration of CO_2 in the atmosphere beyond levels that would occur naturally.[25]

34. Greenhouse gases like CO_2 help to trap heat in the Earth's atmosphere and warm the planet.[26] They are well-mixed gases, so any CO_2 emitted in Minnesota has global effects.[27]

35. The vast majority of climate scientists believe that anthropogenic greenhouse gas emissions have increased the greenhouse effect, resulting in increased average global temperatures.[28]

36. Carbon dioxide has effects on several systems of the Earth's climate including some layers of the atmosphere, oceans, forests, glaciers, and sea ice.[29] These systems are complicated individually, and also interact with one another. *See* ex. 801 at 31-32 (discussing

[23] Ex. 103 at 1-2.
[24] Ex. 107 at 1-2.
[25] *See e.g.* ex. 803 at 22 (a rare isotope of CO_2 that occurs naturally has not increased in concentration in proportion to increased overall CO_2 concentrations).
[26] Ex. 800 at 7.
[27] Ex. 802 at 13.
[28] Ex. 102 sched. 3 at 3.
[29] Ex. 800 at 6.

mechanisms of climate change). Any level of warming, therefore, partly depends upon these feedback mechanisms. *Id.* The extent to which increased levels of carbon dioxide (and other greenhouse gases) warm the planet is the equilibrium climate sensitivity ("ECS" or "climate sensitivity"). Ex. 102 at 4. As the term is used by experts in this proceeding, it refers to the change in the temperature of the Earth that will result from a doubling of carbon dioxide. *Id.*

37. As the Commission first recognized in 1997, the International Panel on Climate Change ("IPCC") prepares reports that "are the most authoritative sources available for information on climate change issues."[30] The IPCC was established by the United Nations Environment Programme and the World Meteorologists Organization in 1988, and continues to be a leading expert.[31] To prepare its periodic reports, the IPCC reviews, summarizes, and synthesizes scientific literature on climate change.[32]

38. The IPCC, upon reviewing the literature, has declared global warming unequivocal and unprecedentedly fast.[33] The oceans are also warming, rising, and undergoing acidification.[34] The IPCC reports that atmospheric concentrations of greenhouse gases have increased to levels unseen in the last 800,000 years, noting that the increase in CO_2 concentrations is "primarily from fossil fuel emissions and secondarily from net land use change emissions."[35]

The External Costs Of Greenhouse Gas Emissions -- The "Social Cost Of Carbon."

39. The emission of CO_2 and other greenhouse gases into the atmosphere is changing the climate, temperature, oceans, and other Earth systems and is predicted to have adverse impacts on humans and the environment.[36] Adverse impacts are expected to result, for example, from sea-level rise displacing populations living in low-lying areas, increased severity and length of heat waves with impact impacting human health and crop production, changes in precipitation affecting agriculture, water quality and water availability, and storm severity and frequency, among other effects.[37] These impacts levy costs on society.[38]

40. The "social cost of carbon" ("SCC") estimates the cost that continued CO_2 emissions will have due to the adverse impacts that result from those emissions. Specifically, the SCC is the current value of damages that will result from the emission of a one metric ton of CO_2 to the atmosphere.[39] The SCC value depends on several factors, including the existing

[30] Ex. 405 Foreword at v; *accord* ex. 102 sched. 3 at 4.
[31] Id.
[32] Ex. 103 at 2; ex. 405 Foreword at v.
[33] *Id.* at 4.
[34] *Id.* at 8, 11.
[35] *Id.* at 11.
[36] Ex. 100 at 3.
[37] Id.
[38] *Id.* at 4.
[39] Id.

concentration of CO_2, the level of expected additional emissions, the predicted effect on temperature, and how future costs are discounted.[40]

The Interagency Working Group's Development Of The Federal SCC

41. Pursuant to Executive Order 12866 and a 2007 federal appeals court case, the federal government must account for the benefits of regulations that reduce CO_2 emissions.[41] In 2009, the Office of Management and Budget convened an Inter-Agency Working Group ("IWG") to develop a standard measure for the costs of such emissions, the Federal SCC.[42]

42. In 2009, the Council of Economic Advisers and the Office of Management and Budget, with participation by the Council on Environmental Quality, the National Economic Council, the Office of Energy and Climate Change, the Office of Science and Technology Policy, the Environmental Protection Agency and the Departments of Agriculture, Commerce, Energy, Transportation, and Treasury convened the IWG to review and develop estimates of the SCC .[43] In 2010, this Inter-Agency Working Group ("IWG" or "working group") published its results, the Federal SCC.[44]

43. The working group selected three commonly used Integrated Assessment Models ("IAMs") to estimate the damage costs of CO2 emissions. These models "combine climate processes, economic growth, and feedbacks between the climate and the global economy into a single modeling framework."[45] These three models, known by their acronyms DICE, PAGE, and FUND, are the same models that the IPCC also relied upon in its Fourth Assessment Report.

44. As models, DICE, PAGE, and FUND share a general structure. They are made up of reduced form representations of economic, climate, and impact models.[46] Therefore, the models are able to combine explicit assumptions of how economic activity drives emissions, how these emissions contribute to climate change, and how emissions impacts can be valued.[47] Numeric computations assess a series of causes and effects over a given period of time.[48] Each step in the model produces an outcome in the form of a trajectory (e.g. average annual Gross Domestic Product, average annual GHG emissions), which subsequently informs the next step.[49] The final step in each model is the damage function, the output of which identifies economic costs associated with climate change.[50]

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[40] Id.
[41] Exec. Order No. 12,866, 58 Fed. Reg. 51,735 (Sep. 30, 1993); Ctr. For Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1203 (9th Cir. 2007).
[42] Ex. 100 sched. 4 at 8.
[43] *Id.* at 9 tbl.2.
[44] Ex. 100 sched. 2.
[45] Ex. 100 sched. 2 at 5.
[46] Ex. 800 at 30.
[47] *Id.* at 24.
[48] *Id.* at 25 tbl. 1, 26.
[49] *Id.* at 26.
[50] *Id.* at 27.

45. Although they share a similar framework, DICE, PAGE, and FUND differ enough that adjustments were needed to ensure outputs across these models could be compared. The IWG identified three major parameters—sensitivity, emissions and socio-economic projections, and discount rate—that it harmonized across the three models.

46. For climate sensitivity, the working group tailored a probability distribution to the IPCC's Fourth Assessment Report range.[51] After considering four different distributions, the IWG selected the distribution from Roe and Baker because of general agreement with its theoretical underpinnings and because it most closely reflects the judgments of the IPCC.[52] The distribution is calibrated to have a central (median) value of 3°C with two-thirds probability that the ECS lies between 2°C and 4.5°C and zero probability that it is less than 0°C or greater than 10°C.[53]

47. For socioeconomic and emissions projections, the IWG selected five scenarios from the Stanford Economic Modeling Forum exercise EMF-22.[54] Four scenarios represent futures in which CO_2 emissions continue relatively unabated ("business as usual") for many years, while the fifth assumes successful efforts to limit carbon dioxide emissions.[55] The EMF-22 "business as usual" trajectories span a range of plausible future scenarios, in which CO_2 concentrations are stabilized at between 612 and 889 parts per million (ppm) in 2100.[56] The fifth scenario accounts for more significant worldwide action to mitigate emissions and assumes CO_2 concentrations are stabilized at 550 ppm.[57] The EMF exercise limited the horizon to the year 2100 in order to model reduction needs through the end of this century.[58] The IWG extended these scenarios to the year 2300 in order to capture the full extent of CO_2 damages.[59]

48. The IWG also applied annual discount rates to the cost models. The IWG, after reviewing the literature on cost of carbon discounting, selected three discount rates: 2.5 percent, 3 percent, and 5 percent.[60]

49. With 10,000 values for climate sensitivity and the five emission and socio-economic scenarios, the IWG produced 150,000 model runs at each discount rate, or 450,000 estimates total.[61] The IWG averaged the 150,000 results for each discount rate to produce three summary values for the SCC.[62] Finding that the models incompletely account for catastrophic

[51] Ex. 100 sched. 2 at 12-15; ex. 102 at 4.
[52] Ex. 100 sched. 2 at 13-14.
[53] *Id.* at 13.
[54] *Id.* at 15-16.
[55] Id.
[56] Id.
[57] Id.
[58] *Id.* at 15.
[59] Ex. 101 at 16.
[60] *Id.* at 11.
[61] Ex. 100 sched. 3 at 13.
[62] Id.

damages, the IWG also reported the 95th percentile value at a 3 percent discount rate—a higher-damage scenario.[63]

50. The IWG's process culminated in 2010 with the release of the full schedule of federal SCC values by year in 2007 dollars, three centralized values averaging model runs for separate discount rates and the fourth value representing the 95th percentile of the 3 percent discount rate.[64]

51. In 2013, the IWG updated the Federal SCC by running updated versions of all three models under the same parameters it used the first time. [65]

52. In 2015, the IWG responded to comments and updated its schedule of summary values for the SCC.[66]

53. For 2015, the Federal SCC summary values in 2007 dollars are $56 (2.5 percent discount), $36 (3 percent discount), $11 (5 percent discount), and $105 (3 percent discount, 95th percentile).[67] 2007$ and per metric ton, whereas others are short ton.

WHETHER THE FEDERAL SCC IS A REASONABLE MEASURE OF THE EXTERNAL COSTS OF CARBON

54. The preponderance of the evidence shows that the Federal SCC is a reasonable measure of external costs of carbon. The IWG employed a reasonable process, used appropriate models, and made reasonable assumptions in its development of the Federal SCC. Parties critical of the IWG have not shown that the evidence in support of the Federal SCC is insufficient to amount to a preponderance of the evidence.

55. In 2009, OMB and the Council of Economic Advisers drew representatives from several federal agencies with pertinent expertise together to form the Interagency Working Group with the goal of calculating externality values for greenhouse gas emissions.[68] The group worked by consensus and participants expressed satisfaction that the final product included their input.[69]

56. The working group reviewed available literature and science, discussed key inputs and assumptions, and considered public comments.[70] As the IWG expressed, "[t]he main objective of this process was to develop a range of SCC values using a defensible set of input

[63] Ex. 100 at 16.
[64] Id.
[65] Ex. 100 sched. 3 at 3.
[66] Ex. 101 at 2.
[67] *Id.*
[68] Ex. 100 sched. 4 at 9 tbl.2.
[69] Ex. 100 sched. 4 at 13.
[70] *Id.* at 17; ex. 800 at 45.

assumptions that are grounded in the existing literature."[71] The working group based the Federal SCC on prevalent research in the field and relied upon existing academic literature in both its choices of models and modeling decisions.[72]

57. In 2014, the Government Accountability Office, in response to a request from Congress, reviewed the process employed by the IWG and issued a detailed report.[73]

58. In November, 2013, the Office of Management and Budget requested comment on the Federal SCC and in July, 2015, the IWG issued a Response to Comments to explain its decisions and respond to various critiques and questions raised in comments received.[74]

59. The technical support documents issued by the IWG with the 2010 Federal SCC as well as the 2013 update are clear and provide sufficient detail to allow experts in the field to understand and critique the IWG's work. In particular, the IWG is transparent about the assumptions it made in its modeling and the uncertainties inherent in calculating the Federal SCC.

60. The preponderance of the evidence shows that the IWG's selection of the three models DICE, PAGE and FUND, to use in developing the Federal SCC was reasonable

61. Economists testifying on behalf of the Clean Energy Organizations and the Agencies noted that these models are the three most commonly cited and prominent models in the field.[75] The IPCC relies upon these same models in their reports.[76]

62. Most of the alternative values proposed in these proceedings are also based on these models, either in whole or in part. The Minnesota Large Industrial Group, Ottertail Power, Minnesota Power and Great River Energy (collectively, "MLIG") sponsored an alternative value from Dr. Anne Smith based on runs of the models using different assumptions.[77] Likewise, Xcel Energy staff member Nick Martin developed a range of values that Xcel has submitted as its alternative to the Federal SCC. Mr. Martin's analysis is based on the IWG's outputs from the three models.[78] Peabody Energy sponsored testimony of Dr. Mendelsohn, who proposed values based on his run of the DICE model, and Dr. Tol, who proposed an estimate based on FUND.[79]

63. The IWG's decision to use the three most-cited and accepted Integrated Assessment Models in the academic literature was reasonable and has not been seriously contested in this proceeding.

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[71] Ex. 100 sched. 2 at 3.
[72] Ex. 100 sched. 4 at 13.
[73] Ex. 100 sched. 4.
[74] Ex. 101 sched. 1.
[75] Ex. 100 at 6; Ex. 800 at 31-33.
[76] Id.
[77] Ex. 300 sched. 2.
[78] Ex. 600.
[79] Exs. 214, 236.

Criticisms Of The IWG's Federal SCC

64. Several parties to these proceedings have raised arguments against the federal SCC. These witnesses have failed, however, to show by a preponderance of the evidence that the assumptions and choices made by the IWG render the Federal SCC unreasonable.

Standardization of model inputs

65. The IWG ran the three models side by side and then averaged the results.[80] In order to do so, the IWG had to harmonize certain parameters within the models. The most impactful standardized parameters were the equilibrium climate sensitivity, socio-economic and emissions trajectories, and discount rates.[81]

66. Such standardization is conventional in economic analysis,[82] and the IWG made its choices clear.[83]

67. Dr. Hanemann detailed how the IWG standardized external model inputs (the "drivers") of future population, income, and emissions, as well as parameters for non-CO2 radiative forcing and the climate sensitivity value.[84] To standardize projections of income, population, emissions, and non-CO2 radiative forcing, the IWG used results of the highly authoritative Energy Modeling Forum's ("EMF") 22nd model inter-comparison study (Clarke et al., 2009).[85]

68. Dr. Hanemann testified that, in his opinion, it was appropriate for the IWG to draw the standardized values of the socioeconomic/emissions inputs from the EMF-22 model inter-comparison exercise, which had just been completed prior to the IWG's study. He explained that the EMF model inter-comparison exercises are seen as authoritative in the economic literature on climate change and mitigation policy.[86] In Dr. Hanemann's expert opinion, it was also appropriate for the IWG to standardize the non-CO2 radiative forcing across the three models. Non-CO2 emissions constitute a relatively small part of total GHGs. By harmonizing their treatment, this made the models more readily comparable.[87]

69. Dr. Hanemann summarized the standardized IAM inputs in his Figure 4.[88] To standardize income, the IWG removed the optimization performed by DICE, and made income exogenous to DICE in the same manner as PAGE and FUND. The IWG used the same income projections for all three models.[89] For population, the three models use slightly different

[80] Ex. 800 at 46.
[81] Ex. 100 at 8; ex. 800 at 47.
[82] Ex. 802 at 30.
[83] Ex. 104 at 22.
[84] Agencies Ex. 800 at 46 (Hanemann Direct).
[85] Id. at 49-51; Agencies Ex. 801 at 17 (Hanemann Rebuttal).
[86] *Id.* at 50, 66-67.
[87] *Id.* at 67.
[88] *Id.* at 49.
[89] *Id.* at 48.

exogenous projections. As part of the standardization, the IWG used a common population projection for all three models.[90] Finally, the three models treat non-CO2 greenhouse gasses slightly differently. The IWG standardized the treatment of non-CO2 greenhouse gasses the same, so as to place PAGE on the same footing as DICE.[91]

70. Dr. Polasky acknowledged that there is a trade-off due to the standardization and some value is lost with the loss of internal consistency of the individual models.[92] Still, this harmonization was necessary and reasonable under the circumstances.[93]

Equilibrium climate sensitivity

71. Equilibrium climate sensitivity establishes the relationship between emissions and temperature change and how much the temperature will increase as a result of increased CO_2 concentrations impacts the damage costs of emissions. The exact relationship between CO_2 concentrations and temperature is unknown at this time, and researchers' ranges for the value vary.[94]

72. The IWG input 10,000 different values for sensitivity into the models, calibrated to the IPCC's consensus statement in the Fourth Assessment.[95] This reasonably accounts for the uncertainty in the parameter without giving undue weight to possible but unlikely sensitivity values. It also relies upon the most authoritative source on climate change, the IPCC.

73. Peabody witnesses Bezdek, Lindzen, Happer and Spencer criticized the sensitivity values and, more generally, the established relationship between greenhouse gas emissions and temperature increases. They asserted that the actual ECS is lower than the range used by the IWG and that temperature readings show a "hiatus" demonstrating that the model calculations over-estimate warming. These witnesses have not shown that the evidence in support of the IWG's ECS is insufficient to establish a preponderance of the evidence.

74. Because the IWG used a distribution of values, the low sensitivity values that the Peabody witnesses promote *are included* in the IWG's federal SCC as some among many of the possible climate sensitivity values. That is the appropriate way to deal with uncertainty.

75. The best available evidence supports the relationship between CO_2 concentration and temperature reflected in the model runs done by the IWG. Peabody witnesses Spencer, Lindzen, and Happer rely on estimates of sensitivity based on the 20th Century record, only one basis for estimating sensitivity.[96] Paleo-climate records and model simulations suggest sensitivity

[90] *Id.*
[91] *Id.*
[92] Ex. 104 at 22.
[93] *Id.* Tr. Vol.2B at 78, lines 16-120.
[94] Ex. 405 (IPCC 5th Assessment Report, Working Group I, Chapter 12, p. 1110, box 12.2, Figure 1) (showing many researchers' assessed sensitivity ranges); *accord* Ex. 801 at 31-32; ex. 600 at 39.
[95] Ex. 101 sched. 1 at 11.
[96] Ex. 221 at 1; ex. 233; ex. 209 at 9; ex. 202 at 7.

closer to the high end of the IPCC's range.[97] Dr. Spencer created a global temperature data set based on readings from satellites, but his analysis of this data set, which concludes that the Earth is experiencing a hiatus in warming, has had a series of errors.[98] Dr. Spencer and colleagues made errors first in correcting for changes in satellites' orbits, and later, in correcting for temperature differences between night and day, with both errors decreasing temperature changes.[99] The data also suffers from the challenges of calibrating between the instruments themselves, which orbit only a few years and fail unexpectedly.[100]

76. As the IWG explained, legitimate research led the IPCC to update the low end of its ECS estimate in its Fifth Assessment Report.[101] Because the IPCC Fifth Assessment Report came out after the IWG's latest updates to the SCC, it will consider an update to the probability distribution in the future.[102] This approach is reasonable.

77. The Peabody witnesses' testimony on this issue is entitled to less weight than the testimony of other witnesses.

A. The record demonstrates that several of the claims made by these witnesses are inaccurate or misleading. Drs. Abraham and Dessler, for example, have convincingly shown that these witnesses rely on narrowly selected literature, some of it not peer reviewed, to support their positions.[103] As Dr. Dessler testified:

> One of the guiding principles of science is to use all of the available data when testing hypotheses. Reliable science does not throw out the vast majority of the data that disagrees with a hypothesis, and then use the remaining tiny fraction to conclude that the sought-after result is correct. This type of 'cherry picking' is how Drs. Spencer, Lindzen and Happer reach the conclusions in their testimony.[104]

B. These witnesses also misrepresented or misinterpreted the sources they used, including Dr. Lindzen mischaracterizing the science on CO_2 absorption as "the Bern model," and misusing his sources.[105] Similarly, Peabody witnesses frequently referred to the IPCC reports as if they were

[97] Ex. 103 at 5.
[98] Ex. 103 at 11-12.
[99] *Id.* at 8-9.
[100] *Id.* at 10.
[101] Ex. 101 sched. 1 at 12.
[102] Id.
[103] Ex. 102 at 23-24; ex. 103 at 13-14.
[104] Ex. 103 at 3.
[105] Ex. 803 at 8; ex. 106 at 6 (for his specific claims regarding sensitivity, Dr. Lindzen relied upon sources including Stevens, Fyfe, and Stott that did not draw his conclusions, one of whose authors explicitly denied that their work supports such claims).

products of the IPCC's own research, even though the IPCC acts only as a reviewer of other science.[106]

C. These witnesses failed to rebut or acknowledge problems with the sources they used, including Dr. Spencer failing to adequately explain the errors in his own analysis.[107] Dr. Bezdek alone failed to cite to more than one or two peer-reviewed sources in either his direct or his rebuttal testimony.[108]

78. The preponderance of the evidence demonstrates that it was reasonable for the IWG to rely on the calibrated Roe and Baker distributions which include a wide range of ECS values.

Socio-economic and emissions scenarios

79. The selection of future socioeconomic and emissions scenarios necessarily involves predicting the future and, therefore, a level of uncertainty. Although the CO_2 damage models respond slightly differently to inputs of future emissions and GDP, these factors affect results from all three.[109] Socioeconomic conditions clearly influence emissions. Emissions, in turn, affect atmospheric concentrations of CO_2, which determine the temperature increases and damage from additional CO_2.[110]

80. The IWG selected five socioeconomic and emissions scenarios assessed by Stanford Energy Modeling Forum exercise EMF-22. The IWG selected these peer-reviewed scenarios because they established internally consistent trajectories for Gross Domestic Product ("GDP"), population, and emissions, an advantage when assessing damages dependent on these factors.[111]

81. The scenarios chosen by the IWG have been peer reviewed and published recently.[112] The IWG selected multiple values to include in its analysis. These decisions respond to uncertainty and produce reasonable results.

82. Parties opposed to the Federal SCC have suggested that it is not reasonable to assume that emissions will continue to increase, especially in the face of the widespread costs and destruction expected from climate change. They argue that future generations, in the face of grave economic consequences, will somehow reduce worldwide emissions and stabilize CO_2 concentrations at a reasonable level.

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[106] Ex. 804 at 12-13.
[107] In these proceedings Dr. Spencer did not address the error found most recently, the problem with calibrating the temperature changes between day and night found by Po-Chendly in 2015. *Compare* ex. 103 at 8-11 (Dr. Dessler details the major issues found with Spencer's analysis), *with* ex. 227 at (Dr. Spencer defends his analysis by attacking Dr. Dessler's source's data and arguing that the Po-Chendly 2012 paper analysis was not thorough enough).
[108] Ex. 803 at 25; ex. 804 at 6.
[109] Ex. 100 sched. 2 at 27; ex. 100 at 9.
[110] Ex. 100 at 9.
[111] *See* ex. 101 sched. 2 at 15.
[112] Ex. 100 at 15.

83. Witnesses arguing that emissions will be significantly controlled in the future have provided no evidence of current or likely future global efforts of the scale needed to establish a lower emissions trajectory. The Clean Energy Organizations and the Agencies have, in contrast, produced testimony on the likelihood of sufficient controls on CO_2.[113] There is also a significant time lag between the emission of CO_2 and the temperature related effects of those emissions, meaning that decision-makers may be slow to act.[114]

84. The IWG *did* include a future scenario in which significant emission reductions are achieved. This choice was reasonable given what we know today and was based on a preponderance of evidence, rather than an optimistic hope for international cooperation and resolution.

Discount rates

85. Although the discount rate is not uncertain per se, it is contentious as well as influential on the final SCC.[115]

86. There are generally two main approaches to discounting—one that is focused on actual market behavior and the long-term market rate of return on capital, and one that involves value judgments about the weight that should be given to future generations' welfare versus the welfare of the current generation.[116] When used together, the IWG's chosen discount rates satisfy both parameters.[117] The working group's final SCC presents the values at different discount rates separately "[b]ecause the literature shows that the SCC is quite sensitive to assumptions about the discount rate, and because no consensus exists on the appropriate rate to use in an intergenerational context[.]"[118] The IWG reasonably assessed controversy in the literature and the final SCC does not obscure this parameter's impact on costs.

87. Several witnesses argued that the IWG should have included an SCC value at a 7 percent discount rate, relying primarily on the OMB Circular A-4 Guidance document.[119]

88. It was reasonable for the IWG to apply the discount rates it did.

A. The IWG and others have reviewed the research applying discount rates to the social cost of carbon, and the IWG's selected rates fit within most applications, while a 7% discount rate would be an outlier.[120]

[113] Ex. 101 at 46; Ex. 801 at 26.
[114] Ex. 801 at 26.
[115] Ex. 100 sched. 2 at 17; ex. 100 at 11.
[116] Ex. 100 at 11-12; *Id.* sched. 2 at 17-19.
[117] Ex. 100 sched. 2 at 23.
[118] *Id.* at 25.
[119] *See, e.g.,* Ex. 236; ex. 217; ex. 228.
[120] Ex. 104 at 8-9.

B. As a coordinating agency for the IWG, the OMB approved the chosen discount rates. Additionally, circular A-4 laid out conditions under which lower rates are appropriate: long time frames raising ethical considerations and considerable uncertainty about future conditions. Both apply to assessing the external costs of carbon dioxide.[121]

C. Damages are exerted primarily upon consumers, and a rate corresponding to capital investments would, therefore, be inappropriate to apply, even if the final SCC is applied to entities that make capital investments.[122]

89. Several parties also argued against inclusion of the 2.5% discount rate. But the IWG's decision to report this lower discount rate was reasonable.

A. The 2.5% discount rate is appropriate because of the long time horizon being discounted.[123]

B. The evidence shows that lower discount rates are more prevalent than higher discount rates among scientists who study the economic impact of climate change. Dr. Tol's meta-analysis found that only two papers out of thirty-nine used a discount rate above 5 percent. In contrast, he found that 10 studies used a discount rate below 3%. And among those, six studies used a discount rate of 1 percent or less.[124]

90. The evidence supports the IWG's use of 2.5 percent, 3 percent, and 5 percent discount rates to establish an externality value for a pollutant which, while emitted today, will have consequences for many generations well into the future.

Model time horizon

91. MLIG, Peabody, and Xcel Energy offered testimony critical of modeling the costs of carbon over a very long period of time.[125] These parties criticize the Federal SCC because its model horizon, which extends to 2300, must incorporate too much uncertainty.

92. CO_2 remains in the atmosphere for hundreds of years, and negative effects likely outlast the gas itself.[126] When assessing the damages CO_2 causes, the IWG reasonably let the nature of the gas guide its model horizon.

93. Witnesses for the Agencies and the Clean Energy Organizations, as well as the IWG itself, acknowledge that there is uncertainty inherent in making future predictions, but

[121] Ex. 101 sched. 2 at 21-22.
[122] Ex. 104 at 8-9
[123] Ex. 101 sched. 2 at at 24; Ex. 802 at 46.
[124] Ex. 101 at 22.
[125] *See* ex. 300 at 22 (Dr. Smith asserting predictions over such a time horizon are too speculative to be useful); ex. 601 at 44 (Mr. Martin noting that the further out in time, the more disconnected the models become to empirical bases); ex. 235 at 58-60 (Dr. Bezdek asserting that forecasting to 2300 is like creating "science fiction").
[126] Ex. 101 sched. 1 at 15, 29; ex. 100 sched. 2 at 25.

reject the alternative option, which is to ignore likely but uncertain damages altogether.[127] As one witness noted, "[i]t is also not valid to conclude that the proper response to large uncertainty is to just ignore it."[128]

94. Ignoring the long life of CO_2 would produce absurd results. A shorter model horizon, such as the one Dr. Smith applied, effectively assumes that damages past that horizon are zero.[129] Dr. Smith provided no evidence that damages after the shorter time horizon are in fact likely to be zero.[130]

95. The IWG's model horizon reasonably incorporates likely future damages from present emissions of CO_2.

Damage functions in the models

96. The models the IWG used employ conservative damage functions, and the IWG did not alter them.

A. The models used by the IWG are conservative because they place minimal weight on catastrophic changes and incompletely account for several processes that are difficult to quantitatively assess, including ocean acidification, species loss, increased precipitation, and extreme weather.[131]

B. The models assess Gross Domestic Product effects as contemporaneous rather than continuing, i.e., the damage functions do not assess the damages' impacts on growth *rate*.[132]

C. One witness also pointed out that the models are likely to underestimate damages specifically because they draw from older literature.[133] Newer studies tend to find higher damages, so these models' reliance on older studies would cause them to underestimate damages.[134]

97. It is likelier that the models underestimate than overestimate damages.

98. Parties opposed to the Federal SCC argued that the damage functions overstate the likely damage resulting from climate change, asserting that the models do not account for the benefits of CO_2 emissions and temperature increases, that the damage functions lack sufficient empirical basis, and that the models do not specifically track dose of CO_2 to economic response. These arguments are incorrect and do not establish that the IWG's choice with regard to damage functions was unreasonable.

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[127] *See* Ex. 101 at 15.
[128] Ex. 101 at 6.
[129] Ex. 101 at 20.
[130] Trans. Vol. 2a at 78-79.
[131] Ex. 100 at 19-20, 23; ex. 801 at 55.
[132] Ex. 100 at 20; ex. 801 at 55-56.
[133] Ex. 801 at 48. According to a study by the Electric Power Research Institute, DICE and FUND in particular favor studies before 2002, while PAGE favors studies before 2010. *Id.* at 47.
[134] *Id.* at 48.

99. Peabody witnesses Bezdek, Happer, Lindzen, and Mendelsohn argue that the models inadequately account for the benefits of CO_2 emissions and increased temperature. These witnesses assert that plant life worldwide already flourishes due to current increased levels of CO_2, and that even greater increases will improve agricultural productivity, especially in cooler areas like Minnesota.[135] This testimony has been refuted and is accorded little weight.

100. The models do account for potential benefits to agriculture from increased CO_2 concentrations.[136]

101. The fertilization benefit is not as simple as Peabody's witnesses assume. Under controlled (i.e. laboratory) conditions, CO_2 does fertilize plants.[137] But outside of a laboratory, increases in atmospheric CO_2 affect other aspects of plants' and crops' real-world habitats.[138] The IPCC has evaluated climate impacts on agriculture and found a net negative impact.[139]

102. As regards effects of CO_2 and warming on Minnesota plant life in particular, the only witness that has researched the question, the Clean Energy Organization-sponsored Dr. Reich has concluded that "negative effects [will] likely [ ] outweigh positive effects in the near-term and [ ] the aggregate impact [will become] increasingly negative [ ] further into the future."[140]

103. The benefits that opponents of the federal SCC claim CO_2 has brought or will bring to plant life are either accounted for or outweighed by costs.

104. Witnesses for Peabody argued that the models' damage functions have an insufficient evidentiary basis.[141] Critics have cited the work of Dr. Robert Pindyck, an economist at MIT, to argue that the damage functions in the models are circular because they rely upon one another for justification.

105. The functions are not circular, or based on one another, but on research and studies of sectoral impacts.[142] Dr. Pindyck, while acknowledging the uncertainties and shortcoming of current models, actually supports use of the Federal SCC or a higher estimate of damages.[143]

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[135] Ex. 228 at 11, 16-17(Bezdek); ex. 200 at 10-11 (Happer); ex. 209 at 16 (Lindzen); ex. 216 at 12-14 (Mendelsohn).
[136] Ex. 101, at 54-55; *see also* Ex. 801, at 4.
[137] Ex. 101 at 53; ex. 803 at 19.
[138] Ex. 101 at 53; ex. 107 at 4; ex. 801 at 12; ex. 803 at 20.
[139] Ex. 803 at 21.
[140] Ex. 107 at 4.
[141] Dr. Bezdek asserted that the functions—that is, the formulae themselves—were made up entirely. Ex. 228 sched. 2 at 105-108. Dr. Smith argued that the damage functions lack an empirical basis beyond 3° C warming. Ex. 300 at 18.
[142] Ex. 801 at 38-39.
[143] *Id.* at 36-37; ex. 101 sched. 1 at 8. The critique of circularity applies primarily to the DICE model's quadratic functions because no researcher has proven a quadratic relationship between

106. The damage functions used in the models are based on the best available evidence and the most informed judgments of the model authors. The fact that there is uncertainty in the functions does not make the IWG's reliance on these three models unreasonable.

107. One witness also argued that the models lacked a basis in economic theory. But it would be unreasonable to expect that area of the field, with its focus on qualitative predictions given certain assumptions, to provide answers to the quantitative and empirical questions that climate damage models must answer.[144]

108. Although modelers must make some assumptions, the models are based on empirical evidence, as is appropriate to the context.

109. Dr. Smith argued that the models' damage functions lack sufficient specificity of dose-response relationships. Although the models do not assess physical impacts as a direct result of emissions and then relate these into damages, such an analysis would be prohibitive for the complicated processes of climate change. No modeler could perform dose-response analysis for carbon.[145] Analysts use dose-response functions to assess narrowly defined outcomes calibrated to specific conditions, rather than the large spatial and temporal scales or complicated feedback mechanisms in situations such as climate change.[146]

110. Model writers and the IWG reasonably chose other means to assess damages.

111. The Federal SCC is a reasonable measure of the external costs of carbon. The IWG relied on the best available scientific and economic research on climate change to guide its decisions. It selected not one but all three most commonly used models to assess climate damages, and standardized them so as to compare results. The working group reasonably accounted for uncertainty in the field when it incorporated multiple values for the standardized parameters of sensitivity, socioeconomic and emissions projections, and discount rate. For each of these parameters, it selected reasonable inputs that neither assumed the impossible nor ignored available evidence. It assessed its results, and pulled out the 95th percentile value at a 3 percent discount rate to represent an unlikely but higher risk scenario. The four final summary values represent a synthesis of the best available science in the field and reasonably account for the uncertainty inherent in the task.

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emissions and damages, but the FUND and PAGE models use different functions, and all rely upon studies of sectoral impacts to form a basis for damages. *Id.*

[144] Ex. 801 at 39.

[145] Ex. 801 at 39-40.

[146] Id.

ALTERNATIVE EXTERNALITY VALUES FOR CO_2

112. Xcel Energy, MLIG and GRE/MP/OTP, and Peabody have offered alternative values to the Federal SCC in this proceeding. But none has met its burden to show by a preponderance of the evidence that its proposed value is preferable to the Federal SCC.

Xcel Energy's Proposal

113. To develop an alternative to the social cost of carbon, Mr. Martin, Xcel's Environmental Policy Manager, engaged the Brattle Group to calculate a range of estimates around the central value, or median, of all outputs from the IWG's model runs.[147] He selected the 25th percentile values for each of the three discount rates, 2.5 percent, 3 percent, and 5 percent, and then averaged these three values to reach the low-end of the range.[148] He selected the 75th percentile values at the three discount rates, and averaged those values to reach the high-end of the range.[149]

114. Xcel's proposed range is less useful than the Federal SCC and unreasonable because (1) the mean better represents the IWG's data than the median; (2) the choice of end points was arbitrary and subjective; and (3) averaging across discount rates is inappropriate.

115. The mean is a more appropriate tool to assess the IWG's raw data.[150] The IWG chose to represent the distribution of data from model runs using the mean and not the median. As the IWG explained itself explained in response to comments, the median will give a more typical outcome, but the mean provides a measure that gives full weight to the tails of a large distribution. "In the climate change context, sound decision-making requires consideration . . . of less likely outcomes that could have very large (or small, or even negative) damages (the tails of the distribution)."[151]

116. The median is not useful to assess climate damage scenarios because there is no "typical" future amongst many—Minnesota will experience only one future. Cutting out the worst possible damage scenarios would prevent the Commission from preparing for unlikely but more dangerous climate outcomes.[152] Unlike a median, or a range that prioritizes the median, the mean combines information about the magnitude of damages with the likelihood of these damages.

117. Xcel's choice of range is arbitrary and subjective. Martin's only principle in selecting this range was to establish a range whose end points would not point the Commission in opposing directions.[153] This focus on the Commission's final use of the values Martin chose

[147] Ex. 600 at 28, 56-60.
[148] *Id.* at 56-60.
[149] Id.
[150] Ex. 101 at 36-37.
[151] Ex. 101 sched. 1 at 26.
[152] Ex. 101 at 37.
[153] Ex. 602 at 12-13; *see* ex. 600 at 57 (calling a wider range not practicable).

the endpoints based on whether a desired result was achieved, rather than attempting to describe the IWG data.[154] Trimming the data in this way is also unreasonable because the data excluded are within the accepted distribution.[155] Witnesses for other parties convincingly noted that the endpoint selection was arbitrary and lacked a foundation in economic and decision theory.[156]

118. It was unreasonable to average across the different discount rates to reach a single low and high value. Experts that agree on little else agree that averaging across discount rates is inappropriate. Averaging data from three separate discount rates prevents the Commission from comparing the SCC at different discount rates and obscures the discount rates' strong effect on the SCC.[157] As we found, *supra*, because CO_2 persists in the atmosphere a very long time, discount rates strongly influence the final SCC. Furthermore, averaging separate discount values defies economic theory because the IWG data does not incorporate a range of all possible discount rates or a probability distribution.[158] In spite of other disagreements, witnesses for the Clean Energy Organizations, the Agencies, MLIG, and Peabody all agreed on this point.[159] Drs. Hanemann, Smith, Mendelsohn, and Wecker all echoed this criticism. Dr. Wecker also emphasized that reducing complicated data in this manner will "*suppress* rather than present decision-makers with information."[160] Xcel's averaging data across different discount rates is not consistent with scientific understanding of discounting.

119. Xcel used the IWG's data, but excluded half of it arbitrarily. If the IWG's model runs encompass a reasonable estimate of likely damages from climate change, then Xcel's range excludes half of the likely values.[161]

120. Mr. Martin argues, to the contrary, that because the range encompasses around 75 percent of a distribution combining all discount rate model runs, it has a 75 percent likelihood of encompassing damages from climate change.[162] But this is only true if the 3 percent discount rate distribution is far likelier than either the 2.5 percent or 5 percent discount rate distributions, because combining data from all three distributions centralizes the 3 percent discount rate.[163]

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[154] *See* ex. 101 at 42.
[155] Ex. 801 at 66-68; ex. 802 at 39-40.
[156] Ex. 303 at 3; Ex. 217 at 8-9; Ex. 242 sched. 2 at lines 206-8.
[157] Ex. 101 at 43.
[158] Id.
[159] Ex. 802 at 39; ex. 303 at 3-6; ex. 217 at 9; ex. 242 sched. 2 at lines 338-40.
[160] Ex. 242 sched. 2 at lines 190-92.
[161] Ex. 101 at 41.
[162] Ex. 602 at 11-12.
[163] *Cf.* ex. 101 at 41 (applying arbitrary parameters for analysis of the IWG's discount rate distributions can mislead). This point stands out strongly when comparing individual discount rate values with the combined discount rate distribution that Martin used at Martin's chosen percentile end points. For 2010, the 25th to 75th percentile range for all discount rates combined, $6 to $35.59, encompasses all of the 25th to 75th percentile range for the 3 percent discount rate, $9.87 to $34.74. *See* schedule 9, ex. 600, at 5 (chart presenting data). For that same year, in contrast this range for all discount rates very nearly cuts out the higher half of the 2.5 percent

121. Xcel's proposed value for the external cost of carbon dioxide is not preferable to the Federal SCC. Prioritizing the median ahead of the mean is unreasonable for the climate change context, the proposed range was chosen arbitrarily and subjectively, and Xcel distorted the IWG's data by improperly averaging across discount rates. The Federal SCC, as the IWG presented it, presents a better available measure of the external costs of CO_2.

Minnesota Large Industrial Group, Ottertail Power, Minnesota Power, And Great River Energy Proposal.

122. Great River Energy, Minnesota Power, Otter Tail Power, and the Minnesota Large Industrial Group's primary witness, Dr. Anne E. Smith, recommends the Commission adopt a per-ton CO_2 externality value range from $1.62 to $5.14.[164] Dr. Smith reached her recommendation by changing 4 key characteristics of the models used by the IWG and re-running the models. The four major assumptions Dr. Smith changed were: (1) the future emission scenario; (2) the calculation of damages after 2100 and 2140; (3) the discount rates; and (4) the geographic scope of damages calculated. All of Dr. Smith's changes to the models lower the estimated externality value.

123. Dr. Smith disagrees with the future emission projections used by the IWG and, therefore, she changed them.[165] The low-end value of Dr. Smith's proposed externality value range is based on a future emissions scenario in which no CO_2 is emitted after 2020. Dr. Smith argues that this measure, as if each ton emitted were the "first ton," is reasonable for CO_2 damages.[166] But CO_2 is not emitted in a vacuum, and the assumption of zero emissions is absurd.[167] Such an analysis seeks to treat greenhouse gases as a "flow" (i.e., like criteria pollutants) rather than the "stock" (damages depend upon current stock) pollutant which they are. To do so would to apply a "category error."[168] Dr. Smith herself admitted that a scenario in which emissions cease in 2020 has absolutely no evidentiary support.[169] Calculating a "first ton" damage estimate runs counter to the preponderance of the evidence.

124. The high-end value of Dr. Smith's range is based on future emissions being midway between zero emissions after 2020 and the emission projection distribution used by the

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distribution (median of $32.65), as well as the lower half of the 5 percent distribution (median of $6.03). *See id.*

[164] Ex. 300 sched. 2 at 47.

[165] Ex. 101 at 10.

[166] Ex. 300 at 20-22; *id.* sched. 2 at 50-64.

[167] Ex. 101 at 14.

[168] Hrg. transcript vol. 2B at 33.

[169] Hrg. transcript vol. 2A at 91.

IWG.[170] Although Dr. Smith alleges an optimal (i.e. greatly reduced) level of emissions is the appropriate baseline, the emissions estimates she modeled are not optimal.[171]

125. Without estimating an optimal emissions level, Dr. Smith's proposed range does not even satisfy her own stated goals. But as discussed *supra*, the IWG's emissions scenarios reflect reasonable estimates of future emissions, including one scenario reflecting emissions reductions.

126. Dr. Smith unreasonably ignored the available evidence on climate action to establish both ends of her suggested range, either to set emissions at zero after 2020, or to "approximate" a currently unlikely optimal emission rate.[172] The approach to both ends of her suggested range is unreasonable.

127. Dr. Smith also shortened the model time horizon and, therefore, failed to assess the full scope of long-lasting carbon pollution.

128. The low end of Smith's proposed range is based on damage calculations only through 2100—all damages that occur after 2100 are completely excluded.[173] The high-end estimate excludes damages after 2140.[174] Dr. Smith admits that each of the models show damages after 2100 and 2140 but claims that those damages are too speculative.[175]

129. Smith's approach to the uncertainty of future damages is unreasonable. There is no indication that CO_2 emissions will decrease immediately, CO_2 persists in the over a very long period of time and damages may result even after the CO_2 has dissipated. Although projecting damages far into the future necessarily involves uncertainty, Dr. Smith's solution improperly assumed that impacts cease after 2100 or 2140 without any justification.[176] Smith unreasonably substituted a falsely certain number: $0.

130. Additionally, Dr. Smith's selection of 2100 and 2140 is arbitrary. These dates appear to be based on a recommendation from an MPCA staff member in proceedings before the Commission in 1997.[177] No scientific support is offered to justify these dates or to explain why 2100 rather than 2150 or 2200 should be used.

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[170] Hrg transcript vol. 2A at 83 ("I calculated the marginal cost per ton at the halfway point across all of the emissions, starting from no further emissions. . . up to a . . . projection of emissions as encapsulated in the IWG's forecasts.").
[171] *Compare* ex. 300 sched. 2 at 63 ("I make no attempt to assess the optimal emissions trajectory that should be the baseline against which optimal [ ] damage[s] should be estimated."), *with id.* 59 ("[T]he appropriate estimate of marginal damages to apply . . . [when modeling the external costs of] CO_2 . . . would be an estimate [based on an optimal] . . . level of emissions[.]").
[172] Ex. 300 sched. 3 at 64.
[173] Hrg. transcript vol. 2A at 89.
[174] *Id.* at 88.
[175] Hrg. transcript vol. 2A at 79.
[176] Ex. 101 at 16; Ex. 802 at 45.
[177] Ex. 101 at 19.

131. Dr. Smith's decision to exclude all damages after 2100 and 2140 was not reasonable and her recommended externality values are not preferable to the Federal SCC.

132. Dr. Smith's recommended low-end and high-end externality values are based on 5 percent and 3 percent discount rates, respectively, without a 2.5 percent discount rate. This decision fails to account for many SCC researchers' practices as well as the uncertainty and ethical considerations of long forecasting.

133. Many SCC researchers use discount rates lower than 3 percent. In one review of the literature, as many (10) papers used discount rates below 3 percent as used the 3 percent discount rate (9).[178]

134. Dr. Smith's discount choices also ignored relevant economic projections and principles. Some economists predict slowed future growth, while many (including those at the OMB) adhere to the principle that lower discount rates are best for projections over long time frames with uncertain conditions.[179] Furthermore, ethical considerations favor small discount rates. As the OMB suggests:

> Although most people demonstrate time preference in their own consumption behavior, it may not be appropriate for *society* to demonstrate a similar preference when deciding between the well-being of current and future generations. Future citizens who are affected by such choices cannot take part in making them, and today's society must act with due consideration of their interests.[180]

135. Eliminating the IWG's 2.5 percent discount rate unreasonably ignores much of the field of research on the SCC, as well as the rational ethical and economic principles that favor low discount rates for long-term analysis.

136. Dr. Smith and MLIG have failed to support her decision to exclude damage costs from outside the United States.

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[178] Ex. 101 at 22-23 (citing a review of the literature undertaken by Dr. Tol).

[179] Ex. 101 sched. 2 at 24; Ex. 802 at 46. Although the agency does not explicitly define how many years a longer time frame entails, OMB's Office of Information and Regulatory Affairs suggests that market rates are unreliable to assess inter-generational values. Office of Management and Budget, Office of Information and Regulatory Affairs, Circular A-4: Regulatory Impact Analysis: A Primer at 12 (Aug. 15, 2011), available at https://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf.

[180] Ex. 101 at 24 (quoting Office of Management and Budget, Office of Information and Regulatory Affairs, Circular A-4: Regulatory Impact Analysis: A Primer at 11-12 (Aug. 15, 2011), *available at* https://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf).

137. There is no real dispute that CO_2 is a global pollutant and that as CO_2 emissions spread globally, their damages spread too.[181] That is, the preponderance of the evidence points towards global, rather than domestic, external costs.

138. Dr. Smith's decision to exclude non-U.S. damages also contradicts Commission precedent. Minnesota's current values for CO_2 recognize that CO_2 is a global pollutant and are based on an assessment of worldwide damages.[182] Specifically, in 1997 the Commission recognized that CO_2 "causes damages globally rather than regionally or locally[.]"[183]

139. Limiting the scope of damages in this manner eliminates the vast majority of damages from consideration.[184] If other governments adopted parallel policies, very little correction for externalities would take place.[185] Such a value would also fail to provide Minnesota with a tool that prepares it for a future in which emitting carbon is not free.[186] Assessing only damages within the U.S. is unsupported by the preponderance of the evidence on greenhouse gases, and resulting values are unreasonable.

140. Dr. Smith's recommended externality value range from $1.62 to $5.14 per ton CO_2 is unreasonable and not a better measure than the IWG's Federal SCC. It appears that Dr. Smith approached her task with the objective of lowering the SCC. Dr. Smith disagrees with IWG modeling only where a plausible-sounding argument can be made to lower the final SCC.[187] This approach is not credible.

141. Furthermore, Dr. Smith's credibility suffers from a similar incongruity as some Peabody witnesses. She pretends conviction that strict carbon regulations, and, therefore, optimal emissions will occur. Yet her testimony as a whole argues against a valuation of CO_2 costs that would help ease Minnesota's transition to optimal emissions.

142. MLIG, Ottertail Power, Minnesota Power, and Great River Energy have failed to establish by a preponderance of the evidence that Dr. Smith's proposed values are reasonable or preferable to the Federal SCC.

143. Similar to Dr. Smith, Dr. Ted Gayer on behalf of the Minnesota Large Industrial Group offered SCC values based on constricting the geographic scope of damages. Dr. Gayer reduced the federal SCC values by a percentage corresponding to the U.S.'s share of global

[181] Ex. 101 at 25; ex. 800 at 12.
[182] Ex. 801 at 15-16.
[183] Order Establishing Environmental Cost Values, Pub. Util. Comm'n Docket No. E-999/CI-93-583 at 15 (Jan. 3, 1997) (Ex. 306).
[184] Ex. 101 at 26; *see also* ex. 300 at 98 (Dr. Smith admits that "[r]estricting the damages to the U.S. reduces the SCC by 81 percent to 84 percent[.]").
[185] Ex. 101 at 26.
[186] Id.
[187] Ex. 101 at 30; ex. 802 at 46.

GDP, resulting in $2.53, $7.36, $11.73, and $20.47.[188] He also restricted these values further, corresponding to Minnesota's share of global GDP, suggesting a high-end estimate of $0.37.[189]

144. For the same reasons that Dr. Smith's proposal fails, Dr. Gayer's proposal is rejected.

Peabody's Proposed Alternative Values

145. Peabody asserted, in its Initial Brief, that the Commission should adopt one of three alternative values: $0, $-17.97 to $-4.05, or retain existing values of $0.44 to $4.53. None of these values is reasonable or a better available measure than the Federal SCC.

A Zero value

146. Peabody proposes a $0 value for the SCC, arguing that uncertainty is too great to support a positive value for the costs of CO_2.[190] It argues that ECS is uncertain. As has already been found, the preponderance of the evidence supports the IWG's use of a probability distribution to reasonably account for this uncertainty.

147. Peabody also argues that temperature models fail because of the so-called "hiatus." Peabody's witnesses that assert such a hiatus rely upon insufficient data to cast doubt on the preponderance of the evidence of the Earth's continued warming and the models' long-term reliability.

148. The preponderance of the evidence demonstrates that the external damage cost of CO2 emissions is very unlikely zero. Peabody's proposal is unreasonable and is not preferable to the Federal SCC based on a preponderance of the evidence.

The Commission's Existing Values

149. Although Peabody in the alternative would support retention of the Commission's current values, it has not submitted sufficient evidence into the record of this proceeding to support the current values. It submitted no new modeling, nor even the results or processes of the modeling that lead the Commission to adopt its current values. At one point, Dr. Mendelsohn noted that he would support retention of existing values, but gave no detailed explanation of his "analysis" and referred to "$5" rather than the existing range of $0.44 to $4.53.[191]

150. Peabody seems to seek to rely upon certain results from Dr. Mendelsohn's modeling to support existing values, and suggests that "[t]he status quo values are also by [sic]

[188] Ex. 400 app. 2 at 15-16.
[189] *Id.* at 17.
[190] Peabody Initial Br. at 113-15.
[191] Ex. 220 at 33.

Dr. Mendelsohn's modifications to the DICE model[.]"[192] But a range from $0.20 to $2.00 is not equivalent to $0.44 to $4.53.

151. Even if the ALJs assumed that Dr. Mendelsohn's model results supported the Commission's current values for the external cost of CO_2, Dr. Mendelsohn's modeling is unreasonable and unsupported by a preponderance of the evidence.

152. Dr. Mendelsohn modeled several values for the external cost of CO_2 using a modified version of the DICE model,[193] and recommended two of these at various points in his testimony. In his direct testimony, he suggested a per ton CO_2 externality value of $4.00 to $6.00 based on a climate sensitivity of 3˚C.[194] He concluded at one point that "the original estimate of the damage of a ton of CO_2 made by the PUC of $5/ton remains a reasonable value[.]"[195] He also stated that "a reasonable and 'the best available measure' for the SCC is between $0.30 and $2.00/ton."[196]

153. Mendelsohn's proposed ranges are unreasonable and unsupported by a preponderance of the evidence because they are conditioned on unjustified assumptions about future emissions and the "beneficial" effects of temperature increases. Additionally, although the Equilibrium Climate Sensitivity value Dr. Mendelsohn chose in his primary testimony and a declining discount rate are not unreasonable model choices, the IWG modeled multiple possibilities for both parameters, which provides a more inclusive, and, therefore, more reasonable SCC. Even if Dr. Mendelsohn had made more reasonable assumptions, it is difficult to imagine that one model run by one individual could be preferable to the considerable effort several federal agencies have undertaken over many years to aggregate the best scientific and modeling information available in developing the Federal SCC.

154. Dr. Mendelsohn's decision to run DICE using the model's "optimized" emissions projection skews his results and is not supported by existing evidence. Without a significant and binding global effort to achieve optimal emissions, there is no basis for concluding future emissions will be optimal.[197] As discussed above regarding Dr. Smith's testimony, a reasonable external cost of carbon would not incorporate counter-factual assumptions. Dr. Mendelsohn's reliance on optimization to model the external costs is not reasonable or preferable to the choice made by the IWG.

155. Dr. Mendelsohn unreasonably altered the DICE model's damage function to erase significant damages. Dr. Mendelsohn argued that climate change will be beneficial until it surpasses either 1.5˚C (to reach his high value) or 2˚C (to reach his low value) above pre-industrial levels, but failed to rebut the vast evidence to the contrary.

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[192] Peabody Initial Br. at 115; *see also id.* at 99-105.
[193] Ex. 214 at 2.
[194] Id.
[195] Ex. 220 at 33.
[196] *Id.* at 34.
[197] Ex. 101 at 46.

156. Mendelsohn claimed that global ecosystems will, on net, benefit from climate change, especially in northern areas such as Minnesota.[198] His claims regarding Minnesota's northern forests paint an incomplete picture.

157. The Clean Energy Organizations sponsored a forest ecologist who has researched climate change effects on Minnesota forests and found Dr. Mendelsohn's claims implausible. As he explained, climate change effects on plant life are not as simple or benign as increased CO_2 availability and longer warm seasons.[199] Different tree species respond differently to temperature increases alone, with a few important species for northern forests growing more poorly under warmer temperatures, and mainly southern Minnesota trees benefitting from increased temperatures only if they can spread and grow quickly enough to keep up with changes.[200] Other climate impacts complicate the picture further, including decreased soil water availability and higher evaporation rates.[201] Climate change will also increase invasive plant and animal species, harmful insect populations, diseases, and forest fires.[202] The articles that Dr. Mendelsohn relies on are not Minnesota-specific.[203] Overall, the picture for climate change in Minnesota is much more complicated than Mendelsohn, an economist, describes. The preponderance of the evidence shows that Minnesota and Minnesotan forests will not benefit from climate change.

158. Dr. Mendelsohn's sources for finding a net benefit to humans either did not assess benefits for ecosystems or were based on laboratory experiments.[204] The scientists that undertook those experiments, unlike Dr. Mendelsohn, recognized that their results would not necessarily apply to open fields.[205]

159. Dr. Mendelsohn's argument that temperature increases are beneficial to both Minnesota and the world is unsupported by a preponderance of the evidence.

160. Although the DICE model's native discount function is reasonable for some purposes, the IWG's multiple discount rates are more reasonable. The IWG ran all models at three commonly used discount rates, and the final SCC presents values for each.

161. Researchers in this area use discount rates lower than 2.5 percent, 3 percent, and 5 percent in large numbers.[206]

162. Although the DICE model uses a declining discount rate and may, therefore, be said to incorporate multiple discounts in some manner, the SCC better incorporates the uncertainty and controversy around this parameter.

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[198] Ex. 216 at 12-14.
[199] Ex. 107 at 4.
[200] *Id.* at 5.
[201] *Id* at 6.
[202] *Id.* at 8-9.
[203] *Id.* at 10.
[204] Ex. 801 at 12; *see* ex. 101 at 53.
[205] Ex. 801 at 12.
[206] *Id.* at 22.

163. In sum, adopting Dr. Mendelsohn's recommendation would base Minnesota externality values on one report from one researcher using his own assumptions applied to one model. Other researchers came to significantly higher results (e.g., $220 per ton; $197 per ton) using the same model but with different assumptions.[207] This highlights the great uncertainty involved in such calculations, and supports the SCC as a better measure of the external cost of carbon because it incorporates greater uncertainty. Even assuming his modeling supported the Commission's current values, Peabody has failed to support this range.

Negative External Cost Of Carbon

164. Dr. Tol purported to run the FUND model "under the same parameters" as Professor Mendelsohn ran the DICE model.[208] Dr. Mendelsohn produced two values at each sensitivity value that corresponded to zero damages before 1.5˚C and 2˚C, but Dr. Tol produced single values. Dr. Tol did not explain whether his model runs modified FUND's damage function to zero out damages before a temperature change of 1.5˚C, a change of 2˚C, or retained FUND's original damage function.[209] He summarily presented results for various equilibrium climate sensitivities, and found $20.05 for a change of 3˚C, $7.06 for a change of 2.5˚C, -$4.05 for a change of 2˚C, -$12.06 for a change of 1.5˚C, and -$17.97 for a change of 1˚C.[210] Because Dr. Tol failed to explain whether or how much he altered the FUND damage function, this range does not present a better alternative than the transparent SCC. Additionally, because any range relying upon these numbers would rely upon Mendelsohn's assumptions in whole or in part, such a range fails for the same reasons that Mendelsohn's recommended values fail.

165. Dr. Bezdek testified that due to the benefits of CO_2 fertilization, the external costs of CO_2 are negative. To reach this conclusion, he cherry picked data and misapplied laboratory experiments to large-scale agriculture.[211] As has been discussed previously, climate change will likely have a net negative impact on plant life and CO_2 fertilization has been incorporated into the calculation of the SCC.

CONCLUSIONS AND RECOMMENDATION

166. The preponderance of the evidence shows that the IWG's Federal SCC is a reasonable measure of the external costs of CO2.

167. The preponderance of the evidence shows that the IWG's Federal SCC is the best available measure of external costs for CO_2.

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[207] Ex. 101 at 51.
[208] Ex. 238 at 8.
[209] As explored by the federal Inter-Agency Working Group, FUND's original damage function does produce very small and negative values for the SCC at an ECS of 3˚C and low temperature changes. Ex. 100 sched. 2 at 10 fig. 1B (representing low value curve as a function of temperature change).
[210] *Id.* at 9 tbl. 3.
[211] Ex. 102 at 15, 27; Ex. 101 at 53.

168. The ALJs recommend that the Commission adopt the Federal SCC as reported in the 2015 update. The full summary values are: $56, $86, $11, and $105.

169. The ALJs recommend that the Commission update its external cost value as the IWG updates its Federal SCC.

Dated: _____ _____

The Honorable LauraSue Schlatter
Administrative Law Judge

Typo: CEOs obviously meant: $56, $36, $11 and $105, 2007$/Metric ton
https://www3.epa.gov/climatechange/EPAactivities/economics/scc.html
However, those numbers are the same as in the Agencies spreadsheet p.2:
201512-116500-02 $2007 Metric Tons, or 201512-116500-03 p. 2 (PDF image)
2015 11 36 56 105 $2007 Metric tons
But
2015 11 37 57 107 $2015 Short tons ... and Minnesota used short tons.
It just happens that the GDP deflator and the short:metric ton conversions essentially cancel. This is all in noise anyway.
So, the CEOs number can be approximated as $2015 short tons as well.