

Surrebuttal Testimony
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Before the Office of Administrative Hearings
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121 Seventh Place East, Suite 350
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In the Matter of the Further Investigation into Environmental and Socioeconomic Costs
Under Minnesota Statute 216B.2422, Subdivision 3

MPUC Docket No. E-999/CI-14-643
OAH Docket No. 80-2500-31888

Exhibit ____ (AES-S)

Surrebuttal Testimony of Anne Smith

**On Behalf of Great River Energy
Minnesota Power, Otter Tail Power Company,
and the Minnesota Large Industrial Group**

Carbon Dioxide

September 10, 2015

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1 **I. INTRODUCTION**

2 Q. PLEASE STATE YOUR NAME.

3 A. Anne Smith.

4

5 Q. ARE YOU THE SAME ANNE SMITH WHO FILED DIRECT AND REBUTTAL
6 TESTIMONY IN THIS CASE?

7 A. Yes, I am.

8

9 Q. HAVE YOU REVIEWED THE REBUTTAL TESTIMONY OF DR. HANEMANN,
10 DR. POLASKY, AND MR. MARTIN?

11 A. Yes, I have.

12

13 Q. WHAT IS THE PURPOSE OF YOUR SURREBUTTAL TESTIMONY?

14 A. The purpose of my surrebuttal testimony is to respond to the critiques of my
15 direct testimony offered by Drs. Hanemann and Polasky and Mr. Martin, with respect to
16 both my general approach and to specific recommendations I made regarding framing
17 assumptions used to develop Minnesota's environmental cost values for carbon dioxide.

18

19 **II. CRITERIA FOR DECISIONMAKING**

20 Q. DR. POLASKY AND DR. HANEMANN CONTEND YOU ARE BIASED AND
21 CONSIDER ONLY THOSE ISSUES THAT SUPPORT A RELATIVELY LOW SOCIAL
22 COST OF CARBON. DO YOU HAVE ANY RESPONSE TO THESE CLAIMS?

1 A. My approach was driven by the criteria I used in evaluating the IWG's IAM-based
2 estimates of social cost of carbon, which were those criteria established in the prior
3 proceeding to determine Minnesota's environmental cost values. Those criteria, which I
4 referenced on page 16 of the report submitted with my direct testimony, frequently led
5 me to recommend framing assumptions that result in lower environmental cost values,
6 but that was not always the case. In addition to those criteria, I also considered
7 principles of benefit-cost analysis, risk analysis, and environmental economics in
8 preparing my recommendations.

9

10 Q. WHAT SPECIFIC CRITERIA GUIDED THE DEVELOPMENT OF YOUR
11 RECOMMENDATION FOR AN UPDATED CO₂ ENVIRONMENTAL COST VALUE?

12 A. As I stated on page 16 of my direct testimony:

13 Based upon the proceeding that initially established the environmental
14 cost values (Docket No. E-999/CI-93-593), I understand environmental
15 cost values are supposed to have a solid evidentiary basis and not be
16 subject to excessive speculation. Also, in the face of uncertainties about
17 key inputs, I understand Minnesota's criterion is to use conservative
18 assumptions. Additionally, the values that Minnesota chooses should
19 reflect the needs and impacts to residents of Minnesota.

20 Those are the criteria I relied upon to evaluate the key framing assumptions necessary

21 to use the IAMs to estimate a social cost of carbon and to offer my own

22 recommendations regarding Minnesota's environmental cost values. All but the last of

23 those criteria formed the basis for the ALJ's Findings of Fact, Conclusions,

24 Recommendation, and Memorandum in Docket No. E-999/CI-93-593 (March 22, 1996)

25 ("ALJ Findings") and the resulting order from the Commission. The criteria were

26 appropriate in that proceeding and no party has offered any reasons why they should be

1 discarded now. In my opinion they continue to be appropriate for use in determining, to
2 the extent practicable, a range of environmental cost values for carbon dioxide. In the
3 1997 proceeding, Judge Klein stated “[t]he adopted values should be conservative.”
4 ALJ Findings at 12. Judge Klein also explained “the possibility of utilities paying more
5 for resources than their environmental benefits justify is just as bad as paying less than
6 their benefits justify. Given the current uncertainty regarding the estimation process,
7 overestimating the damages is a distinct possibility.” ALJ Findings at 17-18. In other
8 words, Judge Klein adopted the principle that how certain one needs to be about a
9 choice depends on the consequences of an error in one direction or the other in that
10 decision context.

11
12 Q. YOU POINT OUT THAT THE LAST OF YOUR CRITERIA – THAT THE VALUES
13 THAT MINNESOTA CHOOSES SHOULD REFLECT THE NEEDS AND IMPACTS TO
14 RESIDENTS OF MINNESOTA – WAS NOT AMONG THE CRITERIA ADOPTED BY
15 JUDGE KLEIN OR THE COMMISSION IN DOCKET NO. E-999/CI-93-593. WHY
16 SHOULD THIS CRITERION BE ADOPTED NOW?

17 A. This last criterion – that the values Minnesota chooses should reflect the needs
18 and impacts to residents of Minnesota – is based on principles of benefit-cost analysis
19 founded in economic welfare theory. Benefit-cost analysis is an analytic method
20 designed to guide policy makers towards options that will improve the net welfare of
21 their community. If conducted inconsistently with its original principles, the benefit-cost
22 method loses its ability to inform policy makers whether their decisions will enhance the
23 welfare of their constituents. One of those original principles is to account for the costs,

1 preferences, and benefits of the residents of the political jurisdiction contemplating a
2 policy or regulation, and to report any non-jurisdictional benefits separately. In essence,
3 this principle recognizes, as Judge Klein did, that one's choices should do no more
4 harm than good to those subject to the policy or regulation.

5

6 Q. DO DRS. HANEMANN AND POLASKY STATE WHAT CRITERIA THEY ARE
7 USING?

8 A. No, they do not, and I believe that is a problem. Any social cost of carbon
9 calculated using IAMs, such as the IWG's social cost of carbon or the alternative values
10 I present in my direct testimony and report, is determined by the framing choices used
11 in running the models. The exceedingly wide range of values resulting from the
12 sensitivity analysis I performed shows the importance of those framing choices. The
13 Commission, therefore, needs a principled way to evaluate the framing assumptions
14 and choose which framing assumptions are appropriate to use in determining
15 Minnesota's range of environmental cost values for carbon. That requires the
16 specification and application of criteria that reflect the context of how Minnesota's
17 environmental cost values will be used. I have explained the criteria I used in my
18 analysis and which are reflected in my recommended range of values. The
19 Commission and ALJ can consider whether they agree with those criteria and whether
20 they believe I have applied them reasonably in choosing which framing assumptions to
21 recommend. Drs. Hanemann and Polasky, in contrast, skip this crucial step and,
22 instead, recommend a wholesale adoption of the IWG's social cost of carbon estimates
23 without exploring whether the IWG's framing assumptions are appropriate for

1 determining Minnesota's environmental cost values. They are making the implicit
2 judgment that the framing assumptions used by the IWG are appropriate for use in
3 setting Minnesota's environmental cost values, and furthermore they fail to explain what
4 criteria the IWG's framing assumptions satisfy or to identify what criteria would be
5 appropriate in the context of Minnesota's law.

6

7 Q. WHY IS THE ARTICULATION OF SPECIFIC CRITERIA IMPORTANT IN THIS
8 PROCEEDING?

9 A. If the Commission sets a range of environmental cost values based on IAM
10 calculations, it will ultimately have to make its own decisions in choosing among framing
11 assumptions, as will the ALJ in making a recommendation. Having specific criteria for
12 the Commission's choices of specific framing assumptions is important because this
13 recognizes that the Commission's discretion in making these choices is not unlimited,
14 and articulating its criteria guides the Commission's deliberation of what framing choices
15 are appropriate, thus enabling identification of a practicable range of environmental cost
16 values that fit the context of Minnesota's law. These criteria could be, as I recommend,
17 those used in the prior proceeding. The Commission and the ALJ are not limited to only
18 accepting or rejecting the IWG's decisions regarding framing assumptions and the
19 resulting range of values.

20

21 I am making recommendations with respect to four key framing assumptions based on
22 explicit underlying criteria; because they are explicit, I am also empowering the
23 Commission and ALJ to make their own framing assumption choices (if they should be

1 different than those I have recommended) when deciding on a range of environmental
2 cost values for carbon. I have testified in detail which data support each framing
3 assumption, and have further testified in my direct testimony and report which framing
4 choices are not supported by empirical evidence or sound policy analysis principles,
5 such that they should not ultimately be used by the Commission. In Table 4 of my
6 report, I provided 32 alternative environmental cost values using a range of potential
7 inputs regarding the four key framing assumptions. With the data in that table, one can
8 also break out damages into U.S. and non-U.S. components so that the Commission
9 can determine whether and to what extent it wants to include non-U.S. damages in the
10 environmental cost values.

11

12 Q. DO ANY OTHER WITNESSES PROPOSE CRITERIA FOR USE IN
13 EVALUATING PROPOSED APPROACHES TO SETTING THE ENVIRONMENTAL
14 COST VALUES?

15 A. On page 2:12-20 of his direct testimony and again at page 13:14-23 of his
16 rebuttal testimony, Mr. Martin proposes seven criteria for the consideration of each
17 party's proposed range of environmental costs. Those criteria are as follows:

- 18 • Reasonably address the inherent uncertainty in estimating climate change
19 damages,
- 20 • Reflect the absence of consensus on discount rate choices,
- 21 • Utilize statistically sound methods,

- 1 • Reflect an appropriate level of risk tolerance, i.e. tolerance for risk that the actual
- 2 value of future climate change damages may lie outside the Commission's
- 3 adopted range,
- 4 • Minimize subjective judgments,
- 5 • Yield a practicable range, and
- 6 • Be transparent, replicable, and updatable.

7 Mr. Martin then, in his rebuttal testimony, assesses each party's testimony against the
8 criteria he sets out. In my previously filed rebuttal testimony, I criticized Mr. Martin's
9 proposed criteria and the degree to which they did not even support his own proposed
10 approach to setting the range of environmental cost values for carbon.

11

12 Q. DO YOU BELIEVE THE CRITERIA OFFERED BY MR. MARTIN ARE
13 REASONABLE AND APPROPRIATE?

14 A. No. Mr. Martin, in my opinion, is offering fundamentally different criteria from
15 those previously relied upon by the Commission. Specifically, he is proposing that the
16 Commission engage in a level of speculative subjectivity that exceeds even that of the
17 IWG's SCC estimates because, unlike the IWG, he assigns specific probabilities to
18 alternative discount rates. His criteria are also internally inconsistent insofar as they call
19 for minimizing subjective judgments while simultaneously calling for the incorporation of
20 a new subjective concept that he calls "risk tolerance."

21

1 Q. DR. POLASKY CONTENDS THAT WHAT YOU CHARACTERIZE AS
2 EXCESSIVE SPECULATION IS SIMPLY A GOOD-FAITH ATTEMPT BY THE IWG TO
3 HANDLE UNCERTAINTY. HOW DO YOU RESPOND TO THAT ARGUMENT?

4 A. Most of the uncertainties the IWG attempted to include in its SCC calculations
5 resulted in extrapolating far beyond any evidentiary basis, using formulas that become
6 so speculative after a certain point in time as to render them purely hypothetical. The
7 IWG's framing assumptions that have resulted in so much speculative content in its
8 SCC estimates may or may not be appropriate for the IWG's purposes, but those
9 framing assumptions are not appropriate if one's criteria for what is "practicable" are to
10 avoid excessive speculation by adopting only calculations with a sufficient evidentiary
11 basis, and using conservative assumptions, as was done during the prior environmental
12 cost proceedings.

13
14 Moreover, there is a significant question whether the use of the IAMs is even
15 appropriate for the purpose for which they were used by the IWG. As Professor
16 Pindyck states in his article "Climate Change Policy: What Do the Models Tell Us?", the
17 original purpose of IAMs was to:

18 [E]lucidat[e] the dynamic relationships among key variables, and the
19 implications of those relationships, in a coherent and convincing way.
20 Since then, the development and use of IAMs has become a growth
21 industry. (It even has its own journal, The Integrated Assessment Journal.)
22 The models have become larger and more complex, but unfortunately
23 have not done much to better elucidate the pathways by which GHG

1 emissions eventually lead to higher temperatures, which in turn cause
2 (quantifiable) economic damage.¹

3 Professor Pindyck goes on to say that these IAM models are essentially useless for
4 defining a monetary SCC value, and that “[t]he problem is not that IAM developers were
5 negligent and ignored economic theory; there is no economic theory that can tell us
6 what [the damage function] should look like.”²

7

8 Q. DO YOU AGREE WITH PROFESSOR PINDYCK’S STATEMENT THAT
9 ECONOMIC THEORY CANNOT TELL US WHAT THE DAMAGE FUNCTION SHOULD
10 LOOK LIKE?

11 A. Yes. In a report that I attached to my expert report, I conducted a detailed review
12 of the literature and theory supporting the parameters and functional forms of the IAM
13 damage functions. My review found that Professor Pindyck’s statement is correct. It
14 found that economic theory has little to say on the shape of the function. Even
15 Professor Martin Weitzman, whose work Dr. Polasky cites on page 18 of his rebuttal
16 testimony, writes, “I cannot prove that my favored choice is the more reasonable of the
17 two...but no one can disprove it either – and this is the point here.”³

18

¹ Pindyck, R. 2013. “Climate Change Policy: What Do the Models Tell Us?” *Journal of Economic Literature*, 51(3): 860-872 (at p. 861).

² Ibid. at p. 867.

³ Weitzman, M. 2009. “On Modeling and Interpreting the Economics of Catastrophic Climate Change,” *The Review of Economics and Statistics*, 91(1):1-19 (at p. 16).

1 Q. IN HIS REBUTTAL TESTIMONY, DR. HANEMANN SAYS YOU DID NOT
2 ACKNOWLEDGE THAT THE IWG OMITTS SOME CATEGORIES OF DAMAGES IN ITS
3 CALCULATIONS. HOW DO YOU RESPOND?

4 A. The determination of what categories of damages should be included in the IAMs
5 is largely a science-based exercise outside my testimony's area of focus. As an
6 economist and risk analyst, I have been focused on analytical framing decisions and
7 economic valuation. However, I am sufficiently familiar with the academic literature
8 regarding the IAMs to state that the categories of damages that Dr. Hanemann lists as
9 missing are not in the IAMs because there is at present no practicable means among
10 the climate and economic science professions for coherently and reliably predicting their
11 likelihood or for monetizing their impact if they should occur. If it were practicable to
12 reliably incorporate them, the IAM modelers would have already attempted to do so.
13 The IWG implicitly acknowledges this fact. Specifically, on page 4 of its 2010 technical
14 report, the IWG states the IAMs are "imperfect and incomplete," reflecting "the limits of
15 existing effort to model these effects." Similarly, at page 9 of the 2010 report, the IWG
16 states that "[g]aps in the literature make ... [representations of adaptation, technological
17 change, and catastrophic damages] ... challenging, which highlights the need for
18 additional research."

19

20 Professor Pindyck more directly explains the impracticability of including the omitted
21 categories of damages in the IAMs:

22 "That such outcomes [from catastrophic climate changes] are
23 ignored is not surprising; IAMs have nothing to tell us about them.
24 As I explained, IAM damage functions, which anyway are ad hoc,

1 are calibrated to give small damages for small temperature
2 increases, and can say nothing meaningful about the kinds of
3 damages we should expect for temperature increases of 5°C or
4 more.Thus we are left in the dark; IAMs cannot tell us anything
5 about catastrophic outcomes, and thus cannot provide meaningful
6 estimates of the SCC.”⁴
7

8 Professor Pindyck notes this limitation in the practicability of using IAMs to make
9 complete SCC estimates is not possible to correct because it involves impacts that are
10 “unknowable.” For that reason, he believes that climate policymaking requires a simpler
11 risk management approach rather than attempting to force IAMs to accomplish that
12 which is clearly impracticable.
13

14 Q. DR. HANEMANN ALSO CLAIMS THAT YOU FAIL TO ACKNOWLEDGE THE
15 POSSIBILITY OF CLIMATE TIPPING POINTS. HOW DO YOU RESPOND?

16 A. It is not practicable to incorporate the possibility of climate tipping points into an
17 IAM-based SCC calculation any more than the IAM modelers have already done. The
18 PAGE model includes a possibility of a discrete and discontinuously high damage
19 outcome, and that very high cost event occurs in some of the model runs. I have not
20 removed it, and so in that sense I have in fact acknowledged and accounted for the
21 possibility of a tipping point. However, I also have not altered the IAMs to increase their
22 consideration of the likelihood or severity of a tipping point, as altering science
23 assumptions was not a focus of my testimony. Notably, in recommending the adoption
24 of the IWG’s social cost of carbon, Dr. Hanemann is, in effect, taking the same
25 approach I am. Both of us are accounting for the possibility of a tipping point only to the

⁴ Pindyck, op. cit. at p. 869.

1 extent that it is included in the PAGE model. I note, however, that when such an event
2 occurs in a PAGE run, the damage estimates associated with that run (which drive up
3 the overall SCC estimate) are even more speculative.

4
5 Q. Dr. HANEMANN CRITICIZES YOUR TESTIMONY FOR NOT AGREEING THAT
6 A DEGREE OF RISK AVERSION SHOULD BE ACCOUNTED FOR IN THE
7 CALCULATION OF DAMAGE COSTS. HOW DO YOU RESPOND TO THIS
8 CRITICISM?

9 A. Dr. Hanemann is suggesting that we use a risk aversion factor to effectively add
10 a risk premium to the SCC estimates. That is, that an estimate of the environmental
11 cost value that can be calculated using reliable evidence and conservative assumptions
12 should then be increased by some unstated amount to account for uncertainty in the
13 calculated damages. Minnesota's environmental cost statute does not contain any
14 language suggesting that the value determined by the Commission should be increased
15 by some factor so that it reflects more than just those costs which can be practicably
16 determined. The risk aversion approach would also represent just one more ad hoc,
17 speculative adjustment. Moreover, if one wishes to account for the types of
18 uncertainties in question for climate policy, the risk aversion approach suggested by Dr.
19 Hanemann would not be consistent with sound risk management methods. The climate
20 risk issue is one of extremely high consequence but low probability outcomes (tipping
21 points and other catastrophic scenarios) combined with a range of higher probability
22 outcomes of moderate to low consequence. Decisions as to how to respond to such a
23 range of scenarios are not suited to decision-making driven by expected values, and

1 this problem cannot be remedied by simply applying a risk aversion factor to the IAM
2 damage estimates, even if one could empirically estimate an appropriate degree of risk
3 aversion. Professor Pindyck, in his “Climate Policy Dilemma” explains that this is the
4 very problem with attempting to address the climate policy need with SCC estimates.⁵
5 Professor Pindyck concludes that a risk management approach that does not attempt to
6 value the damage per ton using IAMs, but which instead characterizes the more severe
7 outcomes and experts’ best estimates of their probabilities is what is required to
8 motivate action. Based on my professional experience in the field of decision analysis, I
9 agree with Professor Pindyck’s assessment. This approach would allow risk aversion to
10 be accounted for without having to resort to abstract notions of societal risk aversion for
11 which there is no empirical basis. But additionally, a decision-analytic approach of the
12 sort described by Professor Pindyck would directly account for the flexibility society has
13 to respond in the future as new information arises regarding the actual degree of climate
14 impact. It would also balance the decision on how much to spend on incremental
15 emissions reductions today with decisions to fund research and other investments today
16 to create future technologies and infrastructure that will be better able to mitigate the
17 impacts of the worst-case outcomes. Each of these other categories of investment,
18 which the IAMs ignore, will affect the estimate of future damages from an incremental
19 ton of emissions.

20

⁵ Pindyck, R. 2013. “The Climate Policy Dilemma,” Review of Environmental Economics and Policy
7(2):219-237.

1 Thus, addressing risk aversion requires simultaneously addressing these many other
2 elements of climate risk management that IAMs also ignore. Consequently, I do not
3 recommend adopting environmental cost values for use in Minnesota's resource
4 planning that are deliberately inflated in an ad hoc manner to address risk aversion.
5 Instead, for use in resource planning, where "the possibility of utilities paying more for
6 resources than their environmental benefits justify is just as bad as paying less than
7 their benefits justify" (ALJ Order at 18), the sounder practice would be for the
8 Commission to set a range of environmental cost values that reflects only those
9 outcomes that are reasonably quantifiable using sound evidence and conservative
10 assumptions. Use of more speculatively-imbued estimates of SCC values such as Dr.
11 Hanemann advocates should be reserved for national policy choices, where the
12 consequences of doing too little or too much would not be disproportionately
13 concentrated on one narrowly-defined sector and population as is the case for the
14 Commission's decision.

15

16 **III. INDIVIDUAL FRAMING ASSUMPTIONS**

17 **A. Appropriate Modeling Horizon**

18 Q. HOW DOES DR. HANEMANN ADDRESS YOUR RECOMMENDATION THAT
19 AN APPROPRIATE MODELING HORIZON IS BETWEEN 2100 AND 2140?

20 A. Dr. Hanemann makes three points regarding the appropriate modeling horizon.
21 First, Dr. Hanemann argues that I incorrectly rely on the assumption that the IWG
22 estimates do not account for societal response to continued emissions and associated
23 temperature increases. He states the IWG estimates do not, in fact, assume continuous

1 emissions growth, and therefore, a measure of societal response is included in those
2 estimates. Second, Dr. Hanemann argues I incorrectly conclude that society is likely to
3 act to avoid the worst effects of future warming. Third, Dr. Hanemann argues that even
4 projections pre-2100 are speculative and thus speculation is unavoidable and ought not
5 to deter the Commission from adopting projections through the year 2300.

6
7 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT REGARDING
8 THE DECLINE IN EMISSIONS GROWTH IN THE IWG ESTIMATES?

9 A. Although it is true that CO₂ emissions levels in the five emissions projections
10 used by the IWG and presented in Dr. Hanemann's rebuttal testimony level off and
11 begin to decline at or around 2200, that does not alter my conclusion that those
12 emissions projections assume an unrealistic level of societal inaction. In Appendix B of
13 my expert report, I show the projections of temperature change resulting from each of
14 the five emissions projections. Each of the temperature change projections continues to
15 climb until the year 2300, notwithstanding the decline in emissions levels that are
16 projected by the IWG to occur in 2200.

17
18 Temperatures reach the very high levels that they do in 2300 in the models not because
19 of emissions over the next decade, but because of a continued accumulation of
20 unregulated global emissions long after the temperature changes start to reach
21 unacceptable levels. For example, as Appendix B to my expert report shows, the
22 majority of the IAM SCC estimates predict that a 4 degree temperature change will
23 begin to occur in or around 2100. However, as Dr. Hanemann's figure 1B shows, the

1 IWG's IAMs assume emissions will continue to rise for up to 100 years after this
2 unacceptable level is reached. This statement holds true even for the "Fifth Scenario,"
3 which is keyed to climate stabilization at 550 ppm, and, like each of the five scenarios
4 reflected in Dr. Hanemann's figure 1B, is given a 20% weight by the IWG. Dr.
5 Hanemann argues this scenario includes a degree of societal response because it
6 shows a drop in emissions much earlier than the other scenarios. However, even under
7 the Fifth Scenario, by 2100 more than half of the model runs have temperatures above
8 the 2 degrees that Dr. Hanemann implies at page 23:17-19 of his rebuttal testimony
9 would be an unacceptable temperature increase. In fact, under the 90th percentile
10 equilibrium climate sensitivity value, Fifth Scenario temperatures are projected to
11 exceed 5 degrees before 2100 in the PAGE model. Accordingly, even under the Fifth
12 Scenario, unacceptable temperature changes occur without any meaningful societal
13 response in the IWG's estimation of SCC values.

14

15 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT THAT
16 PROBLEMS ASSOCIATED WITH COLLECTIVE ACTION WILL RENDER SOCIETAL
17 RESPONSE UNCERTAIN?

18 A. Dr. Hanemann argues a reduction in emissions is an exercise in global collective
19 action. He also contends it is well known that collective action can be fraught with
20 problems. However, it is not clear that Dr. Hanemann's argument will hold true once
21 unacceptable temperature changes – rather than further increases in emissions –
22 become a real-life experience. Under those circumstances, it is unreasonable to
23 assume nations across the globe will even then be unresponsive, and allow

1 temperatures to reach dangerously high levels without acting to protect themselves.
2 Even if such efforts are slow, it is unlikely that no such efforts will occur. Moreover, as I
3 have explained in Section IV.2.C of my expert report, several options that provide a
4 more rapid response, such as geoengineering, may exist to provide a more robust
5 response to temperature increases.

6
7 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT THAT ALL
8 EMISSIONS PROJECTIONS CONTAIN A DEGREE OF SPECULATION, AND THUS
9 THE PRESENCE OF SPECULATION IS NOT A REASON TO DETER THE
10 COMMISSION FROM ADOPTING PROJECTIONS?

11 A. It is true that any forecast of future conditions involves some degree of
12 speculation. However, the further one projects, the more speculative the exercise
13 becomes. The EMF 22 scenarios that the IWG relies on through 2100 are at least
14 informed by knowledge about current technologies and technologies presently in
15 development. The degree of speculation grows at an increasing pace after 2100
16 because even the longest-lived technology rarely remains economical to operate more
17 than about 80 years, and speculation becomes the dominant element of any forecast
18 after about 2140, since even presently foreseeable new technologies will be reaching
19 their obsolescence by then. Furthermore, as technologies change, so too do lifestyles
20 and hence economic value of climatic changes that might be projected in that future era.
21 Accordingly, any empirical basis which would support projections out until 2100 or 2140
22 vanishes after that time.

23

1 Q. HOW DOES DR. POLASKY ADDRESS YOUR RECOMMENDATION THAT AN
2 APPROPRIATE MODELING HORIZON IS BETWEEN 2100 AND 2140?

3 A. Dr. Polasky makes three arguments. First, he argues that properly estimating
4 the marginal damages associated with a unit of emission of CO₂ requires accounting for
5 the impact of that unit as far into the future as it is likely to remain in the atmosphere
6 and cause damages. Second, he argues that the existence of uncertainty is not a
7 reason to assume zero damages after 2100/2140 or to zero out temperature increases
8 above 3 degrees. Third, he states that my report appears to recommend the years
9 2100 and 2140 based on precedent from the earlier proceeding and argues that the
10 Commission should defer to the IWG's expert judgment over the record from the earlier
11 proceeding.

12

13 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT THAT
14 PROPERLY ESTIMATING MARGINAL DAMAGES REQUIRES ACCOUNTING FOR A
15 UNIT OF CO₂ FOR AS LONG AS IT REMAINS IN THE ATMOSPHERE?

16 A. Dr. Polasky states that a proper estimation of marginal damages must account
17 for all damages associated with a unit of CO₂ for as long as it remains in the
18 atmosphere. However, Dr. Polasky's argument does not establish or discuss why the
19 goal of obtaining the fullest possible accounting, however speculative, should trump the
20 goal of obtaining an estimate which is supported by a sound evidentiary basis.
21 Regardless of whether impacts beyond my recommended modeling horizon may occur,
22 there is an insufficient evidentiary basis to assign a monetized value to those impacts
23 after that horizon. As I stated in my expert report at page 68, the extrapolations used by

1 the IWG to obtain projections after 2100 have been criticized by EPRI as internally
2 inconsistent and inconsistent with known physical facts such as the estimates of known
3 global fossil fuel reserves.⁶ EPRI has also criticized the IWG models for failing to
4 account for diversity in potential regulatory outcomes, and the lack of diversity in the
5 post-2100 forecasts for population, GDP per capita, carbon intensity, net land use CO₂
6 emissions, and non-CO₂ radiative forcing. Moreover, and as I also noted in my expert
7 report at 72-73, the IWG's projections also suffer from the assumption that society
8 would permit exceptionally high temperatures to proceed unchecked despite its
9 projected greater wealth and likely advances in technological know-how in response to
10 the projected accumulation of observable climatic changes. Finally, the IWG emissions
11 projections attempt to make predictions regarding the future relative shares of GDP
12 associated with certain sectors and the extent to which these sectors would be affected
13 by significant temperature increases. These problems become particularly pronounced
14 after 2100 or 2140 because values after 2100 are extrapolated in an ad hoc manner
15 from the EMF 22 scenarios (which end in 2100), and because values after 2100 and
16 2140 suffer from the fact that even the longest-lived technology rarely remains
17 economical to operate more than about 80 years, and that presently foreseeable
18 technological changes could expand the reasonable horizon by about 40 years.
19 Accordingly, any empirical basis which would reasonably support projections out until
20 2100 or 2140 vanishes after that time.

21

⁶ EPRI, 2014, p.4-15.

1 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT THAT
2 UNCERTAINTY IS AN INSUFFICIENT REASON TO ASSUME ZERO DAMAGES
3 AFTER 2100/2140 AND ABOVE 3 DEGREES?

4 A. I do not claim that damages are zero after 2100 and 2140, only that beyond that
5 time the degree of speculation becomes too great to be appropriate for determining
6 near-term financial investments in Minnesota's electricity power system. Dr. Polasky
7 also implies at pages 17:7-11 of his rebuttal testimony that my recommendation of a
8 modeling horizon of 2100 and 2140 is designed to zero-out damages above three
9 degrees. This is incorrect. Although I noted at page 71 of my direct testimony that
10 damage estimates associated with temperature increases of more than 3 degrees
11 become more speculative, I have nevertheless included damages from such increases
12 in my recommended values. Specifically, the majority of the IWG's 450,000 model runs
13 exceed 3 degrees even by 2100 and I have not recommended that these values be
14 excluded. Rather, my recommendation is based on the degree of speculation involved
15 with projections after 2100 and 2140, and this includes damage estimates based on
16 temperature increases exceeding even 10 degrees.

17

18 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT THAT THE
19 COMMISSION SHOULD DEFER TO THE IWG'S JUDGMENTS RATHER THAN THE
20 RECORD FROM THE 1997 PROCEEDING?

21 A. Dr. Polasky states that my expert report relies on the years 2100 and 2140 based
22 on their use in the 1997 proceeding. However, this is incorrect. I relied on the years
23 2100 and 2140 because this is the point at which the speculation in the IWG's

1 emissions projections becomes particularly pronounced due to the fact that values after
2 2100 are extrapolated from the EMF 22 scenarios, and because values after 2100 and
3 2140 suffer from lack of accounting for societal response, the fact that even the longest-
4 lived technology rarely remains economical to operate more than about 80 years,
5 extended by presently foreseeable technological by about 40 years, and lack of
6 understanding about the impacts of temperature increases on society over such long
7 horizons.

8
9 Q. WHAT IS YOUR RESPONSE TO MR. MARTIN'S STATEMENT REGARDING
10 YOUR RECOMMENDATION THAT A MODELING HORIZON BE LIMITED TO ABOUT
11 2100 TO 2140?

12 A. Mr. Martin agrees at pages 43:20 to 44:14 of his rebuttal testimony that the
13 choice of modeling horizon can affect the degree of speculation in the resulting SCC
14 estimates. He also appears to concur with my recommendation that a modeling horizon
15 of 2100 to 2140 is consistent with eliminating portions of the estimates which are based
16 on particularly unrealistic assumptions or have little empirical basis. Mr. Martin further
17 notes at page 44:16-23 of his rebuttal testimony that the Commission is not constrained
18 to adopt the judgment of the IWG on this matter, and that the Commission "could decide
19 a shorter modeling horizon is appropriate to reduce speculation." The only concern Mr.
20 Martin expresses with my recommendation that Minnesota should use a shorter
21 modeling horizon is that he cannot provide any way to incorporate a shorter modeling
22 horizon into his own approach for developing a range of SCC values.

23

1 **B. Marginal Damages**

2 Q. HOW DOES DR. HANEMANN ADDRESS YOUR RECOMMENDATION THAT
3 THE MARGINAL DAMAGE TON SHOULD BE VALUED BASED ON THE FIRST TON
4 EMITTED?

5 A. Dr. Hanemann argues the baseline for my “first ton” recommendation assumes
6 no emissions occur after 2020, and should be rejected as unrealistic.

7

8 Q. HOW DO YOU RESPOND TO DR. HANEMANN?

9 A. Dr. Hanemann is wrong, and it is surprising that he does not recognize what I did
10 as a standard analytical method for backing out a marginal benefit curve from a
11 complex bottom-up damage function model such as an IAM. The emissions projection I
12 used to estimate the marginal damage of the “first ton” was never intended to be an
13 accurate projection of total actual future outcome, but only to understand the sensitivity
14 (i.e., range of variation) of the SCC estimate to different levels of projected future
15 emissions. That analytical device allows me to inform the Commission on how much of
16 the IWG’s SCC estimates are due to emissions yet to be emitted, as opposed to due to
17 historical GHG emissions. Knowing that degree of sensitivity of the IAMs’ SCC values
18 is essential to understanding how much the marginal damage will vary when using
19 alternative (realistic) future emissions projections other than just those five projections
20 that the IWG used. For example, knowing the sensitivity allowed me to estimate the
21 SCC value associated with a baseline that has a very large amount of global emissions
22 control effort, as contrasted to the IWG scenarios that assume no incremental regulation
23 of GHGs for the next 285 years (which I called the “last ton” approach). By knowing this

1 sensitivity, it is also possible to make a rough approximation of the average cost per ton,
2 which I explained in my testimony could be an appropriate estimate under a perspective
3 that the Minnesota environmental cost values are intended to represent an estimate of
4 compensatory damages rather than externality pricing.

5

6 Q. HOW DOES DR. POLASKY ADDRESS YOUR RECOMMENDATION
7 REGARDING WHICH MARGINAL VALUE TO USE FOR AN SCC VALUE?

8 A. First, Dr. Polasky argues that a valuation based on an optimal level of emissions
9 is not appropriate because there is no reason to believe that the optimal level will ever
10 occur. Second, Dr. Polasky argues, like Dr. Hanemann, that a valuation based on the
11 first ton has no merit because it assumes zero emissions after 2020.

12

13 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT REGARDING
14 THE OPTIMAL LEVEL OF EMISSIONS?

15 A. Dr. Polasky argues an optimal emissions projection unrealistically assumes there
16 is a global climate policy in place in which the marginal cost of reducing emissions
17 equals the SCC. Dr. Polasky states "we do not have such [a] policy in place now, nor
18 there is there any guarantee that we will have such policy in the future." However, I did
19 not recommend using an SCC value associated only with some unknown "optimal"
20 emissions trajectory. I only stated that the SCC should be based on a projection that
21 has a level of future emissions consistent with the ultimate goal of regulating this
22 externality. I pointed out through my analyses of the first and last ton that such an SCC
23 value is less than the IWG's SCC estimates, which are based almost exclusively on

1 projections that are *not* consistent with anyone’s view of the ultimate goal from pricing
2 CO₂. I clearly state at page 63 of my expert report that I have made no attempt to
3 assess an “optimal” emissions trajectory. I also state at 64 of my report that I
4 recommended an upper end of the range that “suggests a significant reduction in global
5 emissions relative to BaU, but far less than a zero-emissions policy,” without taking a
6 position on any specific global target for GHG emissions.

7

8 Q. HOW DO YOU RESPOND TO DR. POLASKY’S ARGUMENT REGARDING
9 THE MARGINAL VALUE OF THE “FIRST TON” OF FUTURE EMISSIONS?

10 A. Dr. Polasky argues a projection based on the first ton of emissions should be
11 rejected because there is no rational or scientific basis for assuming zero emissions
12 after 2020. As I discussed in my response to Dr. Hanemann, the use of a zero-
13 emissions projection after 2020 is an analytical device that allows us to infer the degree
14 to which the IWG’s SCC estimates are driven by its assumptions about future GHG
15 emissions growth. Based on this information, one can make reasonable judgments
16 about what a more appropriate marginal damage per ton estimate would be if one
17 assumes (as is appropriate when pricing an externality) that there will be significant
18 reductions in future emissions relative to a “business as usual” baseline. I also
19 recommended that even a leader in adopting an externality price without reciprocal
20 actions coming from other states and nations, such as Minnesota, should not assign
21 itself a value that is inflated by the future emissions of those many other entities until
22 that price is being borne by all. This is the basis for using the “first ton” value as a lower

1 bound for Minnesota's environmental cost value. This is not a statement that it is based
2 on a realistic projection, but only that the "first ton" analysis informs the Commission
3 about how low such a lower bound estimate could reasonably go. Knowing the
4 marginal damage of the first ton as well as of the last ton also allows us to develop an
5 approximate estimate of the average damage per ton without conducting an entirely
6 different average cost analysis. This cost-per-ton estimate is appropriate if one
7 interprets the environmental cost values from a compensatory damages perspective.

8

9 Q. WHAT HAS MR. MARTIN SAID ABOUT YOUR POINTS ON FIRST, LAST AND
10 AVERAGE COST PER TON?

11 A. Mr. Martin agrees at 46:15-24 of his rebuttal testimony with my assessment that
12 the IWG's "last ton" approach overstates damages.

13

14 **C. Discount Rate**

15 Q. HOW DOES DR. HANEMANN ADDRESS YOUR ARGUMENT REGARDING
16 THE APPROPRIATE DISCOUNT RATE?

17 A. Dr. Hanemann argues first that a value as low as 1.4% can be justified. Second,
18 he argues that a consumption rate of discount of 2.5% is compatible with calculations
19 based on reasonable economic assumptions and should not be rejected. Third, Dr.
20 Hanemann argues the IWG's decision to use discount rates of 2.5%, 3% and 5% for the
21 SCC should be respected. Fourth, Dr. Hanemann argues the market rate of interest is
22 inappropriate for updating the CO₂ environmental cost value.

23

1 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT THAT A
2 DISCOUNT RATE OF 1.4% COULD BE JUSTIFIED?

3 A. Dr. Hanemann's defense of a discount rate of 1.4%, as used by Professor Stern,⁷
4 relies on an analysis which assumes a rate of time preference of 0.1%. The rate of time
5 preference reflects the relative value placed on a unit of current consumption and a unit
6 of consumption one year later. A value of 0.1% per year reflects a very low disparity in
7 the value of the future and present units of wellbeing compared to any empirical
8 evidence from human behaviors with respect to themselves or to their children and
9 grandchildren. The justification for the use of that number is a highly subjective moral
10 judgment that argues that intertemporal tradeoffs that we consider acceptable for
11 ourselves are not ethically acceptable for decisions we make that affect both our
12 consumption and the consumption of far-future generations. For that reason, use of the
13 0.1% number for the rate of time preference, and the resulting discount rate of 1.4%, is
14 not appropriate for the Commission to consider if, as in the last proceeding, the
15 Commission requires a sufficient evidentiary basis for the values it adopts.

16

17 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT REGARDING
18 THE MARKET RATE OF INTEREST?

19 A. Dr. Hanemann's argument regarding the market rate of interest focuses solely on
20 the point that the market rate of interest and the consumption rate of discount are not
21 identical. However, I never suggested that they are, or should be. My point, which Dr.

⁷ Stern, N. 2007. "The Economics of Climate Change: The Stern Review," Cambridge University Press.

1 Hanemann does not address, is that the IAMs used by the IWG consider only the
2 change in damages from an incremental ton of reduction, yet the spending to achieve
3 that reduction will somewhat reduce the levels of future societal consumption on which
4 the IWG's damage estimates are based. This reduction in future consumption comes
5 from the diversion of scarce capital to reduce emissions in order to produce those
6 benefits and the amount of this lost opportunity will accumulate at the before-tax market
7 rate of interest, which is higher than the consumption rate of interest. For example,
8 OMB recommends using 7% as a reasonable estimate of the before-tax market rate of
9 interest. This opportunity cost associated with the emissions reduction spending
10 should, ideally, be converted into an equivalent amount of reduction in future
11 consumption levels, and netted against the future projected consumption levels used in
12 the IWG's incremental damage calculations before then discounting the combined net
13 consumption change at the consumption rate of interest. This is known as the "shadow
14 price" approach to discounting, which OMB describes as the "analytically preferred
15 method" for developing a present value when there are both costs and benefits.⁸ If the
16 cost side of the SCC calculation were to be accounted for in the IAMs' estimates of the
17 net societal benefit for an incremental ton of emissions reduction, it would be equivalent
18 to using the benefits-only IAM results but with a discount rate slightly higher than the
19 consumption rate of interest. This was not a recommendation to use the market rate of
20 interest to discount the future incremental damages estimated by the IAMs, as
21 Hanemann's rebuttal seems to be addressing.

⁸ OMB, Circular A-4, p. 33.

1

2 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT THAT A
3 CONSUMPTION RATE OF 2.5% CAN BE JUSTIFIED?

4 A. Dr. Hanemann's empirical defense of a 2.5% discount rate for the SCC
5 calculation focuses solely on the consumption rate of interest, ignoring my point that the
6 IWG has missed the element of use of capital in its modeling approach to its SCC
7 calculations. Once this missing element is considered, the weak empirical basis for Dr.
8 Hanemann's defense of a 2.5% discount rate is offset.

9

10 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT THAT THE
11 IWG'S USE OF A 2.5% DISCOUNT RATE SHOULD BE RESPECTED?

12 A. The IWG's decision to include a 2.5% discount rate is based on considerations
13 that do not rest on empirical evidence, but rather includes giving weight to ethical
14 considerations that cannot be ascribed any evidentiary basis. In the last proceeding,
15 Minnesota favored values with a sufficient evidentiary basis. I have recommended that
16 same criterion be applied in this proceeding. This consideration favors those discount
17 rates with an empirical basis. Additionally, the IWG's approach has omitted accounting
18 for the effect of the opportunity cost of emissions reduction spending on future
19 consumption levels, and that further weighs against IWG's decision to include a 2.5%
20 discount rate.

21

22 Q. HOW DOES DR. POLASKY ADDRESS YOUR ARGUMENT REGARDING THE
23 APPROPRIATE DISCOUNT RATE?

1 A. Dr. Polasky argues first that the 2.5% discount rate is well above the 1.4%
2 discount rate used by Lord Stern, and well within the range found by a meta-analysis
3 conducted by Dr. Tol. Dr. Polasky also argues the IWG properly rejected the 7%
4 discount rate required to be included by OMB Circular A-4.

5

6 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT THAT 2.5%
7 DISCOUNT RATE IS APPROPRIATE?

8 A. Dr. Polasky supports the use of a 2.5% discount rate by demonstrating that it is
9 in the range considered by other economists using IAMs. However, Dr. Polasky has not
10 explained the theoretical underpinnings of Lord Stern's 1.4% rate, or of the rates
11 included in Dr. Tol's meta-analysis. Dr. Polasky has not explained the extent to which
12 those rates are and are not based on evidence of actual persons' preferences and
13 behaviors.

14

15 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT THAT THE IWG
16 PROPERLY REJECTED THE 7% RATE?

17 A. Although I have not specifically recommended the use of a 7% discount rate, I
18 note Dr. Polasky's argument for rejecting it does not rest primarily on empirical
19 evidence, but rather rests on ethical considerations that cannot be quantified and on the
20 existence of uncertainty about future conditions.

21

22 Q. DOES MR. MARTIN AGREE WITH YOUR RECOMMENDATION REGARDING
23 DISCOUNT RATE?

1 A. No. Mr. Martin claims at page 41:21-42:12 of his rebuttal testimony that the IWG
2 has addressed criticism of its choice of discount rates, referring to its July 2015
3 “Response to Comments” to the OMB. Second, Mr. Martin argues at page 42:16-43:2
4 of his rebuttal testimony that the 2.5% discount rate should not be discarded and
5 suggests incorrectly that my only rationale is for discarding the 2.5% discount rate is
6 that it is “subjective.”

7
8 I have three points in response to Mr. Martin. First, I am not aware that any of my own
9 criticisms were provided to the OMB Docket on SCC, and so I have no reason to
10 believe that the IWG has specifically responded to them. Second, Mr. Martin is
11 incorrect that my rationale for not using a rate that low includes more than a mere view
12 that it is “subjective.” Rather, the 2.5% discount rate fails to take into account the
13 opportunity cost of capital necessary to reduce emissions, which is a purely empirical
14 issue, as well as a matter of proper discount rate approach. Mr. Martin has not
15 addressed that point. Third, to the extent that the IWG’s rationale for including a 2.5%
16 discount rate includes unquantifiable value judgments, it is indeed not evidence-based
17 and is incompatible with the Commission’s criteria.

18
19 **D. Geographic Scope**

20 Q. HOW DOES DR. HANEMANN ADDRESS YOUR RECOMMENDATION THAT
21 THE SCC SHOULD BE CALCULATED USING U.S. DAMAGES RATHER THAN
22 GLOBAL DAMAGES?

1 A. Dr. Hanemann argues the geographical scale on which to consider impacts
2 cannot be informed by economic theory and thus the Commission's precedent on this
3 choice should be respected.

4

5 Q. HOW DO YOU RESPOND TO DR. HANEMANN'S ARGUMENT?

6 A. I disagree that economic theory has nothing to say on this matter. I have clearly
7 explained above and in my direct testimony and associated expert report my reasons
8 for why I recommend the Commission not adopt a global scope, based upon, among
9 other things, economic theory related to benefit-cost analysis. Although precedents
10 should be carefully considered in the matter of establishing principles for setting
11 Minnesota's environmental cost values, those precedents should not be permitted to
12 override sound benefit-cost analysis.

13

14 Q. HOW DOES DR. POLASKY ADDRESS YOUR RECOMMENDATION THAT THE
15 COMMISSION USE U.S. DAMAGES TO CALCULATE THE SCC?

16 A. First, Dr. Polasky argues that using only U.S. damages fails from an economic
17 perspective because the theory of correcting externalities requires incorporation of all
18 damages caused by pollution. Second, Dr. Polasky argues Minnesota Statute Section
19 216B.2422 requires all environmental costs associated with a method of electricity
20 generation be included in resource planning decisions. Third, in his response to the
21 testimony of Dr. Gayer, Dr. Polasky addresses the portion of my testimony regarding
22 economic standing.

23

1 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT THAT
2 ECONOMIC THEORY REQUIRES CONSIDERATION OF GLOBAL DAMAGES?

3 A. Dr. Polasky states that "the theory of correcting externalities indicates that the
4 emitting entity . . . must incorporate the damages caused from the pollution to all
5 parties, into their production decision process." He goes on to say that "[i]ncorporating
6 only the damages incurred in Minnesota from a ton of CO₂ emitted in Minnesota would
7 ignore the vast majority of the external costs." Although it is true that incorporating only
8 the damages incurred in Minnesota will not account for the full measure of
9 environmental costs associated with CO₂ emissions, incorporation of global damages
10 will also be economically inefficient unless Minnesota is joined in its efforts by other
11 states and countries. In the absence of such concerted action, incorporating global
12 damages would harm Minnesota and fail to help anyone else. Therefore, the usual
13 rationale relied upon to take into account global damages does not apply here.

14

15 Dr. Polasky also argues that, "[b]y incorporating the full external cost of CO₂ emissions
16 into resource planning decisions in Minnesota, we as a state are both leading and
17 preparing for a future where the price of emitting carbon is no longer free." I disagree.
18 First, Minnesota is already in a leadership role for applying any environmental cost
19 value to itself in advance of reciprocal agreements. Second, the reference to
20 "preparing" for a future with carbon prices lacks logical basis. By pricing its carbon
21 emissions in ways that no other political jurisdictions are doing, Minnesota is placing
22 itself at a distinct and possibly substantial competitive disadvantage. It can avoid such
23 a disadvantage by incurring those externality prices at the same time that the others do,

1 i.e., when there is a reciprocal agreement. Finally, Dr. Polasky has not established that
2 Minnesota cannot prepare for a future in which carbon is no longer free by using a price
3 incorporating Minnesota or U.S. damages only.

4

5 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT REGARDING
6 THE REQUIREMENTS OF MINNESOTA'S ENVIRONMENTAL COST STATUTE?

7 A. The statute only requires the Commission "to the extent practicable" quantify and
8 establish a range of environmental costs associated with each method of electricity
9 generation. Minn. Stat. § 216B.2422, subd. 3(a). The statute does not contain a
10 requirement that a global scope be employed.

11

12 Q. HOW DO YOU RESPOND TO DR. POLASKY'S ARGUMENT REGARDING
13 ECONOMIC STANDING?

14 A. Dr. Polasky argues the typical benefit-cost practice of tying the scope of benefits
15 to be considered to the regulator's political jurisdiction should not be applied under
16 these circumstances because Minnesota is correcting a market failure that is occurring
17 within Minnesota.

18

19 I disagree that benefit-cost analysis is not applicable to this situation. Benefit-cost
20 analysis is commonly considered by economists to be a methodology for assessing
21 policy responses to problems of market failure (for example, see "S-Theory-1" in Farrow
22 and Viscusi, p. 9). Moreover, as I have explained in my response to Dr. Hanemann, the
23 global CO₂ problem will only be managed when addressed at a global level. In the non-

1 reciprocal situation, Dr. Polasky’s argument that using a global scope under the
2 Minnesota law is necessary for “correcting this market failure” fails.

3
4 Dr. Polasky’s argument based on moral considerations also fails. Specifically, he states
5 at page 28:1-4 of his rebuttal testimony that it is “more accurate to frame the issue in
6 terms of reducing the damages that we are inflicting on others. [The use of a global
7 scope] is an act of taking responsibility for the results of our actions.” As my analysis of
8 the marginal damage of the “first” ton emitted in Table 6 of my expert report reveals,
9 under a 3% discount rate, approximately one-third of the IWG’s estimated damage
10 caused by Minnesota emissions is attributable to the actions of others who will be
11 contributing to future emissions, most of whom will be non-U.S. in origin. In fact, as
12 shown in Table 4 of my expert report, which compares U.S. values for the first and last
13 ton assumptions, even for a U.S.-based SCC, 30% of that value is attributable to the
14 future actions of others.

15
16 Q. WHAT HAS MR. MARTIN SAID ABOUT YOUR RECOMMENDATION ON
17 GEOGRAPHIC SCOPE AND WHAT IS YOUR RESPONSE TO HIM?

18 A. In discussing my testimony specifically, Mr. Martin notes I have recommended a
19 non-global scope, and in doing so provides some reasons of his own for a non-global
20 scope (i.e., that reduction in Minnesota’s emissions will likely produce no appreciable
21 reduction in climate damages, and that exclusion of non-U.S. damages reduces
22 uncertainty, respectively). I note he appears to implicitly accept my own reasons for
23 recommending a non-global scope of emissions.

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IV. UPDATEABILITY

Q. PLEASE COMMENT ON THE UPDATABILITY OF YOUR APPROACH.

A. Mr. Martin claims that his approach is easy to update and my approach is not. At the same time, although he agrees it would be nice to consider alternative framing assumptions such as I have recommended, he acknowledges that his approach is too inflexible to apply such alternative assumptions. Mr. Martin is greatly exaggerating the difficulty of performing an update using my approach.

If the IWG were to release an update using three updated models, I believe that any organization with access to computers that can run Excel and its @Risk add-on, Matlab, and C#, that employs research analysts who are comfortable running computer programs and managing data files of outputs, and that has copies of my expert report and work papers, would be able to perform a complete update using the sets of alternative framing assumptions that I have recommended.

Moreover, the IWG updates its SCC values on a cycle of years, not weeks. Thus, the need for an update, if tied to IWG updates, will be infrequent. It should not be a major resource burden for the Commission to re-apply my approach on such an infrequent basis, particularly given this approach will allow it to accommodate any of a wide range of alternative values regarding choices of modeling horizon, which ton to value, geographic scope, and discount rates. In contrast, Mr. Martin's approach, as quick as it may be to apply, cannot accommodate changes in any of these assumptions, other than

1 to alter the weight that it may assign to each of the specific discount rates that the IWG
2 will have used. It is also conceptually flawed, as I have explained in my rebuttal
3 testimony.

4

5

V. CONCLUSION

6 Q. DOES THIS CONCLUDE YOUR SURREBUTTAL TESTIMONY?

7 A. Yes, it does.