

**BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION
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Beverly Jones Heydinger	Chair
Nancy Lange	Commissioner
Dan Lipschultz	Commissioner
Mathew Schuerger	Commissioner
John Tuma	Commissioner

In the Matter of Further Investigation into
Environmental and Socioeconomic Costs under
Minnesota Statute § 216B.2422, Subdivision 3

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

**EXCEPTIONS OF THE MINNESOTA DEPARTMENT OF COMMERCE,
DIVISION OF ENERGY RESOURCES AND THE
MINNESOTA POLLUTION CONTROL AGENCY**

INTRODUCTION

The Minnesota Department of Commerce, Division of Energy Resources (Department or DOC) and Minnesota Pollution Control Agency (MPCA) (jointly, the Agencies) appreciates the thorough and detailed 142-page Findings of Fact, Conclusions, and Recommendations: Carbon Dioxide Values (ALJ Report) of the Administrative Law Judge (ALJ) regarding this complex matter.

The Agencies respectfully submit to the Minnesota Public Utilities Commission (Commission) a single exception to the ALJ Report: the Agencies recommend that the Commission use the year 2300 rather than 2200 as the appropriate modeling time horizon and adopt amendments proposed herein by the Agencies to certain ALJ findings: ALJ Report at Conclusions ¶¶34-35 and Recommendations ¶ 1a.

EXCEPTION

The Agencies had recommended to the ALJ, and continue to recommend to the Commission, the adoption of the Federal Social Cost of Carbon (FSCC) methodology and

damage values developed by the federal Interagency Working Group (IWG). One aspect of the methodology employed by the IWG when developing the FSCC concerns the modeling time horizon—the period of time during which damages caused by CO₂ emissions are counted. Because CO₂ emissions remain in the earth’s atmosphere for hundreds of years, the FSCC, employing what the Agencies believe to be reasonable assumptions and methods, modeled damages through the year 2300. The ALJ Report concluded, however, that extending the modeling time horizon to the year 2300 was not reasonable in light of an increase in “uncertainty” in the modeled assumptions between the years of 2100 and 2300.

The ALJ Report reasoned that “the IWG’s prediction of damages from the year 2100 to the year 2300 [did not] meet the same standards of reliability as the IWG’s predictions of damages from the present to the year 2100” where the IWG used the “peer-reviewed EMF-22 emissions scenarios, which were constructed through the year 2100” and “extrapolated the EMF inputs to the year 2300 based on limited data, without the benefit of peer review.”¹ ALJ Report at Conclusions ¶ 32. The ALJ was concerned that an extrapolation extending the modeling horizon from year 2100 to 2300 involved “a degree of uncertainty that is not reasonably supported by adequate evidence.” *Id.* at ¶ 34. She balanced this increased uncertainty against

¹ “The IWG sought to capture substantially all of the damages from emissions in a given year. To do so, the IWG chose to estimate damages through the year 2300, which in turn required the IWG to extrapolate the five EMF-22 scenarios over an additional 200 years. The required inputs were extrapolated, and involved the following assumptions:

- Population growth rate declines linearly, reaching zero in the year 2200.
- GDP/per capita growth rate declines linearly, reaching zero in the year 2300.
- The decline in the fossil and industrial carbon intensity (CO₂/GDP) growth rate over 2090-2100 is maintained from 2100 through 2300.
- Net land use CO₂ emissions decline linearly, reaching zero in the year 2200.
- Non-CO₂ radiative forcing remains constant after 2100.”

ALJ Report at Findings of Fact ¶¶109-110 and notes 230-232 (*citing* Ex. 800, WMH-2 at 25, 43-47 (Hanemann Direct)).

“the importance of accounting for the CO₂ that will remain in the atmosphere beyond the year 2100,² and the understated nature of the FSCC,”³ and concluded that it is reasonable to implement the IWG’s extrapolation, but only for 100 years, to the year 2200, rather than for 200 years, to the year 2300. She explained her balancing approach by stating that, “[w]hile the evidentiary underpinning is no greater for this extrapolation than it would be to extend the model to the year 2300, this approach lessens the danger of multiplication of errors within the extrapolation while providing a response to the strong evidence of damage from CO₂.”

The Agencies believe that, rather than accept the approach of the ALJ Report, the better policy is for the Commission to adopt the FSCC in its entirety, including modeling the time horizon to 2300, as the IWG did, and to modify the model to reduce the time horizon only if the FSCC is so changed in the future. The Agencies offer the following reasons for retaining a modeling horizon of 2300.

First, there is no factual basis for the assertion that economists can forecast the state of the economy in 2100 or 2200 more reliably than they can forecast it in 2300. While the state of the economy in 2200 and 2300 are both uncertain, and 2300 is further in the future than 2200,

² “The ALJ concluded that, “a preponderance of the evidence demonstrates that a ton of CO₂ released into the atmosphere will not be fully absorbed into the land or the oceans for a minimum of two hundred years” and found “that it will be hundreds of years before that ton will be fully absorbed.” ALJ Report at Conclusions ¶ 30. The ALJ concluded that, “a preponderance of the evidence demonstrates that CO₂ will continue to have a cumulative impact on the climate for as long as it remains in the atmosphere.” ALJ Report at Conclusions ¶ 31.

³ “The ALJ concluded that, “based on unreported and underreported health and environmental impacts, along with the IWG’s acknowledgement that the FSCC is not based on the most current research, the preponderance of the evidence demonstrates that the FSCC understates the full environmental cost of CO₂.” ALJ Report at Conclusions ¶ 13. The ALJ concluded, “the FSCC likely understates damages and that the risk of a “tipping point” is not well-represented within the scope of the 2.5, 3.0 and 5.0 percent rate of discount.” ALJ Report at Conclusions ¶ 20.

there is no operational, or meaningful, sense in which one can compare those uncertainties and conclude that one prediction is more reliable than the other.

Moreover, the warming in both periods (before 2100 and from 2100-2300) is driven by the same climate system representation and the same damage function. The damage function is expressed as a percentage of GDP. DOC Ex. 800 at 26 (Hanemann Direct). There is greater uncertainty about the future level of GDP in 2300 versus 2100, but *there is not necessarily more uncertainty about the damage as a percentage of GDP*. For a given amount of warming in a future year, the damage is represented as the same percentage of whatever the GDP happens to be. That restrains the impacts of uncertainty regarding the future level of GDP. DOC Ex. 800 at 26-29 (Hanemann Direct). For these reasons, the Agencies contend that greater uncertainty the further one projects into the future is not a reasonable justification for truncating the time horizon chosen by the IWG.

Second, the ALJ Report on this point appears mistakenly to find that the EMF-22⁴ calculation for year 2100 included a temporal variable such that uncertainty increased over time, from the present “through” 2100.⁵ This is incorrect. Contrary to the ALJ Report, Conclusion ¶ 32, the EMF-22 emissions scenarios were not “constructed through the year 2100”, but were instead constructed exclusively for the year 2100. DOC Ex. 801 at 25 (Hanemann Rebuttal). Dr. Hanemann, the Agencies’ expert witness, specifically said that it was not significant that, whereas the EMF-22 calculated its projections for 2100, the IWG made projections through 2300. He explained that this is because EMF-22 had an entirely different objective than the

⁴ The EMF-22 was a highly authoritative source for the required inputs, and the IWG used five of the model projections presented at the EMF forum. DOC Ex. 800 at 50 (Hanemann Direct).

⁵ ALJ Report, Conclusion ¶ 32 (The ALJ Report mistakenly describes the EMF-22 emissions scenarios as being “constructed *through* the year 2100”) (emphasis added).

IWG: “EMF-22 was not a cost-benefit analysis of climate mitigation policies. It did not consider damages from climate change. Instead, it focused on cost minimization in reducing emissions to meet targets being considered in current climate policy debates.” DOC Ex. 801 at 24 (Hanemann Rebuttal). The “climate targets were *atmospheric concentrations* of CO₂ of 450 ppm, 550 ppm or 650 ppm in 2100. The whole focus of the EMF-22 was to look at abatement costs to meet a goal specifically in 2100. EMF-22 *did not consider damages*, either before or after 2100” and “therefore sheds no light on the relative merits of damage projections that terminate before or after 2100.” DOC Ex. 801 at 24-25 (Hanemann Rebuttal) (emphasis added). Contrary to the ALJ’s Finding at ¶ 265, that in EMF-22, “[d]amages were not considered in any other year,” in fact, in EMF-22, damages were not considered at all.

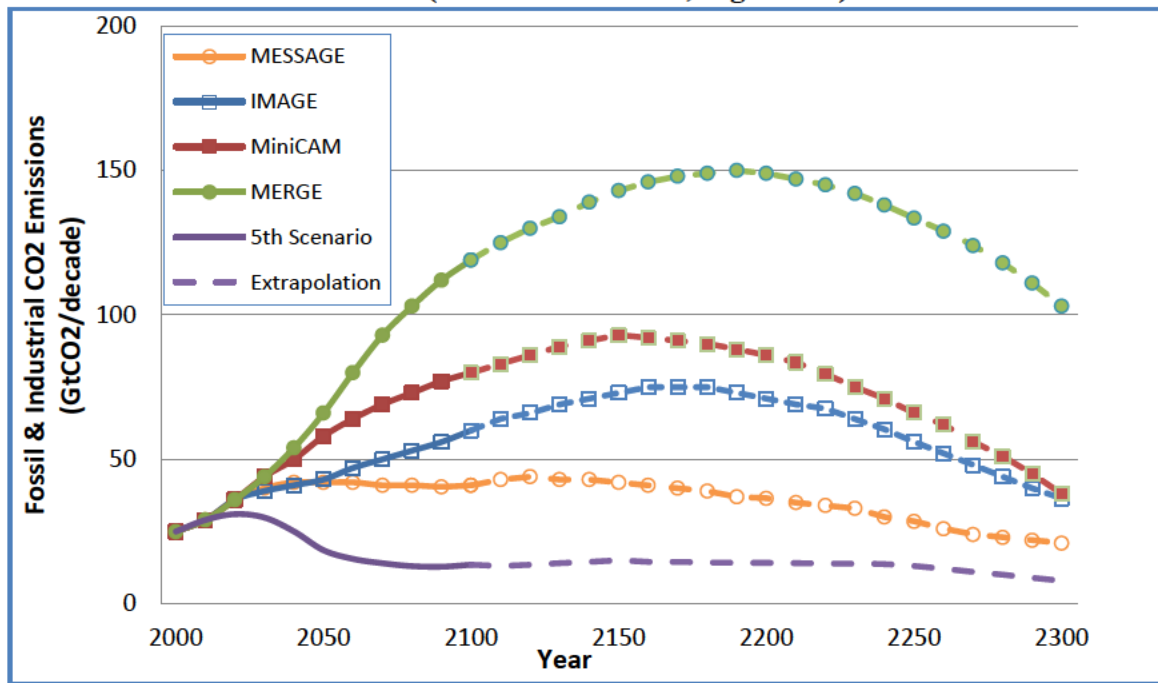
What this means, among other things, is that the reasonable assumptions the IWG made when calculating FSCC damages were entirely the work of the IWG, as to all years before and after 2100. The credibility and reliability of those assumptions (noted in fn. 2 above) were independent of year 2100 being the year in which the EMF-22 atmospheric concentrations were projected.

The Agencies also note that, contrary to the ALJ Report’s descriptions of EMF-22 projections as being based on “data” and subject to peer-review (ALJ Report, Conclusion ¶ 32) the EMF-22 projections were not based on a set of known data, facts, evidence, or peer-reviewed analyses; they were simply “projections into the far future based on reasonable assumptions.” DOC Ex. 801 at 25 (Hanemann Rebuttal).

Third, regarding uncertainty, the evidence shows that uncertainty is accounted for in that the EMF-22 and IWG did not predict a single future emissions scenario, but rather employed a range of five scenarios, including one--to which the IWG gave a 20% weight--in which the

emission projection is keyed to stabilization of atmospheric CO₂ at 550 ppm (the low trajectory in Figure 1B, reproduced below). In all five scenarios, projected emissions level off and decline, as can be seen in Figure 1B (below).

Figure 1B: IWG’S EMISSION SCENARIOS - PROJECTIONS THROUGH 2300
(source: IWG 2010, Figure A4)



Dr. Hanemann further explained that there obviously is uncertainty regarding how people will value and respond to climate impacts in the next centuries – for example, how people will react if sea levels rise by several meters and threaten to inundate coastal areas. The existence of uncertainty is not a valid reason to truncate the analysis to the time period before such impacts occur. DOC Ex. 802 at 43 (Hanemann Surrebuttal); *see also* CEO Ex. 101 at 12 (Polasky Rebuttal). Moreover, Dr. Hanemann explained, societal/technological adaptation is not the major area of uncertainty. “The larger consideration is that the degree of warming being projected by climate models after 2100 was last experienced by this planet millions of years ago, before *Homo sapiens* existed. Since these climate outcomes are unprecedented in human history, there are no historical data to which the social and economic impacts could be calibrated. The

lack of calibration, however, is not a valid reason to ignore such unprecedented climate risks” by simply truncating the analysis. DOC Ex. 802 at 34-37, 43-44 (Hanemann Surrebuttal). It is reasonable for the Commission to find that there is not an unreasonably greater scientific uncertainty in the model after 2200 than there is in the model in 2100, and that the IWG’s choices represent reasonable expert opinion and are not arbitrary.

Fourth, regarding the ALJ’s conclusion that approximately 50 percent of the damages used to calculate FSCC estimates at a three percent rate are in the post-2100 era, the ALJ referred to Dr. Smith’s sensitivity analysis, which showed how varying four assumptions made by the IWG (and questioned by Dr. Smith) affected the FSCC value. Specifically, Dr. Smith showed that adhering to all the assumptions made by the IWG except using a 2100 time horizon resulted in a FSCC for 2020 of \$24.63/tonne (2014\$) compared to \$46.88 when a 2300 time horizon was used, a nearly two-fold difference. OTP, MP, GRE Ex. 300 at 31 (Smith Direct) (Table 4). The ALJ concluded from this that, since nearly half of the damage cost that comprises the FSCC is attributable to damages after 2100 (but before 2300) and there is generally greater uncertainty of damages after 2100, that curtailing the time horizon from the year 2300, as chosen by the IWG, to 2200 was a reasonable choice. ALJ Report, Conclusions ¶¶ 32 – 35.

While Dr. Smith correctly points out that the value of the FSCC is sensitive to the time horizon (OTP, MP, GRE Ex. 302 at 75-79) (Smith Direct Attachment AES-D-2) the Agencies do not see this as a reasonable justification for truncating the time horizon. The reason for the substantial proportion of damages after 2100 is largely attributable to the fact that annual damages are getting worse every year because warming is increasing. This is counteracted by the fact that, with discounting, the further in the future damages occur, the less impact those damages have on the current year’s FSCC. DOC Ex. 800 at 53-56 (Hanemann Direct). As

Dr. Smith's example showed, the proportion of the damage value attributable to damages between 2100 and 2300 decreases precipitously under the 5 percent and 7 percent discount rates. But the fact that, in spite of discounting (at a 3% rate in Dr. Smith's example), a substantial portion of the damage value is attributable to damages after 2100 suggests that damages are significantly increasing after 2100. There is not a valid reason to discount the harmful effects of future warming more than is accomplished by using an appropriate discount rate.

Moreover, the Agencies question the ALJ's supposition of increased uncertainty for 2300 compared to 2100. The warming in both periods (before 2100 and from 2100-2300) is driven by the same climate system representation and the same damage function. The damage function is expressed as a percentage of GDP. DOC Ex. 800 at 26 (Hanemann Direct). There is greater uncertainty about the future level of GDP in 2300 versus 2100, but *there is not necessarily more uncertainty about the damage as a percentage of GDP*. For a given amount of warming in a future year, the damage is represented as the same percentage of whatever the GDP happens to be. That restrains the impacts of uncertainty regarding the future level of GDP. DOC Ex. 800 at 26-29 (Hanemann Direct). For these reasons, the Agencies contend that greater uncertainty the further one projects into the future is not a reasonable justification for truncating the time horizon chosen by the IWG.

Fifth, while well-reasoned, the ALJ's recommendation on this one issue – the truncation of damages after 2200 – was neither proposed by a party to the proceeding nor assessed by any of the expert witnesses; indeed, nothing in the record suggests that such a proposal has been assessed by any expert in this field. The Commission may wish to be cautious before rejecting one out of the multitude of assumptions made by the IWG.

Finally, the ALJ Report's reasoning was a *balancing* of scientific uncertainty resulting from projections with the *certainty that some damage* is occurring, and should be accounted for, in establishing reasonably accurate values. An additional factor the Commission may wish to consider in the balance involves feasibility and practicability: the record does not contain the "truncated" values recommended by the ALJ Report and neither the Agencies nor their consultant have the data to perform a re-calculation of the values using a shortened time horizon of 2200. The effort and expense needed to recalculate the FSCC is unknown to the Agencies at this time.

Further, this recalculation, if subsequently shown to be feasible, would need to be re-done every time the IWG updates the FSCC⁶ and it is highly likely that the FSCC will continue to be updated. The FSCC model was adopted in 2010, has been updated three times to date, (ALJ Report at Findings ¶¶ 64-65), and the IWG has stated its opinion that the FSCC "should be updated over time to reflect increasing knowledge of the science and economics of climate impacts." *Id.* As Dr. Hanemann explained, "[a]s time passes, we will know more about the likely trend of emissions during the coming decades. That information can – and should – be used to update future estimates of the SCC" (DOC Ex. 801 at 26 (Hanemann Rebuttal), and, as the federal government updates its estimates of the FSCC, those estimates will be available for use by the State of Minnesota in determining the environmental externalities associated with CO₂ emissions. DOC Ex. 800 at 93 (Hanemann Direct). It is more practicable and conservative for the Commission to conclude that the record in this docket supports accepting the assumptions made by the IWG.

⁶ A recalculation would be required unless the FSCC is amended in the future to include only values reflecting damages through 2200 (an amendment the Agencies believe is unlikely to occur) or unless the Commission declines to update the values as the FSCC is updated.

The Commission may wish to consider these additional concerns in the balance when deciding whether to amend the ALJ Report on this issue of a shortened model time horizon.

Based on the reasoning above, the Department requests that the ALJ Report be amended as follows:

CONCLUSIONS ¶¶ 32 – 35 (PP. 119-120 OF ALJ REPORT).

32. The Administrative Law Judge concludes that the CEOs and Agencies ~~failed to demonstrate~~ that the IWG's prediction of damages from the year 2100 to the year 2300 meets the same standards of reliability as the IWG's predictions of damages from the present to the year 2100. The IWG used the ~~peer-reviewed~~ EMF-22 emissions scenarios, which were constructed based on varying assumptions through for the year 2100. The IWG extrapolated the EMF ~~inputs scenarios~~ to the year 2300 based on ~~limited data, without the benefit of peer review~~ reasonable assumptions.

33. ~~The Administrative Law Judge concludes the Utilities and MLIG demonstrated by a preponderance of the evidence that approximately 50 percent of the FSCC estimates at a three percent rate are in the post 2100 era.~~

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

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

RECOMMENDATIONS ¶ 1 (PP. 123-24 ALJ REPORT)

1. The Administrative Law Judge respectfully recommends that the Commission adopt the Federal Social Cost of Carbon as reasonable and the best available measure to determine the environmental cost of CO₂, establishing a range of values including the 2.5 percent, 3.0 percent, and 5 percent discount rates, with the following amendment:
 - a. ~~The FSCC values will be re-calculated to reflect a shortened time horizon extending to the year 2200.~~

CONCLUSION

For the reasons stated above, and consistent with its testimony, post-trial briefs and proposed facts in this matter, the Department respectfully requests that the Commission adopt the Report of the ALJ, with the single exception discussed herein.

Dated: May 5, 2016

Respectfully submitted,

s/ **Linda S. Jensen**

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May 5, 2016

Mr. Daniel P. Wolf
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RE: In the Matter of the Further Investigation in to Environmental and Socioeconomic Costs
Under Minnesota Statute 216B.2422, Subdivision 3
PUC Docket No. E-999/CI-14-643;
OAH Docket No. 80-2500-31888

Dear Mr. Wolf:

On behalf of the Minnesota Department of Commerce, Division of Energy Resources,
and the Minnesota Pollution Control Agency, please find Exceptions for filing in the above
referenced matter.

Respectfully submitted,

s/ **Linda S. Jensen**

Linda S. Jensen

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and Minnesota Pollution Control Agency

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Enclosure
cc: Service List

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RE: In the Matter of the Further Investigation in to Environmental and Socioeconomic Costs
Under Minnesota Statute 216B.2422, Subdivision 3 (2014)
PUC Docket No. E-999/CI-14-643;
OAH Docket No. 80-2500-31888

[illegible]

I, Annabel Foster Renner, hereby state that on the May 5, 2016, I filed by electronic eDockets the attached **Exceptions of the Minnesota Department of Commerce, Division of Energy Resources, and the Minnesota Pollution Control Agency** and eServed or sent by US Mail, as noted, to all parties on the attached service list.

See attached service list for PUC Docket No. E-999/CI-14-643;
OAH Docket No. 80-2500-31888

/s/ Annabel Foster Renner
ANNABEL FOSTER RENNER

Subscribed and sworn to before me on
this 5th day of May, 2016.

/s/ **LaTrice Woods**
Notary Public – Minnesota
My Commission Expires January 31, 2020.

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