

Before the Office of Administrative Hearings
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For the Minnesota Public Utilities Commission
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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

Initial Brief of Otter Tail Power Company

Criteria Pollutants

March 15, 2015

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I. INTRODUCTION

Otter Tail Power Company (“Otter Tail”) is an electric utility serving approximately 61,000 customers in Western Minnesota plus an additional 70,000 customers in North Dakota and South Dakota. Otter Tail is committed to providing reliable and affordable service to its customers, and has taken significant steps to decrease its dependence on coal generation and reduce its emissions of pollutants. It recognizes the significant role played by the use of environmental cost values in Minnesota’s resource planning process and the importance of accurately quantifying such values.

The Minnesota Public Utilities Commission (“Commission” or “MPUC”) should adopt the values proposed by Dr. Williams Desvousges as the environmental cost values for PM_{2.5}, SO₂, and NO_x, the criteria pollutants. Otter Tail, which did not participate in the Criteria Pollutant phase of the case and has not, therefore, proposed any environmental cost values for PM_{2.5}, SO₂, and NO_x, is concerned that even Dr. Desvousges values are dramatically higher than the current values. However, the evidence shows that, of the environmental cost figures presented in this matter, those from Dr. Desvousges best satisfy the Commission’s criteria. Not surprisingly, the Commission has in the past preferred values that are detailed and subject to accurate modelling. The Commission initiated this proceeding so that the environmental cost values could be updated in response to the current state of scientific understanding. Dr. Desvousges’ work satisfies those criteria. The model used by Dr. Desvousges – CAMx – is a state of the art comprehensive model that models the transportation and chemical interaction of pollutants. CAMx is widely accepted in the scientific community, satisfies EPA standards, was specifically developed to model criteria pollutant emissions, models emissions from point sources, and models the dispersion of the three pollutants in question from three hypothetical

sources using plume rise, which was calculated hourly using stack parameters and weather conditions that vary by the hour (as opposed to average wind speed and direction information).

CAMx is far more accurate than InMAP and AP2, the untested reduced-form models relied upon by Drs. Marshall and Muller, who respectively testified on behalf of the Clean Energy Organizations (“CEOs”) and the Department of Commerce and Pollution Control Agency (the “Agencies”). Moreover, contrary to Commission precedent, the values proposed by Dr. Marshall and Dr. Muller inappropriately include estimates of nationwide damages and do so based on inaccurate atmospheric modelling, which overstates the appropriate environmental cost values for the criteria pollutants. Dr. Desvousges approach is also preferable with regard to his consideration of the mortality risks associated with PM_{2.5} emissions and the value of a statistical life (“VSL”) because he takes into account the most recent studies.

The claimed advantages of Dr. Marshall and Dr. Muller’s approaches, values for individual counties and the ability to quickly perform model runs in the future, are illusory. These approaches offer false precision as they are based on less rigorous and less accurate “reduced form” modelling. Certainly, Drs. Muller and Marshall can provide values for individual counties or locations, but those values are not accurate enough to be used as Minnesota’s environmental cost values. Nor have more than twenty years of experience with environmental cost values suggested the Commission has any need to regularly model concentrations of criteria pollutants as part of the resource planning process. The Administrative Law Judges should recommend the Commission adopt Dr. Desvousges values (consistent with the methodology used to establish the Commission’s existing values) calculated using state-of-the-art atmospheric modelling and up-to-date studies. The choice is easy. Resource planning in

Minnesota should be based on the best available modelling and most up-to-date scientific and epidemiological information, not outdated studies and less accurate reduced form modelling.

II. APPLICABLE LAW AND COMMISSION PRECEDENT

Subdivision 3(a) of Section 216B.2422 of the Minnesota Statutes provides that the Commission “shall, to the extent practicable, quantify and establish a range of environmental costs associated with each method of electricity generation.”¹ Utilities are required to use the values established by the Commission, in conjunction with other factors, when evaluating and selecting resource options in Commission proceedings, including in resource planning and certificate of need dockets.² Accordingly, in the Notice and Order for Hearing which commenced this contested case proceeding, the Commission directed the parties to this proceeding to address “[t]he appropriate values for PM_{2.5}, SO₂, and NO_x under Minn. Stat. §216B.2422, subd. 3.”³

Although the Commission did not articulate the standard by which the “appropriate” values should be determined when it began this proceeding, precedent offers significant guidance. Specifically, in the prior proceeding to establish environmental cost values, the Commission clearly preferred proposed values that were supported by accurate and detailed modelling, and rejected models that did not use the most accurate and up-to-date information.

In the earlier proceeding, the ALJ and Commission adopted the most detailed and accurate approach available – the damage-cost study prepared by Triangle Economic Research (“TER”) and authorized by Dr. Desvousges, who has again offered testimony on behalf of

¹ Paragraph (b) of Minn. Stat. § 216B.2422, subd. 3, which is not relevant to these proceedings, required the Commission to establish interim environmental cost values by March 1, 1994.

² *Id.*

³ Notice and Order for Hearing, Docket Nos. E-999/CI-00-1636, E-999/CI-14-643 (Oct. 15, 2014) at 5.

Northern State Power Company, d/b/a Xcel Energy, (“Xcel Energy”) in this proceeding.⁴ ALJ Klein noted that the TER model estimated damages at the zip code level, and estimated emissions concentrations for each hour of the year in order to accurately account for the effects of the relevant pollutants on the population.⁵ The TER model also accounted for three categories of damage: human health effects, agricultural damages, and damage to materials.⁶

The Commission rejected the less detailed and less accurate model proposed by the Environmental Coalition, noting that, among other things, the TER model relied on an EPA recommended air dispersion model, while the Coalition relied upon a “screening” model. In short, the Commission in the prior proceeding chose values based on the most detailed and accurate model then available. The Commission should do so again in this proceeding.

III. BURDEN AND STANDARD OF PROOF

As Administrative Law Judge Schlatter determined in the Order Regarding Burdens of Proof, the appropriate standard of proof in this proceeding is the preponderance of the evidence.⁷ In its appellate review of the 1990s proceeding, the Minnesota Court of Appeals determined the preponderance of the evidence was the appropriate standard,⁸ and in the absence of any other applicable standard of proof it is the standard required under the applicable rule.⁹

Accordingly, any party proposing the Commission adopt an environmental cost value (or range of values) for PM_{2.5}, SO₂, or NO_x, bears the burden of proving by a preponderance of the

⁴ Findings of Fact, Conclusions, Recommendation and Memorandum, Docket E-999/CI-93-583 (Mar. 22, 1996) at ¶ 52 (“ALJ Findings”); Order Establishing Environmental Cost Values, Docket No. E-999/CI-93-583 (Jan. 3, 1997) at 17 (“January 3, 1997 Order”).

⁵ ALJ Findings at ¶ 54.

⁶ *Id.* at ¶ 55.

⁷ Order Regarding Burdens of Proof, Docket No. E-999/CI-14-643, OAH Docket No. 80-2500-31888, (Mar. 27, 2015) at 2 (“Order on Burden of Proof”).

⁸ *In re Quantification of Env't'l Costs*, 578 N.W.2d 794, 801 (Minn. Ct. App. 1998).

⁹ Minn. R. 1400.7300, subp. 5 (“party proposing that certain action be taken must prove the facts at issue by a preponderance of the evidence”).

evidence that the value or values proposed are reasonable and the best available measure.¹⁰ The preponderance of the evidence standard is satisfied by proof that leads the finder of fact to find the existence of the contested fact or issue is more probable than not.¹¹ If evidence of a fact or issue is equally balanced, then the fact or issue has not been established by a preponderance of the evidence.¹² A party opposing a value or range of values must demonstrate, at a minimum, that the evidence offered in support of the value or values has not satisfied the preponderance of the evidence standard.¹³ In this proceeding, the proponents of the adoption of environmental cost values for PM_{2.5}, SO₂, and NO_x must present evidence which makes it more probable than not that their proposed value is the most accurate and reliable value available. The Agencies and CEOs have not satisfied that burden.

IV. ARGUMENT

The environmental cost values adopted by Dr. Williams Desvousges are supported by a preponderance of the evidence. First, the CAMx model relied upon by Dr. Desvousges is a state-of-the-art model, which relies on detailed and accurate inputs for the transportation and chemical interaction of pollutants, is publicly available, has been thoroughly vetted through the peer-review process, and has been approved for air quality modeling by the EPA. In contrast, the reduced form models used by Dr. Marshall and Dr. Muller generate less detailed and accurate modeling of the pollutants in question, are relatively untested, and do not satisfy EPA standards. Second, the geographical scope of damages used by Dr. Desvousges is more consistent with the Commission's precedent than those used by Dr. Marshall or Dr. Muller. Third, Dr. Desvousges used a figure for the concentration response of mortality rates to PM_{2.5} exposure that more

¹⁰ Order on Burden of Proof, *supra* note 7, at 2.

¹¹ *City of Lake Elmo v. Metro. Council*, 685 N.W.2d 1, 4 (Minn. 2004).

¹² *Id.*

¹³ *Id.* at 3, 6.

accurately reflects current literature. Fourth, Dr. Desvousges used a VSL that more accurately reflects up to date literature than the single outdated study relied upon by Dr. Marshall and Dr. Muller.

A. The Commission should Adopt Values based on CAMx

The Commission should adopt the values derived by Dr. Desvousges from the CAMx model. It is undisputed that the CAMx model more accurately models the dispersion and chemical interaction of the pollutants involved in this proceeding. Moreover, CAMx, unlike InMAP and AP2 complies with EPA guidelines. Although Drs. Marshall and Muller assert that CAMx is too computationally intensive and expensive to be used for the establishment of Minnesota's environmental cost values, this position does not stand up to scrutiny as the necessary modelling has already been completed at no cost to the Commission.

i. As a Comprehensive Model, CAMx is More Accurate than AP2 and InMAP

The values offered by the CEOs and the Agencies in this matter are both based on reduced-form models – InMAP and AP2. As Dr. Marshall acknowledges, “reduced form” models attempt to “include only the atmospheric processes that are most important for answering the question at hand and often rely on the output of more complex models.”¹⁴ Therefore, as Dr. Marshall also acknowledges, “reduced form models are often more practical to run than comprehensive models, but may be less accurate.”¹⁵ Comprehensive models, on the other hand “attempt to include everything that is known about the atmosphere in order to make predictions of the impacts of air pollution remissions.”¹⁶ Accordingly, “[t]hese models are considered the

¹⁴ Ex. 115 at 6:9-11 (Marshall Direct).

¹⁵ *Id.* at 6:11-12.

¹⁶ *Id.* at 6:4-6.

most accurate predictors of atmospheric change”¹⁷ *Id.* Dr. Muller similarly noted that the appeal of comprehensive modelling (process or photochemical modelling) is clear, because it reflects the “full complexity associated with a particular context, application, or setting.”¹⁸ AP2 and InMAP are substantially less detailed and accurate than CAMx.

1. Transportation of Emissions

AP2 and InMAP both use massively simplified air dispersion modeling.¹⁹ Specifically, the AP2 model relies on annual average wind speed and direction data, and assumes the instantaneous transportation of emissions from the source to the receptor.²⁰ Like AP2, InMAP also uses annual average meteorological data.²¹ By failing to account for temporal variations in its modeling, AP2 and InMAP will tend to cause overestimations of PM_{2.5} in some areas, and underestimations in other areas. In contrast, CAMx models the emission and transportation of emissions using hourly plume rise and meteorological conditions.²² Accordingly, CAMx more accurately models the transportation of pollutants than AP2 or InMAP.

2. Chemical Transformation Assumptions

AP2 and InMAP make assumptions regarding the location and concentration of emissions which render their chemical transformation calculations unreliable. Specifically, AP2 models the emission of a single ton of each pollutant in isolation. As Dr. Desvousges points out, “modeling a single ton of one pollutant in isolation is not realistic as the other emissions present

¹⁷ *Id.* at 6:6-7.

¹⁸ Ex. 808 at 8:24-9:1 (Muller Direct).

¹⁹ Ex. 605 at 19 (Desvousges Rebuttal)

²⁰ *Id.* at 19:18-22.

²¹ *Id.* at 20:1-3.

²² Ex. 605 at 5:8-10, 20:11-14, 22:16-19 (Desvousges Rebuttal).

will affect the chemistry within the point source plume.”²³ Specifically, modeling pollutants in isolation of one another will overestimate PM_{2.5} impacts from SO₂ emissions.²⁴

InMAP models changes in ambient air concentrations from power plants as an area source. Specifically, InMAP assumes that the emissions for a given county are spread throughout the entire county.²⁵ However, such treatment has a significant impact on the reliability of Dr. Marshall’s results, because “fossil-fired EGUs are not area sources but point sources whose transport, dispersion and chemistry behave very differently from an area source.”²⁶ Specifically, the emissions in a point source plume are more concentrated than the emissions spread across a larger area. Therefore, the chemistry in the point source plume is very different from that in an area source. The high NO_x concentrations in a point source plume will inhibit ozone and secondary PM_{2.5} formation until the plume is dispersed.²⁷ Accordingly, by modelling point sources as area sources, InMAP overstate ozone and PM_{2.5} impacts, leading to inaccurate results.²⁸ CAMx, in contrast, models emissions from an entire unit, which allows for more accurate estimate of the dispersion and chemical interaction of PM_{2.5}, NO_x, and SO₂.²⁹

ii. CAMx Complies with EPA Guidelines for Air Quality Modeling and has been the Subject of Hundreds of Peer-Reviewed Articles.

Additionally, neither InMAP nor AP2 complies with EPA modeling guidelines. In July 2015, EPA proposed revisions to their air quality modeling guidelines.³⁰ The new guidelines recommend that a comprehensive model, such as CAMx, be used when estimating the modeling

²³ *Id.* at 38:1-4.

²⁴ *Id.* at 38:12-13.

²⁵ *Id.* at 63:17-19.

²⁶ *Id.* at 63:19-21.

²⁷ *Id.* at 64:7-9.

²⁸ *Id.* at 64:14-18.

²⁹ *See id.* at 40:9-15.

³⁰ *Id.* at 2:24-3:11.

of ozone and secondary PM_{2.5} concentrations.³¹ InMAP and AP2 are not comprehensive models. Additionally, AP2 fails to comply with EPA guidelines for the additional reason that the current EPA modeling guidelines, adopted in 2005, state a steady-state Gaussian plume model, such as AP2, is appropriate for use when modeling impacts from a source to receptors located up to 50 kilometers away.³² Dr. Muller, however, has used AP2 to model impacts nationally, far beyond the recommended 50 kilometer limit for such a model.

In addition, the AP2 and InMAP models are both largely untested. AP2 was developed between 2009 and 2010, with periodic updates, and only just underwent peer review. InMAP is even newer, and appears to have been the subject of a single peer-reviewed article. In contrast, CAM, which is publicly available, has been the subject of hundreds of journal articles and has been used in numerous EPA rulemakings.³³

While Otter Tail understands Minnesota's regulatory needs and processes can differ from the EPA's, in this instance the Commission should give serious weight to EPA guidelines given that Agency's extensive experience evaluating and using air quality models. The EPA first provided its Guideline on Air Quality Models in 1978 and it has continued to evaluate such models and update its recommendations since then, including the proposed revision published last July.³⁴ Given the choice between two models that fail to comply with EPA guidelines for air quality modeling and one that does comply with those guidelines, the choice is easy. The Commission should choose the model that complies with EPA guidelines unless there are compelling reasons to do otherwise, which is not the case in this matter. Similarly, rather than

³¹ *Id.*

³² *Id.* at 21:7-22:4.

³³ *Id.* at 18:7-15.

³⁴ Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter, 80 Fed. Reg 45,340, 45,341 (proposed July 29, 2015) (to be codified at 40 CRF Part 51).

adopt values calculated by less sophisticated models which are relatively untested in the scientific community, the Commission should adopt values calculated using a model that is recognized and accepted for its accuracy.

iii. County by County Values are Unnecessary and Provide False Precision.

Dr. Muller and Dr. Marshall do not deny that CAMx, as a comprehensive model, is more accurate than the reduced form models that they employ to estimate their results.³⁵ They argue, however, that the use of a reduced form model is required to generate county-by-county values, and to permit additional model runs if future questions arise. However, the record shows that county-by-county values provide false precision, rather than increased accuracy. Moreover, the use of county-by-county values is generally unnecessary in resource planning.

First, the use of county-by-county values “gives the false illusion of precision and accuracy when the opposite is in fact true . . .”³⁶ As Dr. Desvousges noted, the process to develop externality values is “inherently uncertain,” and depends in large part on the accuracy of the models.³⁷ Drs. Muller and Marshall have relied on models that even they admit are less accurate and reliable than CAMx. This uncertainty is compounded by uncertainty and subjectivity in other modeling parameters used by Drs. Muller and Marshall, such as the concentration response used to determine PM_{2.5} mortality rates and the VSL used to monetize these rates. The county-by-county results of these less accurate and largely untested models are not sufficiently reliable for use in setting Minnesota environmental cost values, as demonstrated by anomalies in the results from AP2 and InMAP. For example, Dr. Muller’s modelling of a source in Sherburne County (the home of Xcel Energy’s Sherco coal generation plants) predicted

³⁵ Ex. 115 at 6:1-13 (Marshall Direct) (noting that comprehensive models are considered the most accurate predictors of atmospheric change), Ex. 808 at 8:20-9:1.

³⁶ Ex. 605 at 26:8-9 (Desvousges Rebuttal).

³⁷ *Id.* at 26:13-16.

no increase in PM_{2.5} in that county or two of the bordering counties, which is contrary to both common sense and the results obtained by Dr. Desvousges using the CAMx model.³⁸ Dr. Marshall's results from the InMAP model do not match either those obtained using the more accurate CAMx model or Dr. Muller's AP2 results.³⁹ The Commission ordered this proceeding to incorporate improved scientific knowledge.⁴⁰ It would be counterproductive and contrary to the Commission's directive to rely on a less accurate model simply to generate unreliable values on a county-by-county basis.

Second, resource planning does not require the use of county-by-county values. As Dr. Rosvold testified, "[t]he resource planning process examines the long-term customer needs projected over the next 15 years and develops a plan for a utility to meet those needs."⁴¹ "Specific locations of proposed new resources are usually not part of the resource planning analysis or resulting plan."⁴² "Project and locational specifics for new resources are not generally used in the resource planning process because specific resource locations require consideration of access to transmission facilities capable of bringing the new generation to our customers, proximity to existing gas pipeline, where needed, and project specific detailed costs to build and operate a facility in a specific location."⁴³

A review of recent resource plans filed by Otter Tail Power confirms this observation. For example, in its 2013 Resource Plan, Otter Tail Power evaluated several resource options. Out of six new natural gas resources considered, only one of these, which involved a conversion of existing coal generation to gas generation, was location-specific. All other new

³⁸ *Id.* at 7:20-26.

³⁹ *Id.* at 66:22-24.

⁴⁰ *See* Order Reopening Investigation and Convening Stakeholder Group to Provide Recommendations for Contested Case Proceeding, Docket No. E-999/CI-00-1636 (Feb. 10, 2014) at 2, 5.

⁴¹ Ex. 607 at 25:18-20 (Rosvold Rebuttal).

⁴² *Id.* at 25:23-25.

⁴³ *Id.* at 26:13-18.

resources considered were generic.⁴⁴ Similarly, Minnesota Power's 2015 Integrated Resource Plan proposes to meet Minnesota Power's needs through ownership of a portion of a new natural gas combined cycle plan. The location of the unit is not specified.⁴⁵ Because the vast majority of resources considered in the resource planning process cannot be evaluated in a specific location, the rationale offered by Drs. Marshall and Muller for the use of a less reliable model than CAMx lacks merit.

Dr. Marshall argues that "if future questions arise, costs of running additional CAMx simulations by be prohibitively expensive; for reduced-form models, there is a better chance that future questions will be answered"⁴⁶ However, Dr. Marshall does not identify under what circumstances additional CAMx runs might be needed, and the use of environmental cost values in Minnesota for the last 19 years indicates that none will be. The values proposed by Dr. Desvousges and adopted by the Commission in the last proceeding have not been the subject of additional model runs. Rather, they have been adjusted for inflation on a periodic basis by using the Gross National Product Price Deflator Index.⁴⁷ To reject an accurate, well-accepted model on the highly speculative basis that future model runs might be needed one day would be nonsensical. Instead, the Commission should adopt Dr. Desvousges recommended ranges as Minnesota's environmental cost values.

⁴⁴ See Application for Resource Plan Approval 2014-2018, Docket No. E017/RP-13-961 (Dec. 2, 2013) at 11 of PDF.

⁴⁵ See Minnesota Power 2015 Resource Plan Petition for Approval, Docket No. E015/RP-15-690 (Sept. 23, 2015) at 62.

⁴⁶ Ex. 116 at 10:3-6 (Marshall Rebuttal).

⁴⁷ Order Updating Externality Values and Authorizing Comment Periods on CO₂, PM_{2.5}, and Application of Externality Values to Power Purchases, Docket No. E-999/CI-00-1636 (May 3, 2001) at 3-4, 12. The values have been updated regularly since that time, most recently on May 27, 2015. See Notice of Updated Environmental Externality Values, Docket No. E-999/CI-00-1636 (May 27, 2015) at 1.

B. The Commission should Adopt Values based on Minnesota Damages

The Commission should adopt Dr. Desvousges's values for the additional reason that Dr. Desvousges measured damages in an area confined to Minnesota, plus 100 miles from Minnesota's borders. Drs. Marshall and Muller, however, measured damages across the continental United States. Commission precedent supports a focus on Minnesota damages, and the national damages figures provided by Drs. Marshall and Muller are not sufficiently accurate to be of value.

In the prior proceeding, the Commission agreed that the focus should be on damages in Minnesota. It stated "the Commission has quantified the costs of environmental damage occurring in Minnesota. This is consistent with the approach recommended by the Department and found reasonable by the Commission that the Commission focus on the effects of by-products that cause the most significant costs. With respect to CO₂, this means assessing damage globally; for all other pollutants for which damages are established in this Order, it means quantifying the damage they cause in Minnesota."⁴⁸

The CEOs and Agencies may claim that the "significant cost" language suggests nationwide damages should be used in this proceeding because their experts have opined that Minnesota emissions cause significant damage outside of Minnesota. As a preliminary matter, the EPA already regulates interstate pollution through the Cross-State Air Pollution Rule and has concluded differently. Putting that aside, the damages figures offered by Drs. Muller and Marshall are not reliable. As noted above, the models used to calculate such the atmospheric concentration upon which the nationwide damages are based are largely untested and are not as accurate as CAMx.

⁴⁸ January 3, 1997 Order, *supra* note 4, at 15.

The problems with the reduced form models are compounded when they are used to model the entire continental United States. As Dr. Desvousges explained, the uncertainty increases the farther one extends the geographic application of a model.⁴⁹ Moreover, the use of national damages is particularly problematic as applied to AP2. AP2 relies on a steady-state Gaussian plume to model changes in concentrations of air pollutants.⁵⁰ EPA air quality modeling guidelines state that the use of a steady state Gaussian plume is appropriate to use only for sources up to 50km away from the receptors in question.⁵¹ As Dr. Desvousges points out, “[t]he use of the AP2 model to simulate dispersed emissions nationally, as Dr. Muller’s modeling exercise has done, goes far beyond EPA’s recommended use of this type of model and calls into question the validity of the resulting ambient concentration estimates, which serve as the basis of [Muller’s] proposed values.”⁵² The Commission should keep with past practice and limit itself to Minnesota damages. Given the EPA’s role, there is no need for the Commission to wade into interstate pollution, and the non-Minnesota damages offered by the CEOs and Agencies are not credible.

C. Dr. Desvousges Concentration Response is Up to Date and Accurate

Additionally, the concentration response used by Dr. Desvousges to estimate the likely impact on mortality of increases in PM_{2.5} concentrations is more appropriate for adoption by the Commission than those adopted by Drs. Marshall or Muller.

Dr. Marshall used two cohort studies for the mortality impacts of PM_{2.5}; a study by LePeule et al, which found that mortality rates increased by 14% for every 10 µg/m³ increase in annual average PM_{2.5} concentrations, and an American Cancer Society study by Krewski et al.

⁴⁹ Ex. 605 at 22:19-20 (Desvousges Rebuttal).

⁵⁰ See *id.* at 21:9-12.

⁵¹ *Id.* at 21:13-24

⁵² *Id.* at 21:21-22:1.

that found a 7.8% increase in mortality rate for every 10 µg/m³ PM_{2.5} increase.⁵³ Dr. Marshall used these two studies to represent the ends of a range of likely impact values. Dr. Muller used the same studies to obtain his concentration response.⁵⁴ Unlike Drs. Marshall and Muller, Dr. Desvousges used the LePeule study and a more recent paper on the American Cancer Society cohort, but also included a meta-analysis by Hoek et al.⁵⁵

The LePeule article which forms the basis of Dr. Muller and Dr. Marshall's values contains significant variability, and arrives at a significantly higher value than that reached by the Hoek study. However, neither Dr. Marshall nor Dr. Muller incorporated the Hoek study into their results, nor did they account for the Hoek study in any way. Accordingly, Dr. Marshall and Dr. Muller have ignored a significant portion of the literature in favor a single study which arrives at a significantly higher value than that contained in the meta-analysis used by Dr. Desvousges.

With respect to Dr. Muller's analysis, the use of such a wide range to represent the appropriate concentration response has an additional drawback. Dr. Muller's analysis exacerbates the uncertainty by combining a high concentration response with a high VSL. As Dr. Desvousges testified, by combining the low values for each parameter, Dr. Muller's approach has the effect of "exacerbating the uncertainty surrounding the externality values" and Dr. Muller has provided a range for which the upper and lower quartiles are unlikely to occur.⁵⁶

⁵³ See Ex. 115 at 22:1-7 (Marshall Direct).

⁵⁴ See Ex. 808 at 39:15-19 (Muller Direct).

⁵⁵ Ex. 604 at 22:8-12, notes 10, 12 (Desvousges Direct), Ex. 605 at 49:8-16, 74:3-20 (Desvousges Rebuttal); Ex. 608 at 47:12-51:11 (Desvousges Surrebuttal).

⁵⁶ Ex. 605 at 50:10-16 (Desvousges Rebuttal).

D. Dr. Desvousges VSL is Up to Date and Accurate

A significant driver of the values used is the value of a statistical life. A VSL is an attempt to measure the monetary value that people place on risk to their life of well-being.⁵⁷ The VSL relied upon by Dr. Desvousges is significantly more up-to-date and reliable than those relied upon by Drs. Marshall and Muller.

Dr. Marshall's values are based on a VSL of \$9.8 million (\$2015).⁵⁸ This value is based on a value prepared by the EPA's scientific advisory board.⁵⁹ Dr. Marshall explains that this is the result of 26 labor market and contingent valuation studies published between 1974 and 1991, and adjusted to account for changes in currency value and income growth.⁶⁰ Dr. Muller used two VSL values to generate a range of damage estimates. The higher value used by Dr. Muller is based on the EPA's value of \$9.5 million (\$2011).⁶¹ The lower value used by Dr. Muller is derived from a 2006 meta-analysis performed by Kochi et al, which reports a VSL of approximately \$3.7 million.⁶² Dr. Muller also noted that a recent meta-analysis by Viscusi (2015) produced VSL estimates ranging from \$7.2 million to \$10.5 million.⁶³

In his Expert Report, Dr. Desvousges recommended using estimates from a meta-analysis performed by Kochi, Hubbell, and Kramer. This is the most up-to-date of the meta-analyses conducted since the original damage-cost study, and used the Kochi et al value of \$5.6 million as the chief value for the study.⁶⁴ Dr. Desvousges noted that the USEPA's 1999 meta-analysis used only older studies available at the time of the original proceeding, and should not be used. Accordingly, Dr. Desvousges used a distribution with an average or mean VSL of \$5.9 million,

⁵⁷ Ex. 115 at 25:5-6 (Marshall Direct).

⁵⁸ *Id.* at 25:11-14.

⁵⁹ *Id.*

⁶⁰ *Id.*

⁶¹ Ex. 808 at 41:24-42:1 (Muller Direct).

⁶² *Id.* at 42:2-3.

⁶³ *Id.* at 42:11-13.

⁶⁴ Ex. 604, Schedule 2 at 54 (Desvousges Direct).

and 25th and 75th percentiles of \$4.1 million to \$7.9 million. Dr. Desvousges used Monte Carlo analysis to draw a combined distribution from these sources.

Dr. Muller's high value and Dr. Marshall's value are derived from a meta-analysis based on studies available when the initial proceeding was conducted. There have been several new studies since this time that have larger sample sizes, rely on better statistical techniques, and provide a more thorough investigation of alternative model specifications.⁶⁵ Dr. Desvousges's use of a meta-analysis takes appropriate account of these studies, and represents a more up-to-date approach to the VSL analysis.

E. Application to Sources Beyond 200 Miles from Minnesota

The Commission's Order in the 1993 proceeding required environmental cost values for the criteria pollutants to be applied to *sources* within 200 miles of Minnesota. It stated "the Commission finds that the record supports finding in-state damages from a generating plant located up to 200 miles from the state border"⁶⁶ Dr. Marshall, however, has modelled impacts from sources in counties where at least part of the county is within 200 miles of the Minnesota border.⁶⁷

The application of externality values to sources more than 200 miles from the border of Minnesota is inconsistent with the Commission's 1997 Order, and no party has offered any reason why the Commission's 1997 decision to apply externality values to sources only as far as 200 miles from the border of Minnesota should be altered. The 200-mile limit has served Minnesota well by allowing for the application of environmental cost values to the sources most meaningfully impacting Minnesota while preserving inter-state comity by limiting the extent to which Minnesota interferes with neighboring states. Accordingly, if the Commission does adopt

⁶⁵ Ex. 605 at 75:4-13 (Desvousges Rebuttal).

⁶⁶ January 3, 1997 Order, *supra* note 4, at 16.

⁶⁷ Ex. 115 at 17:13-18 (Marshall Direct)

the values proposed by Dr. Marshall, which Otter Tail does not believe is the appropriate course of action for the reasons discussed above, Otter Tail requests that the Commission clarify that externality values apply only to those sources within 200 miles of Minnesota.

V. CONCLUSION

The preponderance of the evidence presented supports the adoption of the values proposed by Dr. Williams Desvousges. Therefore, Otter Tail recommends that the Commission adopt the values proposed by Dr. Desvousges as Minnesota's environmental cost values for PM_{2.5}, SO₂, and NO_x under Minn. Stat. § 216B.2422, subd. 3.

Dated: March 15, 2015

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