



June 10, 2014

Burl W. Haar
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, Minnesota 55101-2147

**RE: Comments of the Minnesota Department of Commerce, Division of Energy Resources and
the Minnesota Pollution Control Agency**
Docket No. E999/CI-00-1636

Dear Dr. Haar:

Attached are the comments of the Minnesota Department of Commerce, Division of Energy Resources and the Minnesota Pollution Control Agency (together, the Agencies) in the following matter:

Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. §216B.2422, subd. 3.

In its February 10, 2014 *Order Reopening Investigation and Convening Stakeholder Group to Provide Recommendations for Contested Case Proceeding*, the Minnesota Public Utilities Commission (Commission) requested that the Agencies convene a stakeholder group to address the scope of the Commission's investigation into updating and expanding the environmental cost values established under Minn. Stat. §216B.2422, subd. 3, and report to the Commission the results of the stakeholder group's conclusions.

The Agencies submit the attached report, and are available to answer any questions that the Commission may have.

Sincerely,

Handwritten signature of William Grant in black ink.

WILLIAM GRANT
Deputy Commissioner
Minnesota Department of Commerce

Handwritten signature of J. David Thornton in black ink.

J. DAVID THORNTON
Assistant Commissioner
Minnesota Pollution Control Agency

WG/JDT/ja
Attachment

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

**COMMENTS OF THE
MINNESOTA DEPARTMENT OF COMMERCE
AND THE MINNESOTA POLLUTION CONTROL AGENCY**

DOCKET No. E999/CI-00-1636

I. INTRODUCTION AND BACKGROUND

The Minnesota Public Utilities Commission (the “Commission”) issued an order on February 10, 2014 to reopen the investigation into environmental and socioeconomic costs associated with electricity generation. In the Order the Commission directed the Minnesota Department of Commerce and the Minnesota Pollution Control Agency (together, the “Agencies”) to oversee the investigation. Specifically, the Order directed the Agencies to:

... convene a stakeholder group to address the scope of the investigation, whether to retain an expert under Minn. Stat §216B.2422, subd. 8, and the possible role of an expert should one be retained.

Furthermore, the Order directed the Agencies to “report the stakeholder group’s conclusions to the Commission” within four months from the date of the Order. The Agencies convened the stakeholder group and conducted additional research into estimating environmental and socioeconomic costs resulting from emissions associated with electricity generation.

This report serves as the joint recommendation of the Agencies to the Commission. The Agencies’ recommendation considers all the input that was provided both at the stakeholder meeting and via written comments, as well as research by the Agencies into the issues of externality costs associated with emissions from electricity generation. This recommendation addresses the Commission’s questions on the scope of the investigation, need for the retention of an expert(s), and role of that expert(s), as well as some suggestions on the possible processes for the investigation.

II. STAKEHOLDER MEETING

As directed by the Commission, the Agencies convened a stakeholder meeting on April 24, 2014 to allow all interested parties to provide input into the scope and process of the investigation. The meeting was organized and facilitated by Management Analysis & Development (MAD), a division of Minnesota Management and Budget. Additionally, all parties were provided the opportunity to submit input in the form of written comments. (Comments offered at the meeting are summarized in Attachment A, which also includes a list of all meeting attendees. A summary of written comments submitted subsequent to the meeting is included in Attachment B.)

At the stakeholder meeting the Agencies presented six different possible process scenarios for how the investigation could proceed. Three of the scenarios were potential processes for estimating externality values for the criteria pollutants identified in the Commission's Order (sulfur dioxide (SO₂), nitrogen oxides (NO_x), and particulate matter with a diameter less than 2.5 microns (PM_{2.5})). Three additional scenarios were potential processes for estimating externality values for carbon dioxide (CO₂), and, potentially, other greenhouse gasses (GHGs). (A full write-up of these scenarios is included in Attachment C.) The scenarios were developed based on extensive research into the peer-reviewed literature on the economics of air emissions as well as consultations with several experts on the economics of air pollution from academia, the United States Environmental Protection Agency (EPA), economic consulting firms and from an energy wholesaler.

In evaluating the process scenarios, the Agencies proposed seven criteria to hold in mind:

1. **Cost:** total cost to complete the analysis, relative to other options
2. **Time to completion:** estimated time to complete the analysis
3. **Complexity:** relative complexity of the analytical methods involved in the scenario
4. **Credibility:** relative degree to which analytical models represent the complexity of the systems being modeled and thus the relative confidence in the accuracy of the estimates they produce
5. **Specificity to Minnesota:** degree to which specific conditions of Minnesota are incorporated into the modeling
6. **Need for outside contractor:** likely need for an outside contractor(s) to conduct the analysis
7. **Update ability:** relative ease with which externality value estimates could be updated in the future

The Agencies identified eight questions for which to solicit stakeholder input; the first five address scope and process for the investigation and the remaining three address the role of an expert consultant(s), should one be retained:

1. Provide comment on the proposed criteria (listed above) for evaluation of the scenarios. Are there other criteria that should be considered?
2. Describe which of the potential process scenarios you support for development of externality values for criteria pollutants. For CO₂?
3. What input do you have on the general scope of this investigation?
4. Should additional greenhouse gasses besides CO₂ be included in the investigation?
5. What other information exists that is critical to informing how the pollutant externality costs are updated?
6. Should an outside contractor(s) (“expert(s)”) be retained to do this work?
7. If an expert(s) is retained what should be their role?
8. If an expert(s) is retained, what are the critical competencies needed for your preferred criteria pollutant scenario? For your preferred CO₂ scenario?

There was little consensus arising out of the stakeholder meeting or in subsequent written comments. The only issues that did garner consensus of all stakeholders were:

1. The criteria that the Agencies developed to assess potential processes are appropriate,
2. The best and most credible estimates for externality values should be developed, and
3. There should be a high degree of transparency in the analyses.

There was no consensus regarding the process(es) to use to conduct the investigation, the scope of the investigation (specifically, whether other GHGs besides CO₂ should be included), whether an expert consultant(s) should be retained to conduct the investigation, and what the role of the consultant(s) would be should one be retained. In spite of this general lack of consensus, the Agencies considered all stakeholder input along with research and expert opinion in crafting this recommendation.

III. SCOPE OF THE INVESTIGATION

The Agencies identified three scope-related issues to address in this recommendation:

1. Whether other GHGs besides CO₂ should be included;
2. Geographic boundaries within which to consider damages from emissions; and
3. Whether non-human health impacts should be considered in estimating damage costs of emissions.

Opinions about each of these three issues were presented by various stakeholders. Although no consensus was reached on any of them, the Agencies offer the following recommendations.

A. *INCLUSION OF OTHER GHGS*

The Agencies recommend that, at this time, other GHGs should not be included in determining environmental and socioeconomic costs of emissions associated with electricity generation. According to the EPA's current National Emissions Inventory data¹ of emissions from power plants in Minnesota, CO₂ represents over 99 percent of all greenhouse gas emissions (measured in CO₂-equivalents); other GHGs account for less than 1 percent.² Including other GHGs would thus have very little impact on the total estimate of external damages associated with GHG emissions. The Agencies note that the initial petition to the Commission by the Clean Energy Organizations to reopen this investigation did not ask for other non-CO₂ GHGs to be included. Though it is possible to assign externality costs to these pollutants using their global warming potential (GWP) carbon dioxide equivalents, the Agencies conclude that the amount of resources needed to review this approach may outweigh the benefits of assigning externality costs to these pollutants.

B. *GEOGRAPHIC ACCOUNTING OF DAMAGES*

The Commission's order explicitly stated that geographic scope of the application of the externality value for CO₂ (i.e., the previous Commission decision to not apply a CO₂ externality value outside of Minnesota) would not be reevaluated at this time. However, a separate geographical-scope issue arose out of stakeholder discussions that the Agencies conclude should be brought to the Commission's attention. The issue is whether estimates of environmental impacts from emissions within Minnesota (and within 200 miles of Minnesota's borders in the case of non-CO₂ emissions) should be limited to damages within Minnesota or whether all damages should be considered in formulating externality value estimates.

For CO₂, it is clear that because CO₂ is a globally-mixed pollutant, and thus CO₂ emissions in Minnesota have impacts throughout the world (and conversely, CO₂ emissions throughout the world have impacts in Minnesota), total global damages should be considered in assessing CO₂ externality values. When the Commission initially opted to assign an externality value to CO₂ emissions associated with Minnesota electric generators, the value was based on global impacts and damages. The Agencies also note that all the work that we are aware of being done elsewhere to estimate the costs of CO₂ emissions considers global damages.

¹ U.S. Environmental Protection Agency, The National Emissions Inventory, 2013. *2008 National Emissions Inventory Data* [online]. Available: <http://www.epa.gov/ttn/chief/net/2008inventory.html>.

² The estimate that CO₂ represents over 99 percent of all greenhouse gas emissions from power plants in Minnesota is based on the current fuel mix. Should the current fuel mix change significantly in the future, the contribution of other GHGs may change, at which point it may be reasonable to reassess whether to consider non-CO₂ greenhouse gas emissions.

Criteria pollutant (SO₂, NO_x, PM_{2.5}) emissions, however, have local and regional effects. Most (but not all) of the impacts of emissions of these pollutants in Minnesota will occur in Minnesota. Emissions of criteria pollutants within Minnesota have some impacts in neighboring states, particularly those generally downwind from us, to the east and southeast. Similarly, emissions in states that border us will have impacts within Minnesota. This was the reason the Commission originally established that externality values would be applied to criteria pollutants emitted from electric generators located not just within Minnesota but within 200 miles of the state's borders. Given this reasoning, the Agencies recommend that in estimating externality costs for criteria pollutant emissions from Minnesota electric generators, all damages should be considered, not just those within Minnesota.

C. CONSIDERATION OF NON-HUMAN HEALTH IMPACTS

Assessing the impacts of CO₂ (and other GHGs) generally includes all impacts to human welfare, not just to health. The majority (in monetary terms) of impacts of criteria pollutants, however, are human health impacts. Thus, most work currently being done to assess damages of criteria pollutants consider only human health impacts. There are nonetheless other human-welfare impacts of these pollutants, including building materials damage, crop damage, visibility impairment, and ecosystems damage, which can impact the provision of ecosystem services that people use and value. These non-health impacts are generally more difficult to quantifiably link to emissions and to translate into monetary terms. A few stakeholders stated their belief that these other non-health impacts should be considered in estimating externality values associated with emissions from electric generators.

At this point, the Agencies will not make a specific recommendation on whether non-health impacts should be taken into consideration. The Agencies know of no reliable and accurate methods to assess these impacts in dollars per ton of emissions from Minnesota electric generators. Whether these impacts can be accurately quantified and monetized depends on whether whoever ultimately does the analysis to estimate these values (see discussion below) has credible and defensible methods for doing so. Again, while deferring this recommendation on non-health impacts, the Agencies reiterate that the majority of impacts from criteria pollutant emissions are to human health.

IV. PROCESS RECOMMENDATIONS FOR CRITERIA POLLUTANTS EXTERNALITY VALUES

A. RECOMMENDATION: APPLY PHOTOCHEMICAL MODELING PROCESS TO ESTIMATE AIR QUALITY IMPACTS OF ELECTRIC POWER PLANT EMISSIONS, FOLLOWED BY HEALTH IMPACT MODELING AND ECONOMIC VALUATION

The Commission's Order determined that the externality values for the criteria pollutants – SO₂, NO_x and PM_{2.5} – should be investigated. According to economic literature and the experts consulted by the Agencies, the best approach to estimating the external costs of

criteria pollutant emissions is a *marginal damage cost* approach. The marginal damage cost of pollution emissions is the social cost (in terms of health and environmental damages) of emitting one more increment of the pollutant given the current conditions (including current air quality, as well as other factors that affect damages such as population density and population distribution). Because the damages from these emissions are borne by society as a whole and not by the specific producers or consumers of electricity, marginal damage costs are essentially equivalent to externality values in this context.

The marginal damage cost of a ton of an emitted pollutant can change as conditions change. As the scientific understanding of the impacts of emissions change as well as the modelling tools to estimate these impacts advance, the estimates of marginal damage costs can change. This, in fact, is the basic rationale underlying the Commission's decision to reinvestigate these externality costs.

There are a variety of modelling tools that may be employed to estimate marginal damage costs of emissions from power plants in Minnesota. There are essentially three steps to the process of estimating the marginal damage cost of an increment of a pollutant emitted from a Minnesota electric generator:

- 1) ***Link emission to air quality change***: model the resulting change in air quality resulting from the incremental emission of a pollutant spatially across the entire area where that emission has an impact.
- 2) ***Link air quality change to impacts***: model the resulting change in health impacts (and potentially non-human health impacts as well) spatially across the entire area where there is an air quality change.
- 3) ***Estimate monetary value of impacts***: translate these changes in health impacts (and potentially other non-human health impacts) into monetary values. The sum of these values will be the marginal damage cost of the incremental emission.

The Agencies identified three process scenarios to estimate marginal damage costs for the criteria pollutants in question: 1) photochemical modeling; 2) reduced form modeling; or 3) application of existing marginal damage cost estimates. The Agencies described each of these scenarios to the stakeholders and assessed them according to the seven criteria listed above. (See Attachment C for a write-up of these scenarios.) The photochemical modeling approach takes each of the three process steps listed above separately while the other two approaches are likely to combine the steps into a single modeling step.

As stated above, there was not agreement among the stakeholders as to which of these scenarios (if any) should be pursued. If there was agreement to be gleaned from the stakeholders' comments it would be that the most credible results should be produced as long as the costs to produce them are not exorbitant nor would the time to generate them

be unreasonably lengthy. The Agencies conclude that the best way to achieve this goal is via a photochemical modeling approach. However, if the photochemical modeling approach proves to extend the process beyond the decision time frame or beyond budgetary constraints, the reduced form approach would be next best method and could also produce credible externality value estimates for each of the criteria pollutants in question.

B. PHOTOCHEMICAL MODELING STEPS

Given the Agencies' existing resources and current expertise, the photochemical modeling approach would necessitate the retention of an expert consultant (see below). While the exact methodology would in large part depend upon the consultants' recommendation, a possible approach could be to do the following for each pollutant (SO₂, NO_x, PM_{2.5}) under consideration:

Step 1: Link emission to air quality change

- Zero out all emissions of the pollutant from all electric generators in Minnesota urban counties.
- Run the photochemical model to determine air quality (ambient concentrations of PM_{2.5} and ground level ozone) across the state of Minnesota to get a "control" air quality surface that can then be compared to the "baseline" air quality surface had emissions of the pollutant not been zeroed out.

Step 2: Link air quality change to impacts

- Use a separate modelling framework, such as EPA's Environmental Benefits Mapping and Analysis Program (BenMAP) that can estimate the difference in health impacts between the "baseline" and "control" air quality scenarios. BenMAP has been applied in multiple regulatory contexts to estimate the health impacts from air quality changes, including by the EPA in its regulatory impact analyses. Note that there are several different health impact functions from the epidemiological literature that can be used in this process. The Agencies would direct the consultant(s) to select the functions that are the most credible and appropriate for Minnesota, and to be prepared to defend those choices in a contested case proceeding.
- Include non-health impacts if whoever is conducting the analysis has reliable and accurate methods and models to do so.

Step 3: Estimate monetary value of impacts

- Translate the estimated change in impacts between the "baseline" and "control" air quality scenarios into an estimated economic value using the most credible economic valuation functions from the economic literature (again, the Agencies would direct the consultant(s) to choose the most credible functions that are also most applicable to Minnesota). Summing

the values of the individual health outcomes would yield a total economic health impact value that would represent the total externality cost of all emissions of the pollutant under consideration from Minnesota electric generators in urban areas.

- To determine the per-ton externality value for the pollutant from urban area electric generators, divide the total externality costs by the total number of tons of the pollutant emitted from Minnesota urban area electric generators (i.e., the amount of emissions that were “zeroed out” in Step 1) to get a per-ton externality cost for the pollutant being considered.

Existing externality values for criteria pollutant emissions from Minnesota electric generators, originally established in 1997, include separate values for emissions in urban areas of Minnesota, metropolitan fringe areas, and rural areas. Areas outside the state within 200 miles of Minnesota were assigned the same values for criteria pollutant emissions as rural areas within the state. The above steps estimate externality values for all electric generator emissions in Minnesota’s urban areas. These steps could be repeated to estimate externality values for electric power plants in Minnesota’s metropolitan fringe and rural areas. Again, the intent here is to provide a rough generalization of how the process could work; it will likely be expanded and refined by whoever conducts the analysis.

C. AGENCIES’ EVALUATION OF THE PHOTOCHEMICAL MODELING APPROACH

The Agencies evaluated the photochemical modeling approach using the evaluation criteria that were generally agreed to by stakeholders. This evaluation is listed by each criterion below.

1. **Analysis Cost:** Photochemical modeling is a computationally intensive process and would require the retention of an external consultant(s). Therefore, relative to other options, the cost of photochemical modeling is high.
2. **Time to Completion:** Again, because photochemical modeling involves complex modeling processes, the time to completion is high relative to other options, likely in the range of one year from the decision to pursue the approach.
3. **Complexity:** Photochemical modeling involves complex and computationally-intensive analyses and therefore exhibits a relatively high degree of complexity.
4. **Credibility:** Photochemical modeling would produce the most credible externality value estimates, relative to the other options.
5. **Specificity to Minnesota:** Because photochemical modeling uses the exact local conditions (e.g., meteorology and atmospheric dynamics) to model the impacts of emissions on air quality, this approach has the highest specificity to Minnesota. Additionally, in health impact modeling, specific Minnesota

conditions (e.g., population densities and distributions) will also be integral to the modeling process.

6. **Need for outside contractor:** Given the complexity of the photochemical modeling process along with current resources and expertise of the Agencies, an outside contractor(s) will be necessary.
7. **Update Ability:** Given the complexity of the photochemical modeling process, rerunning the models to get new estimates as conditions change may require high effort. However, there may be simplifying assumptions that would render future updates of the externality estimates more tenable.

D. ADDITIONAL CONSIDERATIONS AND RECOMMENDATIONS

The Agencies see the photochemical modeling approach as being the best to generate the most credible estimates that are specific to current Minnesota conditions, and could be derived in a reasonable amount of time and at a reasonable cost. Given state contracting rules that preclude the Agencies from soliciting cost estimates from potential contractors at this stage, the Agencies cannot provide a specific estimate of cost or time frame at this point. The other two options could be considered should the Commission conclude that costs and/or time constraint criteria outweigh the credibility criterion.

The Agencies expect that there may be other issues to resolve as the process proceeds. For example, some stakeholders expressed the hope that they would be able to replicate the analysis done by a potential consultant(s). Given the complexity of these models, the Agencies cannot guarantee easy replicability of the analysis. However, it would be incumbent upon whoever may do the analysis to provide as much transparency as possible, including full documentation along with input and output files, during the contested case process. Another issue stakeholders would like addressed is how best to update these externality values in the future as conditions change without having to repeat the whole process. The Agencies conclude that transparency and updatability issues can be further developed, and potentially addressed as the investigation proceeds.

V. PROCESS RECOMMENDATIONS FOR CARBON DIOXIDE (CO₂) EXTERNALITY VALUES

A. RECOMMENDATION: ADOPT THE FEDERAL SOCIAL COST OF CARBON MIDPOINT VALUES FOR CO₂

Since the December 2013 Commission meeting, the Agencies have reviewed literature and application of existing CO₂ externality values, including the social cost of carbon (SCC) developed by the federal government. Through this review, together with the input from the stakeholder meeting, the Agencies recommend that the Commission adopt the federal government's SCC. Specifically, the Agencies recommend that the Commission adopt the

central 3% discount factor values as the Commission's CO₂ externality value (see section V.B.iii. *Discount Factor Selection* for more information on the discount factors). As is more fully discussed below, the Agencies do not believe it is in the best interests of ratepayers for the Commission to conduct a contested case proceeding to develop a new CO₂ externality damage value(s) when federal agencies have already developed and use a set of CO₂ values. It should be noted that the SCC is not a new concept; it has been used for decades in the climate change literature. For reasons expanded upon below, the Agencies recommend the use of the SCC developed by the federal government (hereafter, simply the "SCC").

The following sections provide an overview of the SCC and the Agencies' rationale in recommending it for assigning externality values to CO₂ emissions.

B. OVERVIEW OF THE SOCIAL COST OF CARBON (SCC)

The SCC values were developed by a federal interagency working group, and the values are used in federal rulemakings to estimate climate benefits of carbon emission reduction efforts.

The EPA's website describes the SCC as follows:

The SCC is meant to be a comprehensive estimate of climate change damages and includes, but is not limited to, changes in net agricultural productivity, human health, and property damages from increased flood risk. However, given current modeling and data limitations, it does not include all important damages. As noted by the [Intergovernmental Panel on Climate Change] IPCC Fourth Assessment Report, it is "very likely that [SCC] underestimates" the damages. The models used to develop SCC estimates, known as integrated assessment models, do not currently include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature because of a lack of precise information on the nature of damages and because the science incorporated into these models naturally lags behind the most recent research. Nonetheless, the SCC is a useful measure to assess the benefits of CO₂ reductions.³

The values for the SCC estimated at a point in time also estimate damages of future emissions to account for the expected increases in damages due to higher concentrations of CO₂ in the atmosphere. For example, under the central 3% discount factor values, a metric

³ U.S. Interagency Working Group on Social Cost of Carbon (2013). *Social Cost of Carbon*. <http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>.

ton of CO₂ emitted in 2014 has a social cost of \$37 in 2007 dollars, and a metric ton emitted in 2038 (25 years later) is valued at \$60 (in 2007 dollars).

i. Development Process

The SCC values were developed through a number of federal agency actions. A federal interagency working group was convened by the Council of Economic Advisers and the Office of Management and Budget in 2009-2010 to design an SCC modeling exercise and develop estimates for use in rulemakings. The interagency group was comprised of scientific and economic experts from various federal agencies. The EPA and Department of Energy hosted a series of workshops in 2010 and 2011 to inform the federal SCC. Information from these workshops has been available on the EPA's website since 2010.

The federal government committed to updating the SCC values as climate science is updated. In May 2013, the interagency group released revised federal SCC values. The May 2013 estimates reflect values that are similar to those used by other national governments, international institutions, and major corporations. Those estimates have been available for public comment in several proposed rulemakings since May of 2013, and the federal agencies have already received comments that are under review.

The federal Office of Management and Budget held a three-month public comment period on the federal SCC that ended February 26, 2014. It is expected that the federal agencies involved in the development of the SCC will issue a response to the public comments received some time this year.

ii. Climate Integrated Assessment Models

The federal interagency work group relied on three integrated assessment models that are commonly used to estimate the SCC. These models are frequently cited in the peer-reviewed literature and used in the IPCC assessment. These models are useful because they combine climate processes, economic growth, and feedbacks between the climate and the global economy into a single modeling framework.⁴

Each model takes a slightly different approach to predict how changes in emissions result in changes in economic damages. In the Policy Analysis of the Greenhouse Effect (PAGE) model, for example, the damages in each period are calculated as a fraction of gross domestic product, depending on the temperature in that period relative to the preindustrial average temperature in each region. In the Climate Framework for Uncertainty, Negotiation and Distribution (FUND) model, damages in each period also depend on the rate of temperature change from the prior period. In the Dynamic Integrated Climate-Economy (DICE) model, temperature affects both consumption and investment. More information on

⁴ U.S. Interagency Working Group on Social Cost of Carbon (2010). *Social Cost of Carbon Technical Support Document*. <http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf>.

these models can be found in the social cost of carbon's Technical Support Documents (original 2010 and 2013 update).⁵

The SCC values estimate damages of future releases of CO₂ emissions, accounting for the estimated changes in atmospheric concentrations of CO₂ by later dates. As such, CO₂ emissions in future years are assigned higher damage costs than CO₂ emissions in the near term because the marginal addition of later CO₂ emissions is anticipated to increase overall damages at a higher rate than near-term CO₂ emissions.

iii. Discount Factor Selection

The choice of a discount rate, especially over long periods of time, raises a number of questions. The Commission addressed the selection of discount factors/rates in their January 3, 1997 *Order Establishing Environmental Cost Values*:

Discount Rate – Once a damage stream has been estimated, it is necessary to select an appropriate discount factor to adjust the damage stream figures downward to present value. Ciborowski calculated the damage estimates using discount rates of 1, 2, 3, and 5 percent. He proposed a discount rate of approximately 1.5 percent based on a study performed by Cline. Although Cline maintained that low discount rates are appropriate when discounting across generations, the Commission agrees with the ALJ that there is insufficient support for that position in the record. The weight of authority in the record supports a range of at least 3 - 5 percent for reducing future environmental damages to present value. Therefore, the range of CO₂ values adopted in this Order are calculated using 3 percent to calculate the high end figure and 5 percent to calculate the low end figure.⁶

In recognition of the issues surrounding the choice of environmental discount factor, and to account for the variation in values resulting from different discount factors, the SCC interagency working group published SCC values under three discount factor values: 2.5 percent, 3 percent, and 5 percent. The interagency working group also published SCC values which represent the 95th percentile SCC estimate across all three climate models at a 3 percent discount rate; this value is intended to represent higher-than-expected impacts from

⁵ U.S. Interagency Working Group on Social Cost of Carbon (2010). *Social Cost of Carbon Technical Support Document*. <http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf>. U.S. Environmental Protection Agency (updated November, 2013). Social Cost of Carbon Technical Support Document. <http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>

⁶ Docket No. E-999/CI-93-583 (Page 27). http://mn.gov/puc/documents/puc_pdf_orders/004231.pdf.

temperature change further out in the tails of the SCC distribution.⁷ More information on the discount factors used in the SCC values can be found in the federal government interagency working group's original 2010 Technical Support Document.⁸ On the SCC 3% discount factor the Technical Support Document states:

The central [discount] value, 3 percent, is consistent with estimates provided in the economics literature and federal Office of Management and Budget's Circular A-4 guidance for the consumption rate of interest. As previously mentioned, the consumption rate of interest is the correct discounting concept to use when future damages from elevated temperatures are estimated in consumption-equivalent units. Further, 3 percent roughly corresponds to the after-tax riskless interest rate.

For these reasons, the Agencies recommend the 3 percent discount factor social cost of carbon values be used for the CO₂ externality values.

C. AGENCIES' EVALUATION OF THE SOCIAL COST OF CARBON

The Agencies evaluated the SCC using the evaluation criteria that were generally agreed to by stakeholders. The Agencies' analysis of the SCC are listed by criteria below.

1. **Analysis Cost:** Adopting the SCC at this time would not require the hiring of an external expert. Therefore, the cost to adopt the SCC values is minimal to none.
2. **Time to Completion:** The SCC values are already developed, and they will be updated by the federal agencies when updates are warranted.
3. **Complexity:** The SCC numbers use complex integrated assessment models (IAMs) and economic valuation techniques that are run on high capacity computing systems.
4. **Credibility:** The SCC values were developed using reviewed climate models, federal interagency reviews, and a national public comment process.
5. **Specificity to Minnesota:** As CO₂ is a global pollutant, this evaluation criterion is not applicable.

⁷ U.S. Environmental Protection Agency (updated November, 2013). Social Cost of Carbon Technical Support Document. <http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>.

⁸ U.S. Interagency Working Group on Social Cost of Carbon (2010). *Social Cost of Carbon Technical Support Document*. <http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf>. U.S. Environmental Protection Agency (updated November, 2013). Social Cost of Carbon Technical Support Document.

6. **Need for outside contractor:** As the values are already developed an outside contractor(s) is not needed.
7. **Update Ability:** As the federal government updates the SCC values, the Commission can adopt these updates without needing to order another investigation.

In addition to the evaluation criteria above, the Agencies recommend the SCC for the following reasons:

1. When the Commission first investigated CO₂ externality values there were no federal values for this global pollutant; with the SCC there are now federal CO₂ values available. It is not an efficient use of ratepayer funds to hire a consultant to develop a CO₂ externality value when values developed by the federal government exist.
2. Given the literature sources used in the federal government's SCC development, the Agencies cannot foresee a CO₂ externality value development approach that would follow a significantly different approach from the methods used in the SCC development. The Agencies are unaware of any different data sets or computational methods that would yield results different than the federal SCC or that would provide more refined results for an individual state. It is doubtful that any credible expert(s) hired would develop values that are significantly different from the range of values in the SCC.
3. The SCC values were developed under a rigorous process that relied on complex integrated assessment models and the work of many economists. A Minnesota contested case proceeding intended to result in a set of values with the same climate and economic analysis rigor as was brought to bear during the development of the SCC values would be extremely costly, time consuming and duplicative.
4. CO₂ is a global pollutant, and the existing Commission CO₂ value was developed using a global damage estimate approach. Given the global nature of the pollutant, it's unclear why the Commission would chose to develop a new set of potential values in the record when the SCC values were developed to measure global damages.
5. The SCC values are marginal damage externality values that measure externality costs for small changes in global CO₂ emissions. As with the criteria pollutants, the Agencies recommend a marginal damage approach be used to evaluate CO₂ externality costs. The Agencies conclude that the SCC is appropriate for use in resource planning because, as a measure of marginal costs, the SCC is consistent with how costs are evaluated in resource

planning. Resource plan evaluations involve comparing the total costs of a utility's base case plan with other scenarios that meet reliability and other requirements. Plans that minimize total costs, including externality costs, are recommended by the Department of Commerce for Commission approval. As each scenario's costs in relation to the base case plan are evaluated in resource plans, it is methodologically appropriate to evaluate pollution differences with the marginal externality impacts they create at the time the CO₂ is emitted. Again, the Agencies recommend that externality values adopted in this investigation, including the SCC, be marginal damage values.

Based on the criteria evaluation and the reasons listed above, the Agencies recommend that the Commission adopt the SCC developed by the federal government.

D. ALTERNATIVE RECOMMENDATIONS

i. Investigation Scoping Recommendations in Lieu of Adopting the Social Cost of Carbon at This Time

If the Commission does not wish to adopt the SCC at this time the Agencies recommend that the Commission consider ways to streamline the proceeding. A few potential ways to accomplish this are:

1. The Commission could establish a set of required damages (e.g., health, non-health) that parties should include in any CO₂ estimates they propose in the record. The purpose of defining which damages parties should assess and monetize is to avoid using the proceeding to determine which climate change damages are "important" and impact society. The Agencies recommend that the scope of damages include the damages assessed by the integrated assessment models used to develop the SCC.
2. The Commission could specify that any externality values proposed by parties should be damage values, not compliance costs, willingness-to-pay/accept, or other value types. The damage value approach aligns with the existing values and past Commission decisions.
3. The Commission could require that proposed CO₂ value estimates offered by parties to be considered in the investigation must account for global damages. This aligns with the Commission's decision on the original CO₂ externality values, and would allow proposed values to be more easily compared because they have the same scope.
4. The Commission could request that parties propose ways to update their preferred CO₂ value in the future.

ii. Expert Role If Social Cost of Carbon Is Not Adopted at This Time

If the Commission does not approve the SCC at this time, the Agencies strongly recommend an outside consultant(s) be retained to assist the Agencies in evaluating proposed CO₂ values. At this time it's unclear whether one consultant could be retained for both the CO₂ and criteria pollutant investigations, or if different experts would need to be retained.

VI. RETENTION OF EXPERT CONSULTANT AND THEIR ROLE

Based on the above recommendations, the Agencies request that the Commission authorize the Agencies to retain an expert consultant to conduct the analysis of criteria pollutant externality values as well as to provide testimony in the contested case proceeding. As noted above, there was no consensus of opinion among the stakeholders of whether a consultant should be retained, nor of what the consultant's role should be. Some stakeholders expressed concern that any expert hired by the State of Minnesota would be seen as biased, and indicated their intent to retain their own expert consultants to provide their own testimony in the contested case proceeding.

The consultant should demonstrate their expertise and competency to do this work, as well as their independence and impartiality from any of the stakeholders (including the Agencies) involved in this process. The consultant will likely not be a single individual, but rather a firm or agency with a high degree of competency, objectivity and impartiality.

VII. SUMMARY AND CONCLUSION

In summary, the Agencies' recommendations to the Commission regarding the scope of the investigation into environmental and socioeconomic costs under Minn. Stat. §216B.2422, Docket No. E999/CI-00-1636 are as follows:

1. Scope of the Investigation

- Non CO₂ GHGs should not be included in the investigation.
- Consideration of external damages from both CO₂ and criteria pollutants should not be limited to just those damages within Minnesota.
- Whether non-human health impacts of criteria pollutants will be taken into consideration will depend on whether the contractor has credible and accurate methods and models to do so.

2. Process of the Investigation

- For criteria pollutants, a photochemical modeling approach should be taken to determine the most credible externality values for Minnesota electric generator emissions. If a photochemical modeling approach is too costly or

time consuming, then a reduced form modeling approach would be the next best option for estimating criteria pollutant externality values.

- For CO₂, the social cost of carbon values developed by the federal government should be adopted.
- If the Commission declines to determine at this time whether the SCC is appropriate to adopt, then the Agencies recommend the retention of a consultant to assist the Agencies in evaluating CO₂ externality values. Further, the Agencies recommend that the Commission:
 1. establish a set of required damages (e.g., health, non-health) that parties should include in any CO₂ estimates they propose in the record;
 2. specify that any externality values proposed by parties should be damage values, not compliance costs, willingness-to-pay/accept, or other value types;
 3. require that proposed CO₂ value estimates offered by parties to be considered in the investigation must account for global damages; and
 4. request that parties propose ways to update their preferred CO₂ value in the future.

3. Retention of an Expert

- A consultant(s) should be retained to estimate externality values for criteria pollutants. If the Commission decides to adopt the SCC at this stage of the proceeding, then a consultant on CO₂ externality values is not necessary. If the Commission defers its decision on the appropriate CO₂ externality value, the Agencies recommend retention of an expert(s) to assist the Agencies in further building the record on this topic.
- The role of the consultant would be to conduct the analysis as well as provide written testimony for a contested case hearing.

Attachment A: Management Analysis & Development Summary of Stakeholder Comments

Discussion of Scenarios for Investigating Externality Costs from Minnesota Power Plants

Thursday, April 24, 2014
Minnesota Public Utilities Commission Large Hearing Room
121 Seventh Place East, Suite 350, St. Paul, MN 55101

Introduction

Department of Commerce (DOC) Commissioner Rothman welcomed stakeholders to the discussion. Bill Grant (DOC) reviewed the background portion of the handout and the purpose for the meeting: to inform recommendations to the Public Utilities Commission (PUC) regarding the calculation of externality values of Minnesota power plants. In addition to today's opportunity for verbal input, the DOC and PCA will be accepting written comments through **May 9th** via the PUC eDocket system, where they will be aggregated and made public. Frank Kohlasch (PCA) further described the preferred scope of the discussion to focus on *how* the investigation will proceed, based on scenarios described in the handout. David Bael (PCA) walked the group through the background documents and scenarios. Scenarios were chosen based on a combination of research on the economics of air emissions and from experts in the fields of air quality and air pollution from emissions. The scenarios intend to inform how best to translate emissions into air quality, then determine environmental impacts and assign values to those impacts.

Initial Questions/ Discussion

- This meeting represents an attempt by the DOC and PCA to gather feedback from its stakeholders and inform the PUC investigation in a transparent manner.
- At this time, the DOC and PCA are focusing on human health costs (versus costs due to loss of biodiversity) because the costs of human health externalities are the largest values, and the science is available assign to values.

Criteria Pollutants Externality Values (Scenarios A through C)

The impacts of criteria pollutants are short term, local and regional impacts that are estimated differently than CO₂ and other greenhouse gasses. Scenarios are arranged from the highest to lowest levels of complexity, effort, credibility and specificity to Minnesota conditions.

- Scenario A** is a full photochemical modelling. It takes into account emissions, meteorology, and complex chemicals in the atmosphere.
- Scenario B** is reduced form modelling. It measures the relationships between emissions and impacts in a more simplified manner.
- Scenario C** is the simplest and easiest. It uses estimates already developed by EPA per time costs of emissions in Minnesota.

Criteria Pollutants Questions/Discussion

- The model would establish a baseline level of pollution for a given area and would therefore include all pollutants—not just those from power plants—in that area. The models will, however, take into account population density.
- The DOC and PCA will be looking at all emissions, not just non-attainment areas. There are health impacts at all levels of these pollutants.
- Scenarios A and B could be customized to Minnesota or extend beyond its borders to measure impact of Minnesota power plants in other areas.
 - The PUC order in terms of pollutants is just within Minnesota, versus areas outside the state that may affect Minnesota air quality. The models could be used further out, but right now the investigation is structured based on the PUC order from February 10, 2014.
- One stakeholder mentioned that Scenario A has the most credibility, but it also takes a lot of time to run the model.
- The accessibility for running the model will depend on the model chosen. Photochemical modelling (Scenario A) access may be more challenging than reduced form (Scenarios B and C). Transparency and credibility are both important criteria for choosing a scenario.
- MCEA supports Scenario B.
- One stakeholder felt that it's a gross omission of this process not to consider other environmental costs.
- Some stakeholders expressed that they felt unprepared to weigh in on the conversation but wanted their voice to be heard.
-

CO₂ Externality Values (Scenarios D through F)

The PUC ordered the DOC and PCA to update the estimate for CO₂ externalities and consider other greenhouse gasses. CO₂ represents the largest portion of gasses emitted compared to all others and has a larger impact.

- D. For **Scenario D**, there is a lot of literature that has determined the impact of CO₂ on climate change. An expert could determine the appropriate estimate or range of estimates, or some other new defensible method, for measuring values in Minnesota.
- E. **Scenario E** uses the federal government's Social Cost of Carbon (SCC) estimate and would likely opt to include other greenhouse gasses and use the Global Warming Potential Index to convert the other greenhouse gasses to CO₂ equivalents.
- F. **Scenario F** applies the same estimates as Scenario E but excludes other greenhouse gasses from the investigation.
- G.

CO₂ Questions/Discussion

- The scenarios are intended to narrow the scope of proceeding and gather stakeholder input on the most appropriate approach. There will certainly be trade-offs between cost and credibility, but this meeting is intended to gather input on which option(s) makes sense to the most people.

- One stakeholder said the scope of the carbon analysis should be left as broad as possible rather than constrained, so we can test a lot of these issues and get multiple solutions.
- Another stakeholder reminded the group and the DOC and PCA to be cognizant of related federal action in progress, particularly those that already incorporate regulation of CO₂.
- One stakeholder felt that Scenario D was not necessary. It will reinvent the wheel to come up with another CO₂ value, when other groups have already done this work.
- Including other greenhouse gasses:
 - Stakeholders that felt other greenhouse gasses should be included said some gasses cause more or less damage than CO₂, and calculating their externality values would be rather simple. Omitting them from the investigation would mean ignoring entire industries. Additionally, some gasses that are less impactful now may become more widely-used in the future and therefore have a larger impact, and it will be beneficial to have measures and regulations in place for them. Minnesota is already seeing the impact of climate change.
 - Stakeholders against the inclusion of other greenhouse gasses clarified that most other gasses are created when fuel is in transit, not at the power plant, so measuring other greenhouse gasses would be a waste of resources. Because 99% of greenhouse emissions are CO₂, excluding other gasses would not leave much out.
- Using the SCC calculation:
 - Stakeholders who support using the SCC calculation believed it generally undervalued actual costs, is a conservative estimate and the discount rates in question were appropriate and stated original costs per ton were \$24, not \$5.
 - Stakeholders against using the SCC as a calculation cited that the OMB says the process was not transparent, and there were a number of comments on the federal docket. They also questioned discount rates and changes in cost per ton from \$5 to \$36. Finally, they pointed out the SCC measures global costs, not just those that affect Minnesota, and this application is an inappropriate use of the SCC.
 - Specificity to Minnesota under the SCC is “N/A” because it calculates the global damage of greenhouse gasses.
- Specificity to Minnesota:
 - Stakeholders who thought calculations should be specific to Minnesota argued that it will be Minnesotans paying for how power plants impact Minnesota, so other parts of the world should not be considered.
 - Stakeholders who thought calculations should go beyond Minnesota borders argued that air quality and its impact on society has no political boundaries and that boundaries have already been decided by the PCA. One stakeholder expressed that all externalities should be considered.
- MCEA supports Scenario E because it has a credible and conservative number with less need for time and resources.
- Stole Rives Law Firm does not support Scenario E.

Expert Role Discussion

- Criteria to evaluate process scenarios are on Page 2 of the handout. The following criteria were suggested as important to stakeholders at the meeting:
 - Transparency: the model needs to be seen
 - Consistency
 - Updatability: things are changing very quickly, and new data will become available.
 - Credibility: current models are lacking, and flaws need to be addressed in a way that balances credibility with other criteria, such as costs.
 - Cost responsibility: Section 62 states that utilities pay, and one respondent questioned whether the right payers were paying. Others thought incorporating regulation costs would be inappropriate.
 - Expertise in chosen model, concentration response function, and application of model results.
 - One stakeholder suggested a team or consulting firm rather than one expert.
- Several stakeholders expressed concern with a DOC or PCA expert becoming the authority for externalities. Suggestions included:
 - Everyone retaining their own expert.
 - Creating a committee of stakeholders to assist an expert, if one were retained. This raised questions regarding how such a committee would be facilitated to avoid individual or group bias.

Closing Remarks

While the idea of soliciting stakeholder input was appreciated, a number of stakeholders expressed discomfort with the premise of this stakeholder meeting. Some felt that they were not prepared to give feedback. Others felt that the discussion should have been carried out in the more traditional, formal venue, such as a courthouse. Many stakeholders indicated that they intend to submit written comments.

Bill Grant (DOC) thanked everyone for participating.

Attendees

Andrew Goodkind, University of Minnesota
Audrey Poer, Center Point Energy
Beth Goodpaster, Minnesota Center for Environmental Advocacy
Bill Dressler, Izaak Walton League of America
Brett Ballavance, Minnesota Power
Brian Draxton, Otter Tail Power
Bruce Gerhard, Otter Tail Power
David Bael, Pollution Control Agency
David Thornton, Pollution Control Agency
Drew Morateka, Stoel Rives
Eric Swanson, Winthrop and Weinstine
Frank Kohlash, Pollution Control Agency
Gayle Prest, City of Minneapolis
J. Drake Hamilton, Fresh Energy

Jessica Tritsch, Sierra Club
Jim Alders, Xcel Energy
Jim Denniston, Xcel Energy
Jim Idzorek, NRG Energy
Jody Londo, Xcel Energy
Kate O'Connell, Department of Commerce
Kathy Hollader, MN 350
Kennie Scheevel, Dairyland Power
Kevin Marquardt, Center Point Energy
Kipp Coddington, Kazmarek Law Firm
Kristin Stastny, Dorsey and Whitney
Kurt Kimber, MN 350
Lauren Ross McCalib, Great River Energy
Leigh Currie, Minnesota Center for Environmental Advocacy
Lori Hoyum, Minnesota Power
Mark Ourada, American Coalition for Clean Coal Energy
Mark Strohfus, Great River Energy
Mark Thoma, Otter Tail Power
Mary Jean Fenske, Pollution Control Agency
Michael Kaluzniak, Public Utilities Commission
Michele Ross, Department of Health
Mike Cashin, Minnesota Power
Patti Leaf, Xcel Energy
Rick Rosvold, Xcel Energy
Sara Smith, Met Council
Sarah Casey, Otter Tail Power
Stan Selander, Great River Energy
Stephanie Hoff, Otter Tail Power
Steven Nyhus, Missouri River Energy Services
Susan Medhaug, Department of Commerce
Tricia DeBleekere, Public Utilities Commission
Tyler Hamman, Lignite Energy Council

Definitions

ALJ: Administrative Law Judge
APEEP: Air Pollution Emission Experiments and Policy Analysis
DOC: Department of Commerce
EEL: Edison Electric Institute
EGU: Electric Generating Units
EPA: Environmental Pollution Agency
IWG: International Working Group
MCEA: Minnesota Center for Environmental Advocacy
OMB: United States Office of Management and Budget
PCA: Pollution Control Agency
PUC: Public Utilities Commission
RFP: Request for Proposal
SCC: Social Cost of Carbon calculation

Attachment B: Summary of Written Stakeholder Comments

(Full comments are available In Minnesota Department of Commerce eDockets system, Docket No. E999/CI-00-1636)

City of Minneapolis

- Supports reinvestigation with particular emphasis on GHG's and climate change.
- Supports photochemical modeling if cost and time frame is reasonable, otherwise supports reduced form modeling.
- Supports using federal government SCC with inclusion of other GHGs.

Clean Energy Organizations

- Support choosing process options that require least time and cost that nevertheless produce credible results.
- Support photochemical model on the condition that it does not take an exceedingly long time, and otherwise supports reduced form model such as APEEP.
- Oppose limiting of damages to MN.
- Support retaining an outside expert using an RFP process; expert should be a firm or team rather than a single consultant. Report of expert would be central document in contested case proceeding.
- Support using federal government SCC with inclusion of other GHGs. This SCC is currently the most credible estimate, is based on the most thorough and up-to-date science, and will be easy to update in the future.
- Sole purpose of this proceeding is to update these values and not to assess how, where, and when the values should be applied.
- Regulatory compliance costs and external costs from emissions are two entirely different things. Regulatory costs have already been internalized into production decisions; any emissions that remain still cause external damages. Thus, there is no issue of double-counting.

Minnesota Department of Health

- Supports inclusion of other GHGs.
- Agree with evaluative criteria, indicating that credibility of the analyses and ability to update estimates in the future are most important.
- Suggests a pilot project to compare results of the different process scenarios.

Minnesota Large Industrial Group

- Need to consider impacts of recent and pending legislative and regulatory changes.
- Opposes using federal government SCC (but offers no alternative suggestion).
- Asserts that every interested party will offer testimony in contested case hearing and the retained expert's testimony should not be deemed the most credible.

Minnesota Power

- Asserts that application of externality values for PM2.5 in areas that are in compliance with EPA's NAAQS is not justified. Claims that there are no health damages when NAAQS are being attained.
- Opposes inclusion of other GHGs because their emissions are so small.

Otter Tail Power

- Opposes inclusion of other GHGs since these emissions are so small.
- Sees it inappropriate to comment of process options since each party will present and defend its process in the contested case hearing.

- Opposes retention of expert, because it is impossible to choose an outside expert that all parties will agree on; instead, each individual party should hire their own outside experts as they see fit.

State of North Dakota

- Assumes that this proceeding will not affect ND facilities.
- Opposes any raising of the externality values within the 200-mile boundary of MN; asserts that doing so would be unconstitutional.

Xcel Energy

- Not necessary to include other GHGs, because their emissions are so small.
- Generally supports damage cost approach for criteria pollutants; support photochemical model or reduced form model as having greatest credibility.
- Cautions against adopting federal government SCC as it currently presents significant procedural and methodological challenges to apply to resource planning.
- Supports hiring consultant to assess best approach for CO2 externality value that would consider the federal government SCC along with other possibilities. Potentially, damage costs should be restricted to climate change impacts on Minnesota.
- Most important criteria are credibility and specificity to MN.
- See that all parties should have the opportunity to engage the expertise they believe necessary to present their best case.

Concerned Citizens

- Citizens letter-writing campaign organized by Sierra Club.
- 657 separate letters all following same form.
- Support reinvestigation using most credible methods.
- Support using federal government SCC and inclusion of other GHGs.

Attachment C: Discussion Document for Stakeholder Meeting

Potential Scenarios for Investigation of Externality Costs from Electric Generation Unit Emissions

Background

In 1993, the Legislature enacted Minn. Stat. §216B.2422, subd. 3, to require the Minnesota Public Utilities Commission (Commission) to “quantify and establish a range of environmental costs associated with each method of electricity generation.” These environmental costs, or “externality values,” include the costs of the damages from emissions produced by power plants that are borne by society as a whole, rather than being borne directly by electric utilities or the consumers of electricity. The statute requires utilities to use the values in Commission proceedings “in conjunction with other external factors, including socioeconomic costs, when evaluating and selecting resource options”

The Commission established interim cost values in 1994, and final values in 1997, for Sulfur Dioxide (SO₂), Carbon Monoxide (CO), Carbon Dioxide (CO₂), Nitrogen Oxides (NO_x), Lead (Pb), and particulate matter less than 10 microns in diameter (PM₁₀). These values are updated annually for inflation.

In December 2013, a motion to reopen the investigation on externality values for particulate matter less than 2.5 microns in diameter (PM_{2.5}), SO₂, NO_x, and CO₂ came before the Commission. In its February 10, 2014 Order, the Commission granted the motion, and requested that the Department of Commerce and the Pollution Control Agency (together, the Agencies) convene a stakeholder group to address the scope of the investigation, whether to retain an expert under Minn. Stat. §216B.62, subd. 8, and the possible role of an expert should one be retained.

In response to the Commission’s Order, this April 24, 2014 meeting is being facilitated by staff from Minnesota Management and Budget’s Management Analysis & Development (MAD) to gather input from interested stakeholders. Stakeholders’ oral comments will be compiled and summarized by MAD staff in the form of a report. After considering stakeholder input, the Agencies will provide a recommendation to the Commission regarding the scope of the investigation by June 10, 2014. The Agencies’ recommendation will include, as an attachment, MAD’s report of this stakeholder meeting.

Written comments are welcome and must be provided by May 9, 2014 to ensure consideration by the Agencies. Provide written comments by filing them electronically using the Commission’s edocket system. Go to <https://www.edockets.state.mn.us/EFiling/security/login.do?method=showLogin> and follow the prompts. The docket number to use is **00-1636**. Alternatively, you can submit written comments to externalities.comments@state.mn.us. The Department of Commerce will compile all comments submitted to externalities.comments@state.mn.us and file them in eDockets under “Public Comment.”

Scope and Process Questions for Stakeholder Input

1. Provide comment on the below proposed criteria for evaluation of the scenarios. Are there other criteria that should be considered?
2. Describe which of the potential process scenarios outlined below you support for development of externality values for criteria pollutants. For CO₂?
3. What input do you have on the general scope of this investigation?
4. Should additional greenhouse gasses besides CO₂ be included in the investigation?
5. What other information exists that is critical to informing how the pollutant externality costs are updated?

Expert Role Questions for Stakeholder Input

6. Should an outside contractor (“expert”) be retained to do this work?
7. If an expert is retained what should be their role?
8. If an expert is retained, what are the critical competencies needed for your preferred criteria pollutant scenario? For your preferred CO₂ scenario?

Proposed Criteria Used to Evaluate Process Scenarios

1. **Cost:** total cost to complete the analysis, evaluated relative to other options
2. **Time to completion:** estimated time from PUC decision of scenario to pursue to completion of analysis
3. **Complexity:** relative complexity of the analytical methods involved in the scenario
4. **Credibility:** relative degree to which analytical models represent the complexity of the systems being modeled and thus the relative confidence in the accuracy of the estimates they produce
5. **Specificity to Minnesota:** degree to which specific conditions of Minnesota are incorporated into the modeling
6. **Need for outside contractor:** likely need for an outside contractor to conduct the analysis
7. **Update ability:** relative ease to which externality value estimates could be updated in the future

Potential Process Scenarios (See the appended *Technical Details* document for additional detail)

Note: The process scenarios outlined below are based on preliminary evaluation by agency staff for the purpose of inviting comment.

Criteria Pollutants Externality Values

TASK: Develop an externality cost value (\$/ton of pollutant emitted) for these pollutants: **SO₂, NO_x, PM_{2.5}**

Scenario A: Full photochemical modelling of air quality resulting from emissions from Minnesota electric generating units (EGUs) followed by analysis of health and environmental impacts using epidemiological studies and estimation of values using economic valuation studies.

Cost	Completion Time	Complexity	Credibility	Specificity to MN	Need for Outside Contractor?	Update Ability
High	Likely greater than one year	High	High	High	Yes	High effort

Scenario B: Employ reduced form model (e.g. the Air Pollution Emission Experiments and Policy analysis (APEEP) model) that estimates dollars per ton values for Minnesota power plants, but parameterize the model specifically to Minnesota (e.g., just consider damages in MN).

Cost	Completion Time	Complexity	Credibility	Specificity to MN	Need for Outside Contractor?	Update Ability
Low-Medium	Likely less than one year	Medium	Medium	Medium	Possibly	Medium effort

Scenario C: Utilize EPA air quality modelling for state-specific air quality resulting from anthropogenic emissions, already done for regulatory impact assessments followed by analysis of health and environmental impacts using epidemiological studies and estimation of values using economic valuation studies.

Cost	Completion Time	Complexity	Credibility	Specificity to MN	Need for Outside Contractor?	Update Ability
Low	Likely less than one year	Low - Medium	Low - Medium	Medium	No	Depends on future production of updated estimates

CO₂ Externality Values

TASK: Develop an externality cost value (\$/ton of pollutant emitted) for carbon dioxide (CO₂). Note the geographic limitations of the environmental cost value will not be changed from the current PUC value.

Scenario D: Hire outside contractor to determine the process for assigning externality values from MN EGUs for CO₂. The contractor also assesses the need for externality values for other greenhouse gasses and the analytical methods to estimate them.

Cost	Completion Time	Complexity	Credibility	Specificity to MN	Need for Outside Contractor?	Update Ability
Medium	Uncertain	Medium	High	N/A	Yes	Uncertain

Scenario E: Apply federal government interagency group social cost of carbon estimates (central estimate along with alternate values based on different discount rates); include other greenhouse gasses as CO₂-equivalents using the global warming potential index.

Cost	Completion Time	Complexity	Credibility	Specificity to MN	Need for Outside Contractor?	Update Ability
Low	Likely less than one year	Low	High	N/A	No	Low effort

Scenario F: Apply federal government interagency group social cost of carbon estimates (central estimate along with alternate values based on different discount rates); exclude other greenhouse gasses.

Cost	Completion Time	Complexity	Credibility	Specificity to MN	Need for Outside Contractor?	Update Ability
Low	Likely less than one year	Low	High	N/A	No	Low effort

Supplemental Document: Technical Details

Scenario A: Full Photochemical Air Quality Modelling for Criteria Pollutants

Photochemical air quality models are large-scale models that simulate the changes of pollutant concentrations in the atmosphere using a set of mathematical equations characterizing the chemical and physical processes in the atmosphere. EPA's Community Multi-scale Air Quality Model (CMAQ) is a photochemical model likely to be used for this analysis. Other potential photochemical models are the Comprehensive Air Quality Model with Extensions (CAMx), and the Weather Research and Forecasting model coupled with Chemistry (WRF-CHEM). CMAQ uses emissions, meteorology, and chemical modelling to predict air quality concentrations of ozone, particulates, and toxics.

The specific methodology to employ photochemical modeling for this purpose will be determined by the analysts, but a rough sketch of a potential methodology would be to do the following for each pollutant (SO₂, NO_x, PM_{2.5}) under consideration:

- 1) Zero out all emissions of the pollutant from all electric generation units (EGUs) in Minnesota urban counties
- 2) Run the model to determine air quality (PM_{2.5} and ozone) across the state of Minnesota to get a "control" air quality surface that can then be compared to the "baseline" air quality surface had emissions of the pollutant not been zeroed out.
- 3) Repeat the above steps for all EGUs in Minnesota's metropolitan fringe area and in Minnesota's rural area.

The steps listed above present a rough idea of the methodology process. Details, including the timing of the modeling (e.g., the year[s] for which baseline and control air quality surfaces are determined) and the geographic resolution of the modelling, would need to be determined

Once baseline and control air quality scenarios are generated for each criteria pollutant and each geographic region then EPA's Environmental Benefits Mapping and Analysis (BenMAP) model could be used to estimate the differences in health impacts and economic values of those impacts between baseline and control air quality levels across the state. BenMAP uses health impact functions from the peer-reviewed epidemiological literature to estimate health impacts. Furthermore, BenMAP can convert predicted health impacts to economic values using valuation functions from the economic valuation literature. Thus, for each pollutant in each geographic region, BenMAP can estimate total economic damages in Minnesota resulting from EGU emissions of that pollutant. Dividing total economic damages by the total Minnesota EGU emissions of a pollutant in a geographic region can then estimate dollar per ton damage values (only considering damages within in Minnesota) for EGU emissions of that pollutant in the geographic region of the state.

This methodology would not take into account non-human health impacts of these pollutants, such as materials damage, but analysts could develop other tools for estimating the economic values of these impacts.

Scenario B: Reduced Form Model for Criteria Pollutants

A reduced form model represents relationships between the environment and pollutants in a simplified manner designed to mimic the essential relationship elements while remaining fast and inexpensive to run across multiple scenarios.⁹ A widely used reduced form model for estimating economic damages from air pollution is the Air Pollution Emission Experiments and Policy Analysis (APEEP) model. APEEP is an integrated assessment model that links emissions of air pollution from all point sources (including EGUs) within the U.S. to exposures, physical effects, and monetary damages. APEEP has been used in many peer-reviewed publications and has withstood some legal scrutiny, having been used to quantify damages in a law suit by the EPA of a Louisiana coal-fired power plant.

Although APEEP generally serves to estimate overall damages from air emissions, the model can be customized to include only damages within Minnesota. Other model parameters, such as the year(s) of estimates, could be customized. APEEP could be used to come up with separate estimates for damages from different geographic regions of Minnesota (urban, metropolitan fringe, rural).

InMAP is another reduced form model being developed here in Minnesota to estimate health impacts of air pollution. This is an as-yet untested model, but may have more specificity to Minnesota conditions and thus may also be considered as a candidate reduced-form model.

Scenario C: Existing State-Specific Air Modelling of Anthropogenic Emissions by EPA for Regulatory Impact Assessment.

EPA has done state-by-state estimates of economic damages from anthropogenic emissions as part of the cost benefit analyses in its regulatory impact assessments. In 2011, to support the regulatory impact assessment for the Final Transport Rule, the EPA used CMAQ to quantify the impacts (air quality contributions) of SO₂ and NO_x anthropogenic emissions on PM_{2.5} and ozone concentrations. Although these do not specifically examine emissions from EGUs, they do quantify impacts from the specific pollutants under consideration in this analysis. These air quality impacts could then be used as inputs into BenMAP to estimate health impacts and economic values of the impacts as described above.

Scenario D: Outside Contractor Determines Appropriate Greenhouse Gas (CO₂ and Perhaps Others) Values for Minnesota

There have been numerous studies to estimate global economic damages from carbon (and other greenhouse gas) emitted to the atmosphere. It would be contingent on the analysts to determine the most appropriate estimate, or to develop new estimates, for use in Minnesota.

Scenario E: Federal Government Social Cost of Carbon Estimates with Inclusion of Other Greenhouse Gasses as CO₂-equivalents

⁹ The Air Pollution Emission Experiments and Policy Analysis Model (APEEP) Technical Appendix. http://www.econ.yale.edu/~nordhaus/Resources/muller_JEEM_Appendix.pdf.

The U.S. Government Interagency Working Group on Social Cost of Carbon consists of 11 federal agencies the Department of Energy, The Department of Agriculture, the Department of the Treasury and the Environmental Protection Agency. In 2010 this group developed estimates for the social cost of carbon (SCC). The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change. The Working Group convened again in 2013 to update its estimates.

The 2013 SCC estimates by this interagency group for emissions in 2015 are a central estimate of \$36 per ton CO₂ (in 2007 dollars, using a 3% discount rate), and a range of \$11 to \$55 per ton CO₂ emitted in 2015 when alternative discount rates (5% and 2.5%, respectively) were used in the analysis. SCC estimates in future years rise steadily, reflecting generally greater expected impacts as atmospheric concentrations of carbon increase. These estimates collapse a great deal of information into single values, namely results from Integrated Assessment Models (IAMs) that model the atmospheric response to carbon emissions, the climate response to atmospheric changes, the human welfare impacts of climate change and the economic values of these impacts at a chosen discount rate.

Other greenhouse gasses (methane, nitrous oxide, hydroflourocarbons, perflourocarbons and sulfur hexafluoride) can be converted into CO₂-equivalents using the Global Warming Potential (GWP) Index. GWP is a relative measure of how much heat a greenhouse gas traps in the atmosphere and compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of CO₂. Thus, the GWP values have been used to convert all of the additional gasses under consideration here into CO₂-equivalents (CO₂-e). Once any gas has been converted into its CO₂-e the marginal damage of a ton of that gas, or the externality cost, can be calculated using the SCC. It should be noted that the vast majority of greenhouse gas emissions from EGUs is in the form of CO₂ so that including externality values of other greenhouse gasses will not significantly affect the overall damage estimates of EGU emissions from fossil fuel based power plants.

Scenario F: Federal Government Social Cost of Carbon Estimates and Exclusion of Other Greenhouse Gasses

Same process as described above without the inclusion of other greenhouse gases.

CERTIFICATE OF SERVICE

I, Sharon Ferguson, hereby certify that I have this day, served copies of the following document on the attached list of persons by electronic filing, certified mail, e-mail, or by depositing a true and correct copy thereof properly enveloped with postage paid in the United States Mail at St. Paul, Minnesota.

**Minnesota Department of Commerce
Comments**

Docket No. E999/CI-00-1636

Dated this 10th day of **June 2014**

/s/Sharon Ferguson

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Matthew J.	Schuerger P.E.	mjsreg@earthlink.net	Energy Systems Consulting Services, LLC	PO Box 16129 St. Paul, MN 55116	Electronic Service	No	SPL_SL_0-1636_2_Interested Parties
Dean	Sedgwick	N/A	Itasca Power Company	PO Box 457 Bigfork, MN 56628-0457	Paper Service	No	SPL_SL_0-1636_2_Interested Parties
Tim	Silverthorn			1096 Kilburn Street St. Paul, MN 551031029	Paper Service	No	SPL_SL_0-1636_2_Interested Parties
Mrg	Simon	mrgsimon@mrenergy.com	Missouri River Energy Services	3724 W. Avera Drive P.O. Box 88920 Sioux Falls, SD 571098920	Electronic Service	No	SPL_SL_0-1636_2_Interested Parties
David B.	Sogard	dsogard@minnkota.com	Minnkota Power Cooperative, Inc.	PO Box 13200 1822 Mill Road Grand Forks, ND 582083200	Electronic Service	No	SPL_SL_0-1636_2_Interested Parties
Beth H.	Soholt	bsoholt@windonthewires.org	Wind on the Wires	570 Asbury Street Suite 201 St. Paul, MN 55104	Electronic Service	No	SPL_SL_0-1636_2_Interested Parties
Wayne	Stenehjem		Office Of Attorney General	Dept. 125 600 E. Boulevard Avenue Bismarck, ND 585050040	Paper Service	No	SPL_SL_0-1636_2_Interested Parties
Eric	Swanson	eswanson@winthrop.com	Winthrop Weinstine	225 S 6th St Ste 3500 Capella Tower Minneapolis, MN 554024629	Electronic Service	No	SPL_SL_0-1636_2_Interested Parties
Steve	Thompson		Central Minnesota Municipal Power Agency	459 S Grove St Blue Earth, MN 56013-2629	Paper Service	No	SPL_SL_0-1636_2_Interested Parties

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David	Thornton	J.David.Thornton@state.mn.us	MN Pollution Control Agency	520 Lafayette Road St. Paul, MN 55101	Electronic Service	No	SPL_SL_0- 1636_2_Interested Parties
Pat	Treseler	pat.jcplaw@comcast.net	Paulson Law Office LTD	Suite 325 7301 Ohms Lane Edina, MN 55439	Electronic Service	No	SPL_SL_0- 1636_2_Interested Parties
Darryl	Tveitbakk		Northern Municipal Power Agency	123 Second Street West Thief River Falls, MN 56701	Paper Service	No	SPL_SL_0- 1636_2_Interested Parties
Roger	Warehime	warehimer@owatonnautilities.com	Owatonna Public Utilities	208 South WalnutPO Box 800 Owatonna, MN 55060	Electronic Service	No	SPL_SL_0- 1636_2_Interested Parties
Paul	White	paul.white@prcwind.com	Project Resources Corp./Tamarac Line LLC/Ridgewind	618 2nd Ave SE Minneapolis, MN 55414	Electronic Service	No	SPL_SL_0- 1636_2_Interested Parties
Robyn	Woeste	robynwoeste@alliantenergy.com	Interstate Power and Light Company	200 First St SE Cedar Rapids, IA 52401	Electronic Service	No	SPL_SL_0- 1636_2_Interested Parties
Thomas J.	Zaremba	TZaremba@wheelerlaw.com	WHEELER, VAN SICKLE & ANDERSON	Suite 801 25 West Main Street Madison, WI 537033398	Electronic Service	No	SPL_SL_0- 1636_2_Interested Parties