Exhibit CEO-4

eDocket ID:

STATE OF MINNESOTA
BEFORE THE PUBLIC UTILITIES COMMISSION

In the Matter of Minnesota Power's	)	
Petition for Approval of the	)	**PUC Docket No. E-015/GR-17-568**
Energy*Forward* Resource Package	)	**OAH Docket No. 68-2500-34672**

DIRECT TESTIMONY OF

ELIZABETH A. STANTON

ON BEHALF OF

MINNESOTA CENTER FOR ENVIRONMENTAL ADVOCACY

FRESH ENERGY

WIND ON THE WIRES

SIERRA CLUB

Applied Economics Clinic

JANUARY 19, 2018

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I. INTRODUCTION

Q. Please state your name, occupation, and business address.

A. My name is Elizabeth A. Stanton, Ph.D. I am the Director and Senior Economist of the Applied Economics Clinic, 44 Teele Avenue, Somerville, Massachusetts 02144.

Q. On whose behalf are you testifying in this proceeding?

A. The Clean Energy Organizations, which is a group that consists of Fresh Energy, the Minnesota Center for Environmental Advocacy, Sierra Club, and Wind on the Wires.

Q. Dr. Stanton, what is your education and professional background?

A. I am the founder and Director of the Applied Economics Clinic, a non-profit consulting group housed at Tufts University's Global Development and Environment Institute. The Applied Economics Clinic ("the Clinic") provides expert testimony, analysis, modeling, policy briefs, and reports for public interest groups on the topics of energy, environment, consumer protection, and equity. The Clinic provides training to the next generation of expert technical witnesses and analysts through applied, on-the-job training to graduate students in related fields and works proactively to support diversity among both student workers and professional staff.

I am a researcher and analyst with more than 17 years of professional experience as a political and environmental economist. I have authored more than 140 reports, policy studies, white papers, journal articles, and book chapters on topics related to energy, the economy, and the environment.

My recent work includes Integrated Resource Plan ("IRP") and Demand-Side Management ("DSM") planning review, analysis and testimony of state climate laws as they relate to proposed capacity additions, and other issues related to consumer and environmental protection in the electric and natural gas sectors. I have submitted expert testimony and comments in state dockets in Indiana, Illinois, Vermont, New Hampshire, Massachusetts, and Louisiana, as well as several federal dockets.

In my previous position as a Principal Economist at Synapse Energy Economics, I led studies examining environmental regulation, cost-benefit analyses, and the economics of energy efficiency and renewable energy. Prior to joining Synapse, I was a Senior Economist with the Stockholm Environment Institute's ("SEI") Climate Economics Group, where I was responsible for leading the organization's work on the Consumption-Based Emissions Inventory ("CBEI") model and on water issues and climate change in the western United States. While at SEI, I led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense Fund, among others.

My articles have been published in Ecological Economics, Climatic Change, Environmental and Resource Economics, Environmental Science & Technology, and other journals. I have also published books, including *Climate Change and Global Equity* (Anthem Press, 2014) and *Climate Economics: The State of the Art* (Routledge, 2013), which I co-wrote with Frank Ackerman. I am also coauthor of *Environment for the People* (Political Economy Research Institute, 2005, with James K. Boyce) and coeditor of *Reclaiming Nature: Worldwide Strategies for Building Natural Assets* (Anthem Press, 2007, with Boyce and Sunita Narain).

I earned my Ph.D. in economics at the University of Massachusetts-Amherst, and have taught economics at Tufts University, the University of Massachusetts-Amherst, and the College of New Rochelle, among others. My curriculum vitae is attached to this testimony as EAS-Schedule 1.

Q. What issues does your testimony address?

A. My testimony addresses the load and energy forecasts which were used by Minnesota Power (the "Company") in developing its preferred plan in the Energy*Forward* petition.[1] I review the reasonableness of the Company's methodology and underlying assumptions used in its load and energy forecasts.

Q. Please summarize your findings and recommendations.

A. Based on a review of the Company's methodology and assumptions, I conclude that the Company has overstated future load and energy requirements, and by extension, the capacity required for its system. The following are my key findings:

1. The Company has underestimated the amount of energy efficiency that it is likely to achieve going forward. This means that the load and energy requirements they model are too high. The high sensitivity[2] modeled by the Company (embedded energy efficiency plus 30 gigawatt hours ("GWh") annual incremental) is a more reasonable base case. It is also the forecast that most closely adheres to the Public Utilities

[1] The background leading to Minnesota Power's petition is included in the Direct Testimony of J. Drake Hamilton.

[2] A "sensitivity" is a model run using a single altered assumption from the base modeling run, with the purpose of testing the model's sensitivity or responsiveness to changes in that assumption.

Commission's (the "Commission's") previous direction to the Company regarding the amount of energy efficiency to be included in future resource planning analyses.

2. The Company has also likely overestimated the future usage of an average residential and commercial customer. This leads to an overestimation of total usage.

3. The Company has failed to conduct sensitivities for future residential and commercial energy and load growth. Its "low" and "high" cases only varied what industrial sites would come to fruition, rather than also assessing variations in commercial and residential load growth. There is significant uncertainty surrounding future residential and commercial requirements that has been ignored. Each of these concepts is explained in further detail below.

4. The Company has also overstated industrial demand. Regarding industrial sites, the Company has included one site that has closed (Blandin paper mill 5) and its base case includes an overly ambitious operating date for one mine (PolyMet's NorthMet mine). The Blandin paper mill (which accounts for 20 megawatts ("MW") of load) should be removed and the PolyMet mine (which accounts for 45 MW) should be delayed several years—at a minimum—in the Company's modeling due to the inconsistency in its projected timeline.

5. From my review, I conclude that the Company's base case should include the high energy efficiency sensitivity modeled by the Company (embedded energy efficiency plus 30 GWh), and should remove Blandin paper mill 5 and delay the PolyMet mine by two to three years.

Q. Why is the load and energy forecast a critical piece of the petition?

A. The Company's expectations for load and energy requirements are key constraints used in its analysis of resource alternatives (using the Strategist model). The Company needs to be able to serve its customers' load and energy requirements through its own generating assets, demand-side management (e.g., energy efficiency), customer self-generation (e.g., small-scale solar photovoltaic installations), market purchases, or a combination thereof. The Company's analysis concluded that the 250 megawatt ("MW") purchase of a portion of the Nemadji Trail Energy Center ("NTEC") combined-cycle natural gas generator was part of the least-cost plan—under its assumed load and energy requirements.[3] However, changes to load and energy requirements would change the model's constraints and, therefore, can impact resource choice. This is shown in the Company's "load sensitivity analysis" discussed by Minnesota Power witness Eric J. Palmer.[4] For instance, in the "low load" case modeled by Mr. Palmer, which does not include some current or future industrial load, the NTEC is only chosen in approximately 50 percent of the scenarios.[5]

Q. How did Minnesota Power determine its load forecasts in this proceeding?

A. The basis for the Company's load forecast in this proceeding is the 2017 Annual Forecast Report ("2017 AFR"). In developing this forecast, the Company conducted econometric modeling using many variables, including historical energy usage, population growth, and economic indicators, among others. The Company then adjusted the load and energy

[3] *Petition for Approval of Gas Plant Proposal*, Docket No. E015/AI-17-586, 1-2 (Oct. 24, 2017) (hereinafter "Gas Plant Petition").

[4] *Direct Testimony of Eric J. Palmer*, Docket No. E-015/AI-17-568, 47-48 (Nov. 9, 2017) (hereinafter "Palmer Direct").

[5] *Id.* at 48, fig. 16.

requirements to account for specific large customers' requirements. The assumptions and methodology used in the 2017 AFR are provided in detail in the Company's 2017 Annual Electric Utility Report.[6]

II. THE COMPANY'S LOAD AND ENERGY FORECASTS ARE UPWARDLY BIASED

Q. Do you have concerns about Minnesota Power's load forecasts?

A. Yes. I have several concerns that I will address in this section. First, the Company has included an insufficient amount of demand-side management[7] in its analysis. Second, the Company has overestimated energy usage per customer. Third, the Company has failed to account for uncertainty in residential and commercial energy and load requirements. Finally, the Company has been overly optimistic in its projections of industrial activity. All of these issues create an upwardly biased load forecast.

A. The Company Underestimated Energy Efficiency

Q. Is the amount of future energy efficiency an important assumption for the Company's load forecast?

A. Yes. Forecasting the amount of energy efficiency is a critical part of any load forecast. It reduces the need for supply-side energy and capacity. Therefore, expectations for energy efficiency can change whether and/or when new generation is planned.

[6] Minnesota Power's 2017 Annual Electric Utility Forecast Report, Docket No. E-999/PR-17-11 (June 29, 2017), also provided in response to CEO Information Request ("IR") No. 2 as "CEO IR 02.01Attachment TS."

[7] "Demand-side management" refers to changes in a consumer's energy demand as a result of utility or third-party efficiency programs, including financial incentives, efficiency measures and programs related to behavior change.

Q. What did the Company claim was already embedded in the load and energy forecasts in terms of energy efficiency?

A. The state Conservation Improvement Program (CIP) has a target savings of 1.5 percent of retail sales annually, which is 46 GWh of incremental savings for Minnesota Power.[8] I refer to this as "embedded energy efficiency" because the Company claims that this amount of savings is already accounted for in the load and energy forecast because they use historical energy sales (including energy efficiency measures, where applicable), dating back to 1990, to forecast their future sales.[9]

The use of historical sales data dating back to 1990 to develop a trendline for future sales may lead to a misestimation of both future sales and savings, as is discussed below in this testimony. This is because the Company's underlying dataset includes years in which energy efficiency programs offerings varied. If the Company has controlled for the effects of changes to energy efficiency program savings and the impacts of measure lifetimes in its regression analysis that has not been made clear.

Q. What did the Company model in terms of incremental energy efficiency—over and above what they claimed was already accounted for?

A. When conducting Strategist modeling, the Company's base case assumed it would save 11 GWh above what the Company claims is already embedded in the load and energy forecast (where the embedded savings are claimed to be 46 GWh). This savings number is expressed in terms of annual, incremental energy efficiency from 2017 through 2020—

[8] *2016 Consolidated Filing, Minnesota Power*, Docket No. E015/CIP 13-409.03 Ex. 2, p. 1 (April 3, 2017).

[9] Gas Plant Petition at 2-5.

shown below in Figure 1.[10] Thus, the base case (that is, the Company's central or most prominent presentation of efficiency savings in its modeling) is "embedded EE [energy efficiency] + 11 GWh," or 57 GWh. This 57 GWh level of incremental savings is found in the Company's 2017-2019 Triennial Filing.[11] The Company also modeled sensitivities adding 15 or 30 GWh instead of 11 GWh to the embedded energy efficiency. I will discuss these sensitivities later in this section.

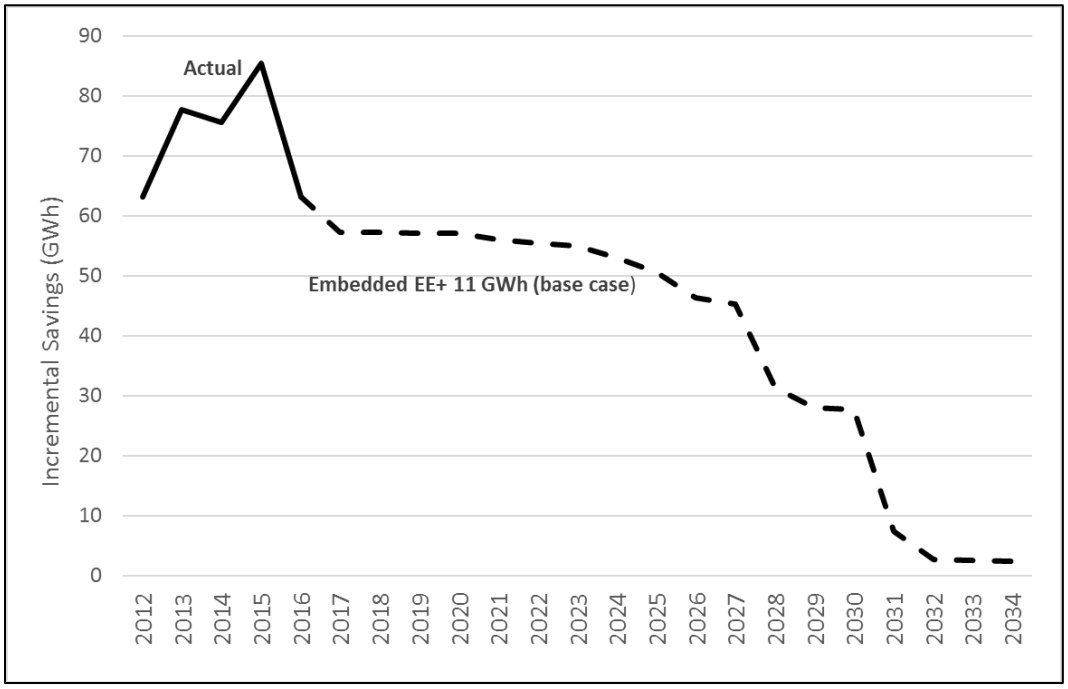

Figure 1: Minnesota Power's Actual Energy Efficiency Savings vs. Base Case Future Assumptions (Annual Incremental GWh)[12]

Q. Is the Company's base case forecast of energy efficiency savings reasonable for planning purposes?

A. No. As shown in Figure 1, the Company's forecast of energy efficiency savings is significantly lower than what it has achieved in recent years, and drops dramatically over

[10] Palmer Direct at 45: 27.
[11] *Id.* at 45: 27-28.

time, reaching zero GWh in 2032. These are unreasonable assumptions on the Company's part that lead to an overestimation of energy and load requirements for its customers.

Q. How has the Company performed in recent years, compared to its energy efficiency savings targets?

A. The Company has far exceeded the energy efficiency savings targets set forth in its CIP plan. Figure 2 shows the CIP targets compared to what the Company actually achieved in recent years. Clearly, the Company has been overperforming in comparison to its projected targets. In the past five years, it has saved an average of 50 percent more than its CIP savings targets. Put differently, the Company has saved an annual average of 24 GWh more than its target.

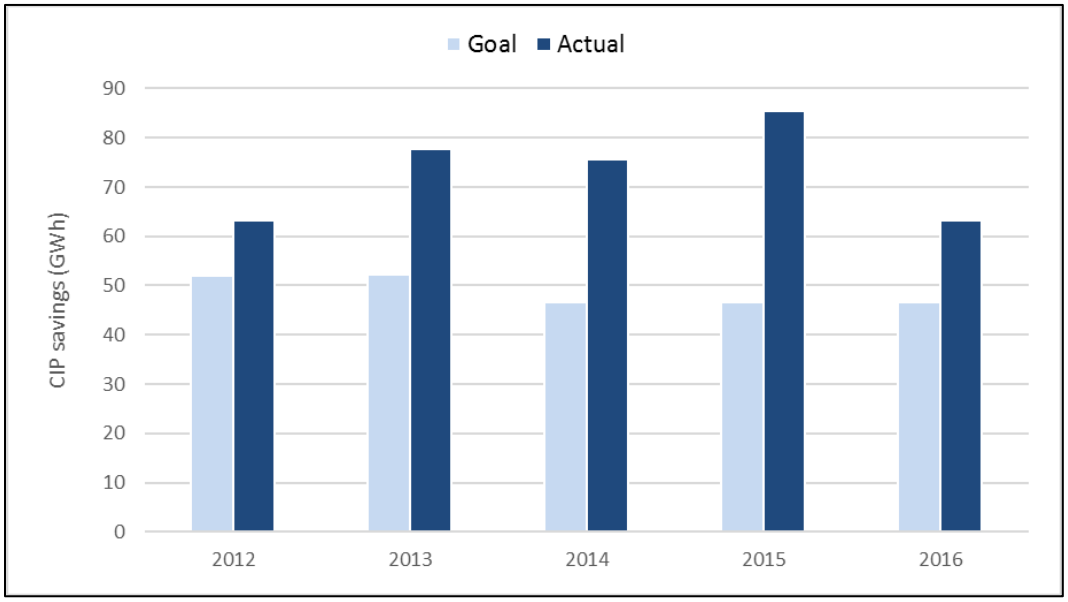

Figure 2: Actual Energy Efficiency Savings vs. Targets (Annual Incremental GWh)[13]

[12] Based on Minnesota Power's Response to CEO IR No. 73, "CEO IR 73.01_Attach."
[13] Based on Minnesota Power CIP Status Reports from 2012 through 2016; at Ex. 2, p.1 and Ex. 5 p.1 of each Status Report.

Q. What sensitivities did the Company model for energy efficiency, in addition to the base case?

A. The Company modeled sensitivities that added 15 GWh and 30 GWh to the "embedded energy efficiency" level (i.e. CIP target). These sensitivities are shown below in Figure 3 together with the "Embedded EE + 11 GWh" base case.

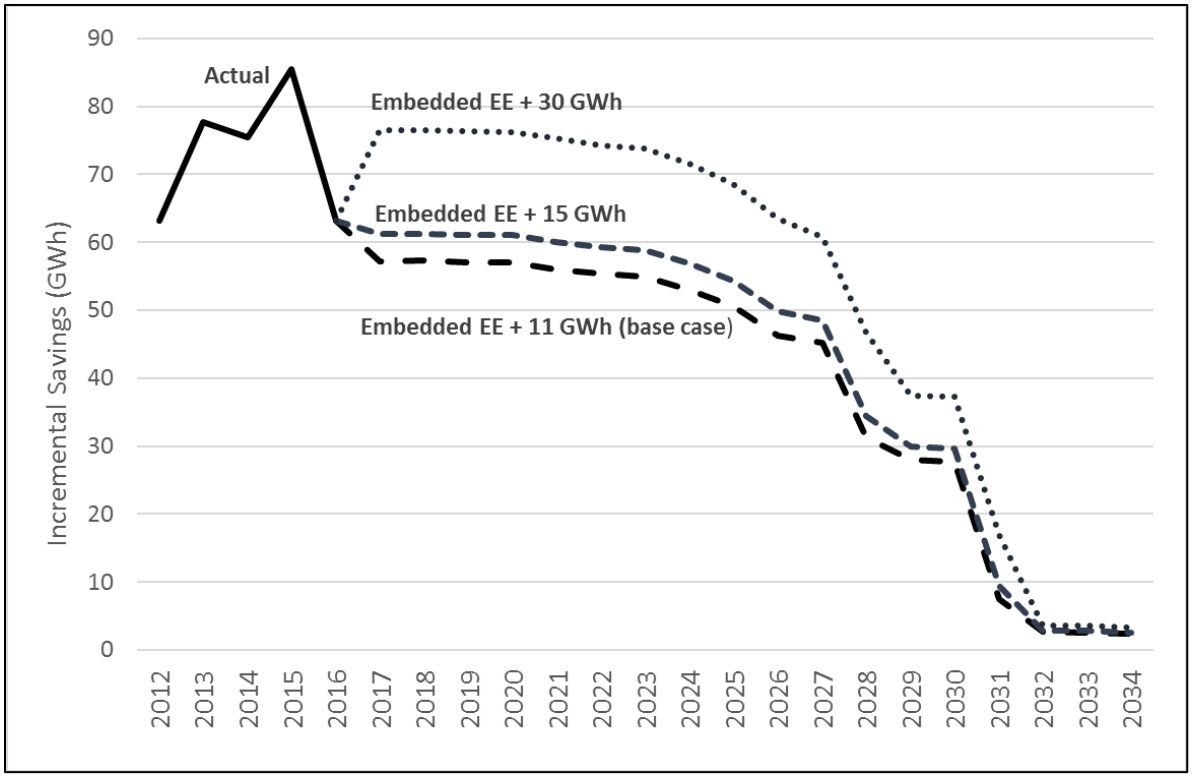

Figure 3: Actual Energy Efficiency Savings vs. Future Assumptions (Annual Incremental GWh)[14]

Q. Which of these futures is the most reasonable to use in the base case?

A. The highest energy efficiency savings forecast (embedded EE + 30 GWh) is the most reasonable because it most closely matches what the Company has achieved in the recent past.

[14] Based on Minnesota Power's Response to CEO IR No. 73, "CEO IR 73.01_Attach."

On average, the Company has saved 73 GWh each year in the past five years. The highest energy efficiency sensitivity modeled by the Company in its high efficiency sensitivity assumes 76.5 GWh in savings for 2018 and 2019—subsequently decreasing each year (see "embedded EE + 30 GWh" in Figure 3). In two of the past five years, the Company has exceeded the 2018 and 2019 levels of savings in the "Embedded EE + 30 GWh" sensitivity.

Q. Why else should the Company have used the highest energy efficiency savings forecast ("embedded EE + 30 GWh")?

A. According to Mr. Palmer, in the 2015 IRP proceeding, "the Commission determined that the Company's average annual energy savings goal should be set at 76.5 GWh," [15] which is the savings level captured in the "embedded EE + 30 GWh scenario." The Company should adhere to the Commission's direction.

Q. What is the reduction in peak load when using the more reasonable "embedded EE + 30 GWh" case compared to the base case modeled by the Company?

A. The "Embedded EE + 30 GWh" forecast would reduce the Company's MISO-coincident peak load by an additional 31 MW in 2025 and 46 MW in 2030 relative to the Company's base case.[16]

[15] Palmer Direct at 45: 20.

[16] Minnesota Power's Response to CEO IR No. 73, "CEO IR 73.01_Attach."

Q. Do you consider the 30 GWh sensitivity to be the upper end of what is achievable for the Company's future energy efficiency savings?

A. No, the "embedded EE + 30 GWh" case is not the upper end of achievable energy efficiency savings. To its credit, the Company has achieved significant efficiency savings in the past. However, when looking forward, the Company is assuming it will underperform in comparison to past years and ignores the Commission's direction for what savings forecast to use in resource planning. Moreover, if the amount of "embedded" energy efficiency that the Company claims is accounted for in the load forecast were too high, the load forecast would be additionally upwardly biased. Even if one assumes that the amount of embedded energy efficiency included is reasonable, the incremental 30 GWh case is a reasonable base case, not a high case. It should not be the highest savings level modeled by the Company. It assumes that the Company merely maintains recent efficiency savings levels—and only in the short-term. The Company may achieve more savings in the future than it has historically or may at least maintain its recent savings levels into the medium and long-term. Thus this future is a reasonable base case, not high-bound scenario.

B. The Company Overestimated Customer Usage

Q. Is the usage per customer an important determinant of load and energy requirements?

A. Yes. The energy requirement is simply the average usage per customer multiplied by the number of customers. Therefore, the assumed growth in each of those measures is an important determinant of energy and load requirements.

Q. Does the Company assume a sharp increase in future energy usage per residential customer?

A. Yes. Shown in Figure 4, the annual residential customer usage fluctuates from year to year. Most recently, it has dropped to below 8.5 megawatt hours ("MWh") per customer. The Company is assuming a sharp increase in this measure in the next two years and then rising through 2030.

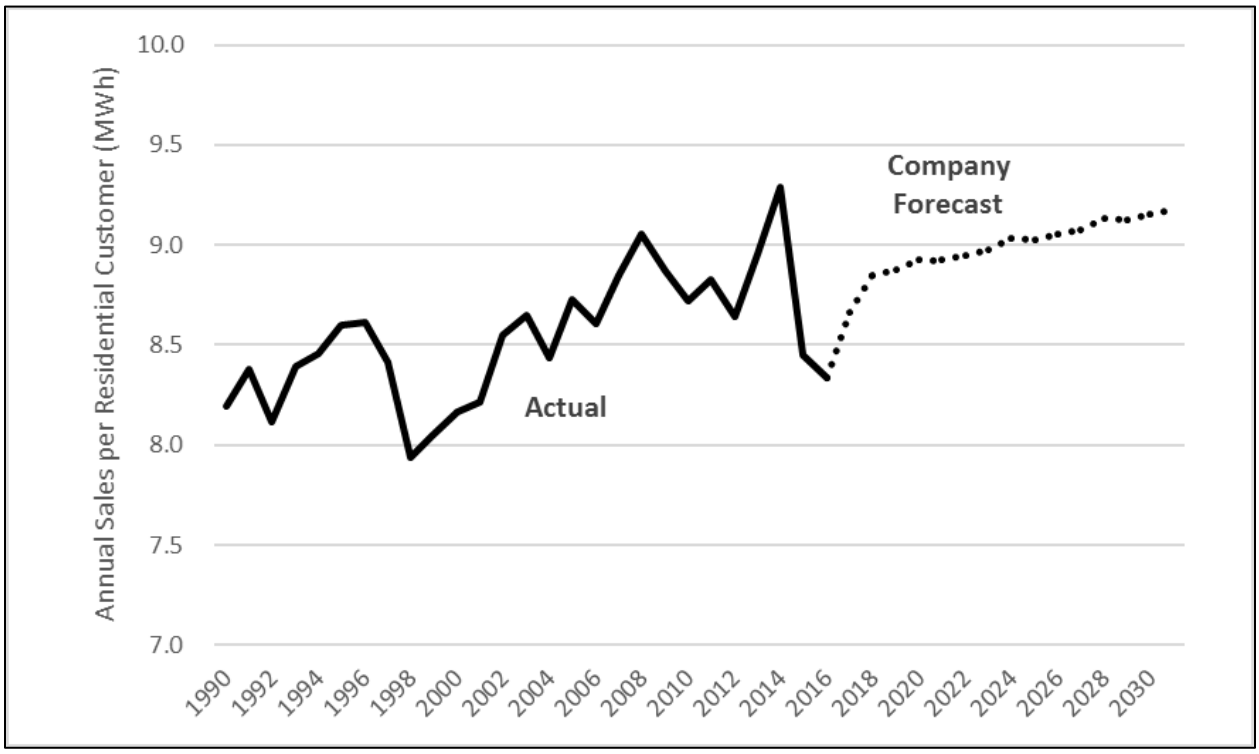

Figure 4: Residential Usage per Customer (Annual MWh)[17]

Q. Is there justification for the Company's assumption of steady growth in residential customer usage?

A. I am not aware of one. The average annual growth rates in usage per residential customer being projected by the Company is significantly higher than it has been recently.

[17] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment."

Figure 5 shows these data for three historical time periods (1990 through 1996, 1996 through 2006, and 2006 through 2016) and the Company's projected growth rate (2016 through 2031). Each historical period shows a decline in annual growth. Despite this evidence, the Company still projects that usage per customer will rebound in the future, closer to its highest (1990-1996) growth period than in recent years.

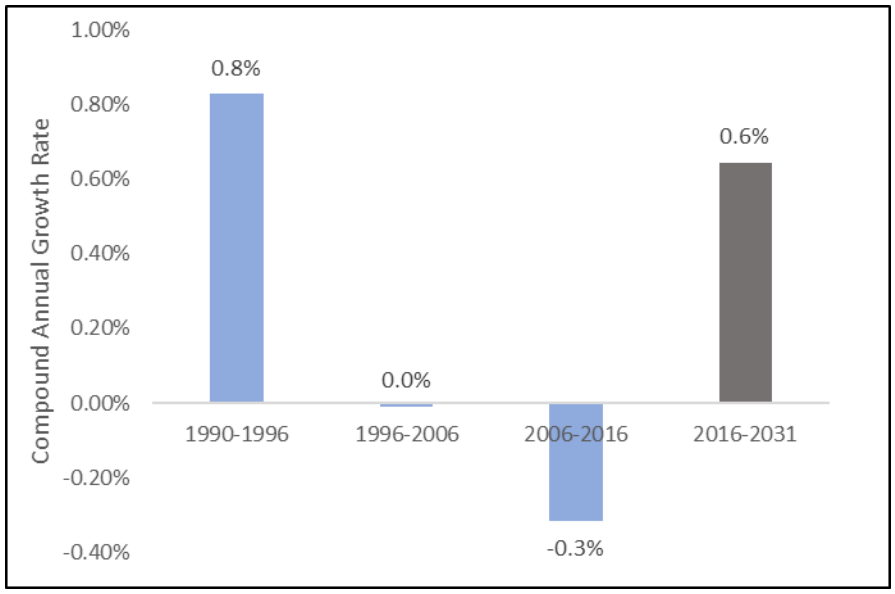

Figure 5: Annual Growth in Residential Usage per Customer[18]

Q. Does the Company's residential energy usage per customer closely match the historical growth from 1990 to 2016?

A. Yes. The Company's modeling used data going back to 1990. Therefore, it picks up trends from 1990 to 2016, the latest year that data were available at the time.

[18] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment."

Q. How much does this trend differ from looking at a ten-year trend (2007-2016)?

A. It differs significantly. Figure 6 shows both the Company's 26-year trend (1990-2016) and a ten-year trend (2007-2016). In the past ten years, usage per customer has been falling, on average, whereas, looking further in the past produces a trend of customer growth. In this case, a simple regression done in Excel closely matches the Company's econometric modeling result for residential customer usage, meaning that a statistic examination of the Company's twenty-six year data suggests the same trend shown in orange in Figure 6.

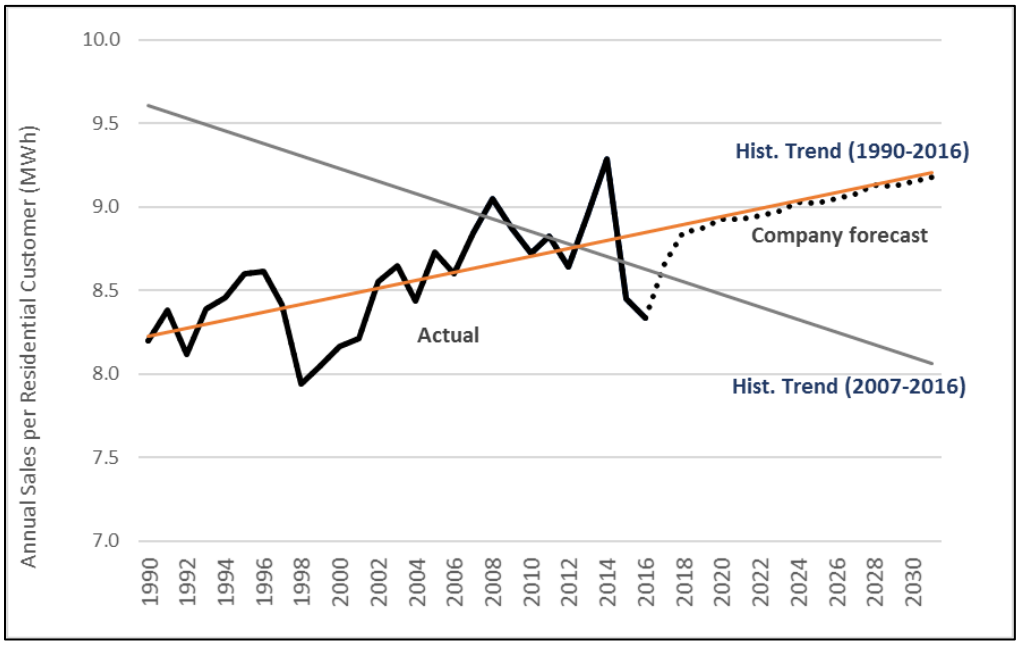

Figure 6: Residential Usage per Customer, Historical Trends (Annual MWh)[19]

[19] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment;" trendline is a linear regression run in Excel.

Q. Does the Company also forecast steady growth in commercial customers' usage?

A. Yes. Shown below in Figure 7, the Company projects a similar pattern of steady growth in commercial usage. Actual commercial customer usage has fallen dramatically since 2007, yet the Company expects an imminent resurgence.

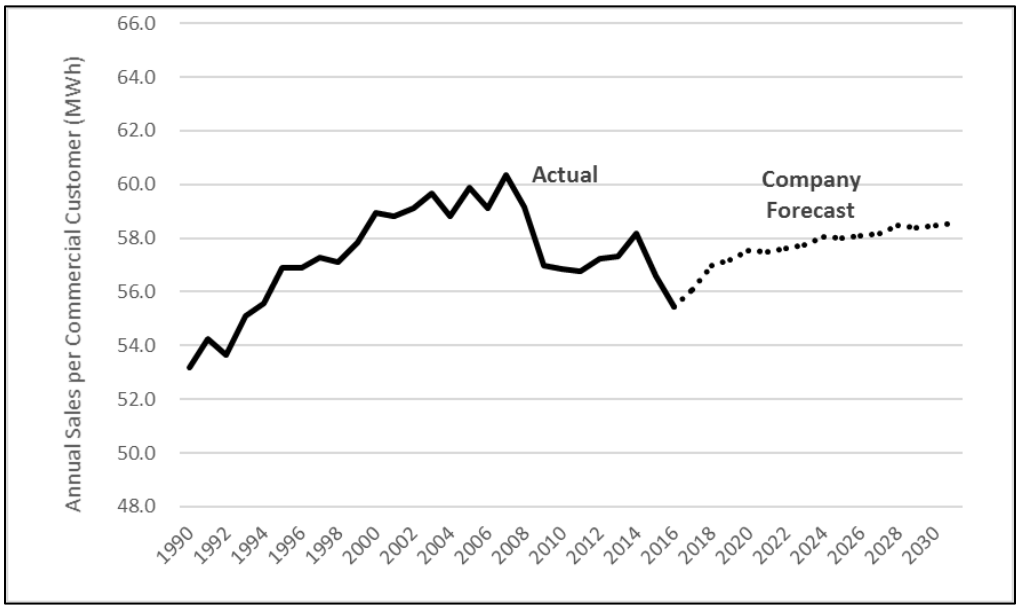

Figure 7: Commercial Usage per Customer (Annual MWh)[20]

Q. Did you compare the historical and projected growth in commercial usage per customer?

A. Yes. Figure 8 shows the average annual growth for usage per commercial customer. As with residential usage, commercial customers have been using less energy in more recent historical periods. In the past decade, usage has dropped by 0.6 percent each year, on average. Yet the Company expects a 0.4 percent *increase* in usage per customer through 2031, on average.

[20] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment."

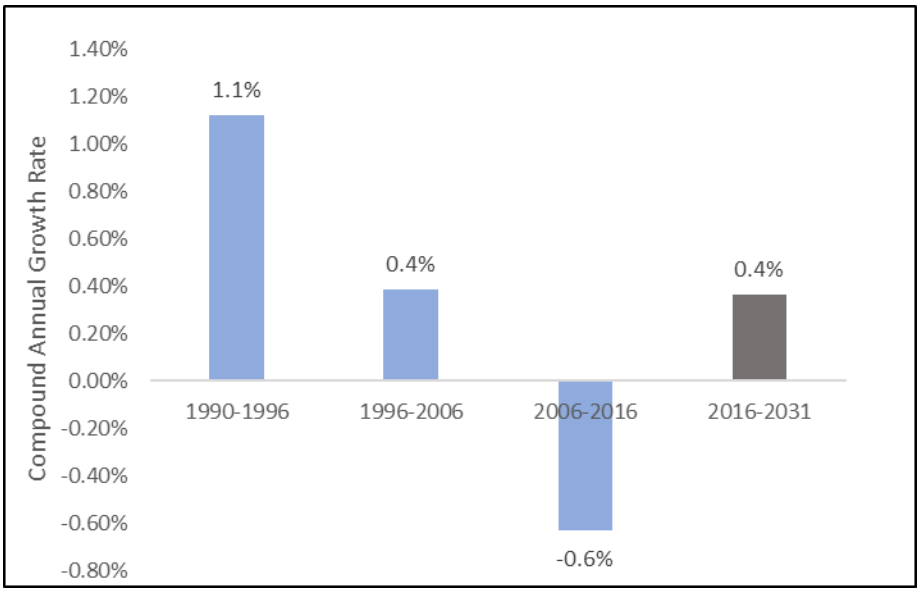

Figure 8: Annual Growth in Commercial Usage per Customer-CORRECTED[21]

1 **Q. Does a similar difference in trends occur with commercial customer usage?**

2 A. Yes. Shown in Figure 9, as with residential customer usage, the trends go in different
3 directions. The Company's long-view produces growth in usage per commercial customer
4 whereas the 10-year trend produces a decline.

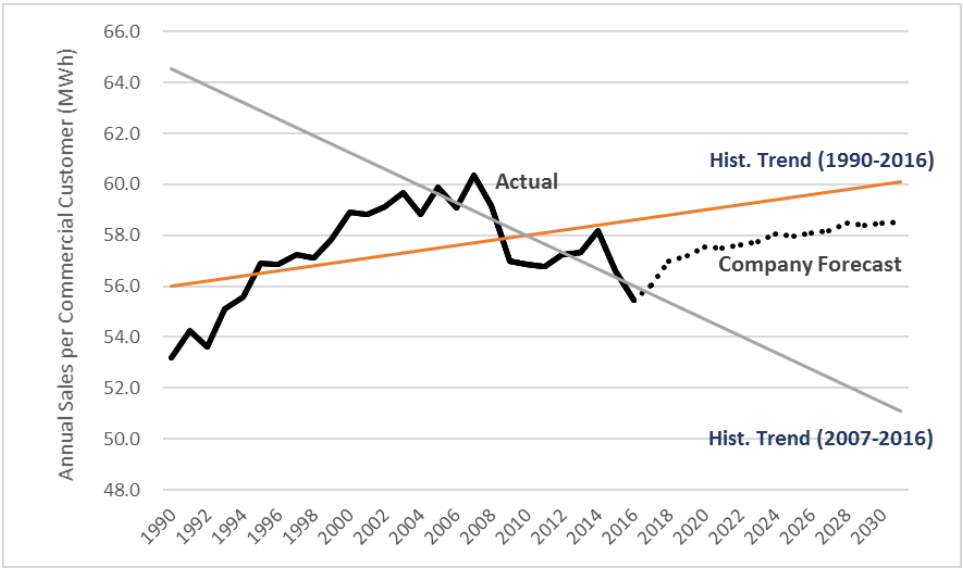

Figure 9: Commercial Usage per Customer, Historical Trends (Annual MWh)[22]

[21] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment."

Q. How does using the more reasonable ten-year historical data set change the modeling results?

A. I asked the Company to re-run its model using only the last ten years' worth of energy efficiency savings data, which I believe is more reasonable for the reasons discussed above. This change to the Company's methodology resulted in a reduction of 26 MW summer peak load in 2025, and 40.6 MW in 2030—compared to the Company's original methodology.[23]

Q. Is the Company's justification for not limiting its data set to more recent years reasonable?

A. No. A more reasonable data set would include only the last 10 years of data to assess future savings potential, for the reasons discussed above.

C. Apart From Demand-Side Management, The Company Did Not Conduct Sensitivities For Residential And Commercial Demand

Q. What load forecast scenarios did the Company examine?

A. The Company developed three load scenarios: base, low and high. These scenarios modeled differences in future industrial activity in the Company's service territory:

- The **base scenario** assumes specific levels of activity at existing industrial sites (projected by the Company) and it assumes that the proposed PolyMet mine (45 MW) is fully operational in 2020.

[22] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment;" trendline is a linear regression run in Excel.
[23] Minnesota Power's Response to CEO IR No. 73, "CEO IR 73.01_Attach."

- The **low scenario** is identical to the base scenario, except it excludes the PolyMet mine completely. Thus the low scenario load forecast is 45 MW lower than the base scenario forecast after 2020.

- The **high scenario** includes PolyMet as well as the proposed Magnetation 2&4 mine (26 MW) and Mesabi Metallics (70 MW). Thus the high scenario forecast is 96 MW higher than the base scenario forecast and 141 MW higher than the low scenario forecast.

Q. Did the Company assess potential variability in demand from residential or commercial sectors?

A. No, the Company only modeled one forecast of load and energy requirements for the residential and commercial sectors. This is unreasonable because, as shown in Figure 10 below, residential and commercial load has fluctuated substantially in the past. There is always uncertainty with what the load requirements will be in the future. However, the Company has only considered one path forward for residential and commercial customers.

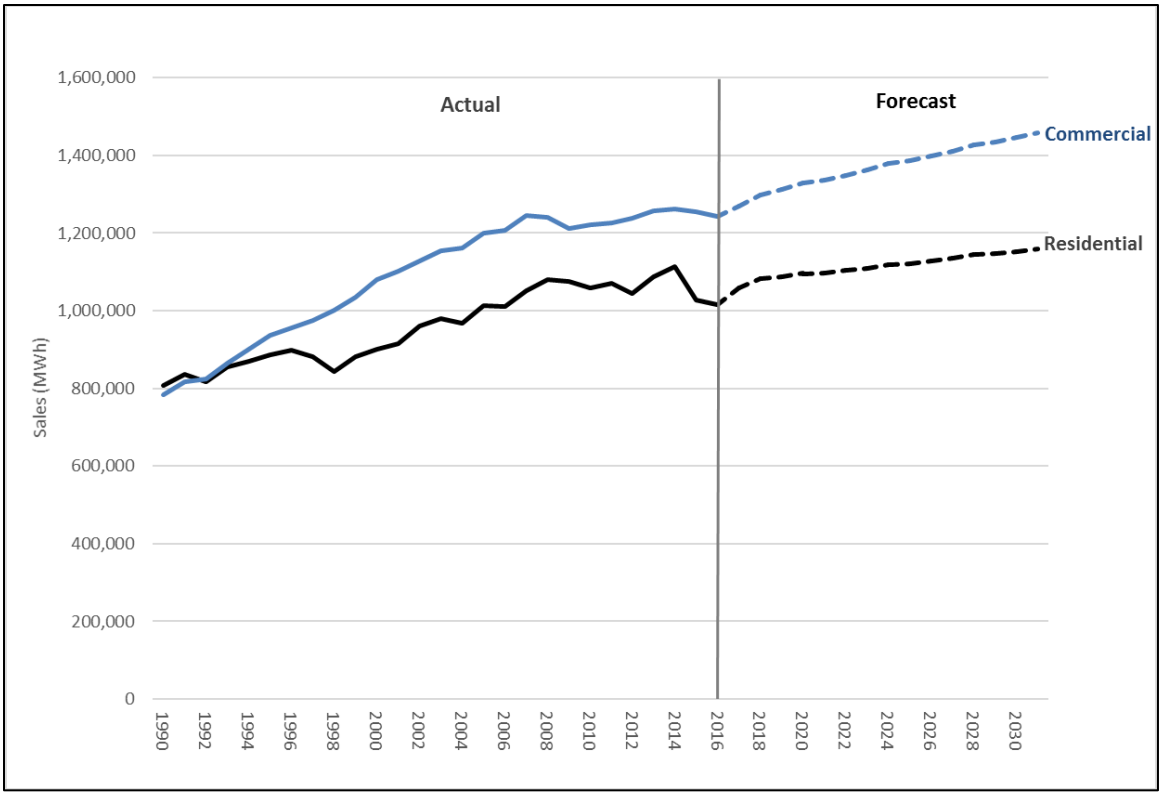

Figure 10: Company's Commercial and Residential Sales Forecasts[24]

Q. Is it standard practice for a utility to model sensitivities for residential and commercial load growth?

A. Yes. Other utilities acknowledge the uncertainty in future load growth by modeling a range of outcomes. For instance, Xcel Energy runs a probabilistic analysis to account for uncertainty of variables affecting demand.[25]

D. The Company Assumes Too Much Future Industrial Activity

Q. Do you have concerns about the assumptions Minnesota Power made about the future industrial load on its system?

[24] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment."
[25] *Xcel 2015 Upper Midwest Resource Plan*, Docket No. E002/RP-15-21, App. I, 8-14 (Jan. 2, 2015).

A. Yes. The Company has likely overestimated industrial activity in its territory. This leads to an overestimate of capacity need. First, the UPM Blandin paper mill 5 closed in 2017 yet is still included in all of the Company's forecasts. Minnesota Power witness Ms. Julie Pierce claimed that the impact of removing this customer would reduce demand by less than 20 MW.[26] Second, the PolyMet copper-nickel mine is included in the Company's base case while it is excluded in the low case. The base case assumes that this mine will be fully operational by 2020.[27] However, this is unlikely given the many regulatory hoops this project must jump through. PolyMet only recently received a draft Permit to Mine from the Minnesota Department of Natural Resources, but these are subject to comments and objections. Furthermore, there are a number of permits that PolyMet has yet to receive from both state and federal authorities, along with a construction timeline. This casts further doubt onto the actual commencement of mining operations.

Q. Does the inclusion of these customers that are not on Minnesota Power's system alter the analysis of the need for the proposed gas plant?

A. Yes, to an extent. Blandin paper mill 5 should clearly be removed from the analysis. The PolyMet mine is more uncertain. It is possible that it does not become operational by 2020. However, even if it were delayed by four years it would not change the capacity need in 2025—all else remaining equal.

[26] *Direct Testimony of Julie I. Pierce*, Docket No. E-015/AI-17-568, 48: 3 – 6 (Nov. 9, 2017).
[27] Based on Minnesota Power's Response to CEO IR No. 3, "CEO IR 03.03 Attachment;"

Q. Do you recommend an alternative forecast with more reasonable assumptions about the future industrial load on Minnesota Power's system?

A. Yes. I recommend that the Company's base case should include the high energy efficiency sensitivity modeled by the Company (embedded EE + 30 GWh), remove Blandin paper mill 5 and delay the Polymet mine by two to three years. These changes would reduce summer peak load by approximately 71 MW in 2025 and 95 MW in 2030—compared to the Company's base case.[28]

Q. Based on your analysis, is Minnesota Power's anticipated capacity need consistent with its Petition in this proceeding?

A. No. The Company has overstated its energy and capacity needs in multiple ways, including the following: underestimating energy efficiency, overestimating usage per customer, and overestimating industrial activity. All of these issues contribute to an upwardly biased assessment of need.

Q. Please summarize your methodology for correcting the issues you identified with Minnesota Power's load forecast.

A. I have utilized the Company's high energy efficiency sensitivity, used the Company's response to my request for using a 10-year historical trend in the econometric model, and removed the Blandin paper mill 5. I replicated the Company's summer capacity surplus/deficit analysis presented by Mr. Palmer with the following adjustments[29]:

[28] This calculation assumes that Blandin represents 20 MW of summer peak and that other peak reductions are additive.

[29] Palmer Direct at 52, Fig. 19.

1. I removed the 250 MW NTEC purchase.
2. I removed the peak load from Blandin paper mill 5.
3. I used the high EE sensitivity ("Embedded EE + 30 GWh)
4. I used a ten-year historical energy efficiency savings dataset.

Q. What are the results of the modeling using these corrected assumptions?

A. Figure 11 shows that under these assumptions, the Company would only have a deficit of 23 MW in 2025—increasing to 103 MW by 2030—without the NTEC purchase. There may not be a need for additional supply-side resources until 2030 if any of the following occur: 1) load grows at a slower rate than I assume, 2) the Company fulfills small capacity deficits with capacity market purchases, or 3) the Company pursues more demand response, such as the 54.9 MW of new peak load reduction proposed by Ms. Sommer. If the Company pursued the latter, it would have a capacity surplus in 2025 without the NTEC purchase.

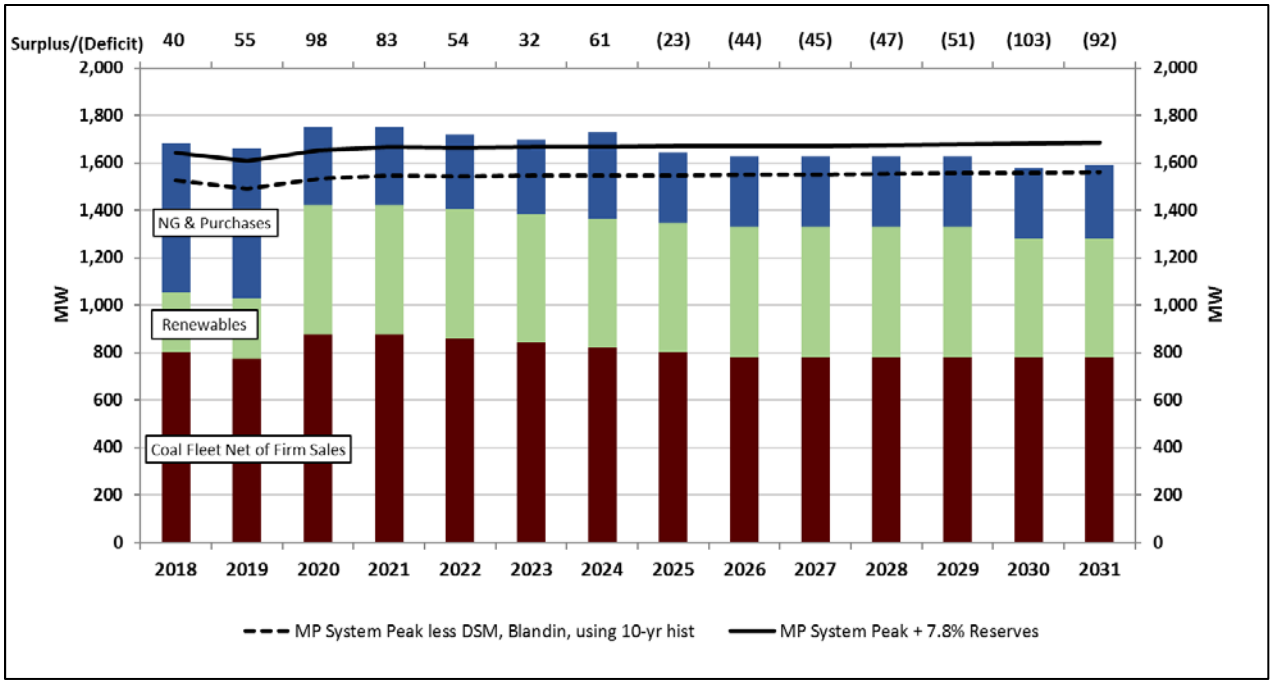

Figure 11: Summer Capacity Surplus/Deficit (MW) Based on Revised Load Forecast[30]

III. CONCLUSION

Q. Please summarize your testimony in this case.

A. Based on a review of the Company's methodology and assumptions, I conclude that the Company has overstated future load and energy requirements, and by extension, the capacity required for its system. The following are my key findings:

1. The Company has underestimated the amount of energy efficiency (EE) that they are likely to achieve going forward. This means that the load and energy requirements they model are too high. The high sensitivity modeled by the Company (embedded EE plus 30 GWh annual incremental) is a more reasonable base case. It is also the forecast that most closely adheres to the Commission's previous direction to the

[30] Based on Minnesota Power's Response to CEO IR 92, "CEO IR 92.01_Attach_Public."

Company regarding the amount of energy efficiency to be included in future resource planning analyses.

2. The Company also has likely overestimated the future usage of an average residential and commercial customer. This leads to an overestimation of total usage.

3. The Company has failed to conduct sensitivities for future residential and commercial energy and load growth. It conducted "low" and "high" cases but only varied which industrial sites would come to fruition. It also conducted sensitivities for demand-side management. However, there is significant uncertainty surrounding future residential and commercial requirements that has been ignored.

4. Regarding industrial sites, the Company has included one site that has closed (Blandin paper mill 5) and its base case includes an overly ambitious operating date for one mine (PolyMet's NorthMet mine). The Blandin paper mill (which accounts for 20 MW of load) should be removed and the PolyMet mine (which accounts for 45 MW) should be delayed several years—at a minimum—in the Company's modeling due to the inconsistency in its projected timeline.

I recommend that the Company's base case include the high energy efficiency sensitivity modeled by the Company (embedded EE + 30 GWh), remove Blandin paper mill 5 and delay the PolyMet mine by two to three years**.**

Q. Does this conclude your direct testimony?

A. Yes.

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PROFESSIONAL EXPERIENCE

Applied Economics Clinic. Somerville, MA. *Director and Senior Economist*, February 2017 – Present.

The Applied Economics Clinic provides technical expertise to public service organizations working on topics related to the environment, consumer rights, the energy sector, and community equity. Dr. Stanton is the Founder and Director of the Clinic (www.aeclinic.org).

Liz Stanton Consulting, Arlington, MA. *Independent Consultant*, August 2016 – January 2017.

Providing consulting services on the economics of energy, environment and equity.

Synapse Energy Economics Inc., Cambridge, MA. *Principal Economist*, 2012 – 2016.

Consulted on issues of energy economics, environmental impacts, climate change policy, and environmental externalities valuation.

Stockholm Environment Institute - U.S. Center, Somerville, MA. *Senior Economist*, 2010 – 2012; *Economist*, 2008 – 2009.

Wrote extensively for academic, policy, and general audiences, and directed studies for a wide range of government agencies, international organizations, and nonprofit groups.

Global Development and Environment Institute, Tufts University, Medford, MA. *Researcher*, 2006 – 2007.

Political Economy Research Institute, University of Massachusetts-Amherst, Amherst, MA. *Editor and Researcher – Natural Assets Project*, 2002 – 2005.

Center for Popular Economics, **University of Massachusetts-Amherst**, Amherst, MA. *Program Director*, 2001 – 2003.

EDUCATION

University of Massachusetts-Amherst, Amherst, MA

Doctor of Philosophy in Economics, 2007

New Mexico State University, Las Cruces, NM

Master of Arts in Economics, 2000

School for International Training, Brattleboro, VT

Bachelor of International Studies, 1994

AFFILIATIONS

Global Development and Environment Institute, Tufts University, Medford, MA.

Senior Research Fellow, 2007 – present

TEACHING EXPERIENCE

College of New Rochelle, New Rochelle, NY

Assistant Professor, Department of Social Sciences, 2007 – 2008

Tufts University, Medford, MA

Adjunct Professor, Department of Urban Environmental Policy and Planning, 2007, 2017

Fitchburg State College, Fitchburg, MA

Adjunct Professor, Social Sciences Department, 2006

University of Massachusetts-Amherst, Amherst, MA

Adjunct Professor, Department of Economics, 2003 – 2006

Castleton State College and the Southeast Vermont Community Learning Collaborative, Dummerston, VT

Adjunct Professor, 2005

School for International Training, Brattleboro, VT

Adjunct Professor, Program in Intercultural Management, Leadership, and Service, 2004

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