PSC REF#:366128

Public Service Commission of Wisconsin
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BEFORE THE
PUBLIC SERVICE COMMISSION OF WISCONSIN

Joint Application of American Transmission Company LLC, ITC Midwest LLC, and Dairyland Power Cooperative, for Authority to Construct and Operate a New 345 kV Transmission Line from the Existing Hickory Creek Substation in Dubuque County, Iowa, to the Existing Cardinal Substation in Dane County, Wisconsin, to be Known as the Cardinal-Hickory Creek Project	Docket No. 5-CE-146

DIRECT TESTIMONY OF MARY NEAL
ON BEHALF OF CITIZENS UTILITY BOARD

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

A. My name is Mary Neal. I am a Senior Project Manager at MRW and Associates, 1736 Franklin St., Oakland, CA, 94612.

Q. Please state your educational background and experience.

A. I received my B.S., Mechanical Engineering in 2005 from the University of California, Davis, and my M.A., Energy and Environmental Analysis in 2010 from Boston University. I have worked in energy consulting for the regulated utility industry for close to ten years. As part of my consulting work, I have reviewed several Wisconsin electric utility fuel cost plans. Moreover, I have reviewed electric utility plans for the acquisition and building of new resources, as well as capital upgrades to existing units for utilities in four states, including Wisconsin, and in two Canadian provinces. I have also provided extensive analysis of electric utility cost allocation models and assisted in analyzing electric and gas rate design in various regulatory proceedings. In addition, I have critiqued and helped develop electric utility integrated resource plans. Prior to my work in consulting I worked

for Solar Turbines, Inc. for three years, designing low-emissions combustion systems for industrial gas turbine engines. My resume is provided in Ex.-CUB-Neal-1.

Q. Have you testified before this Commission before?

A. Yes. I presented testimony on Madison Gas and Electric Company's 2013 Fuel Cost Plan before the Public Service Commission of Wisconsin ("PSCW" or "the Commission") in Docket 3270-UR-118 and on Wisconsin Public Service Corporation's 2015 Fuel Cost Plan in Docket 6690-UR-123 and 2016 Rate Case in Docket 6690-UR-124. I also filed testimony in Joint Dockets 05-CE-145/05-CE-147, relating to Wisconsin Electric Power Company's application to upgrade the Elm Road Generating Station and its associated fuel handling system to accommodate increased fuel flexibility.

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

A. I am testifying on behalf of the Citizen's Utility Board of Wisconsin ("CUB").

Q. What is the purpose of your direct testimony?

A. My testimony presents the results of my analysis of American Transmission LLC, ATC Management Inc. (collectively "ATC"), ITC Midwest, and Dairyland Power Cooperative's ("Applicants") Application for PSCW Certificate of Public Convenience and Necessity ("Application") for the Cardinal-Hickory Creek Transmission Line Project ("the Project") in this proceeding. Specifically, I researched the following:

- Whether the Applicants' analysis of the benefits of the Project was reasonable and how such benefits would vary for different Wisconsin utilities
- Whether the Applicants' analysis of benefits of alternatives to the Project was reasonable

- Whether Applicants considered all reasonable alternatives to the Project, especially because technological advancements since 2011—when the project was first analyzed—have spurred development of solar and lithium ion ("Li-ion") batteries

Q. Are you sponsoring any exhibits associated with your direct testimony?

A. Yes. I am sponsoring the following exhibits:

- Ex.-CUB-Neal-1: Resume
- Ex.-CUB-Neal-2, Ex.-CUB-Neal-3, Ex.-CUB-Neal-4, Ex.-CUB-Neal-5, Ex.-CUB-Neal-6: Applicants' Responses to CUB Discovery Requests
- Ex.-CUB-Neal-7: U.S. Energy Information Administration, "U.S. Battery Storage Market Trends," May 2018
- Ex.-CUB-Neal-8: Bloomberg New Energy Finance, "Battery Power's Latest Plunge in Costs Threatens Coal, Gas," March 26, 2019

I. Cardinal-Hickory Creek Project Benefits

Q. Please briefly describe the benefits of the Project quantified by the Applicants.

A. The Applicants studied the following potential benefits[1] of the Project:[2]

- **Energy Cost Savings:** Benefit of more efficient generation dispatch, lowering generation production costs, market prices, and transmission congestion and losses.
- **Insurance Value:** Economic value of lower energy prices than would otherwise have occurred during emergency events because a project is in service.

[1] Applicants also estimated the Project's impact on market competitiveness, but this is not included in the discussion in this testimony because the benefits were not quantified in dollars of savings to Wisconsin customers.

[2] Ex.-Applicants-Application, Revised Appendix D, Planning Analysis, pages 22-24.

- **Capacity Loss Savings:** Benefit of increased capacity due to lower transmission losses or increased generation. The Project provides Capacity Loss Savings through reduced transmission losses.
- **Avoided Reliability and Asset Renewal:** Avoided cost of transmission assets needed for reliability or to replace existing aging assets.

Q. What were the quantitative benefits of the Project based on the results of the Applicants' analysis?

A. Table 1 below summarizes the results for each future scenario presented in the Direct Testimony of Tom Dagenais. These scenarios incorporate different assumptions about future generation additions, generation retirements, load, fuel prices, and carbon reductions, which impact the estimates of Energy Cost Savings benefits. These futures are described in detail in Appendix D to the Application,[3] and are summarized briefly below:

- **Existing Fleet ("EF"):** Generation fleet is largely unchanged and natural gas prices are low.
- **Policy Regulations ("PR"):** Assumed carbon regulations drives some increase in coal retirements and renewable generation additions. Natural gas prices remain at reference levels.
- **Accelerated Alternative Technologies ("AAT"):** A robust economy drives technological advancement, increasing renewable generation additions. Natural gas prices are high due to increased demand.
- **Policy Regulations Variants:** The PRFoxconn case is the same as the PR future but adds 200 MW of load due to the opening of the proposed Foxconn manufacturing facility in Mount Pleasant, Wisconsin. The PR with Midcontinent Independent System Operator

[3] Ex.-Applicants-Application, Revised Appendix D, Planning Analysis, pages 41-43.

("MISO") Low Energy ("PRLE") future is the same as the PR future but uses the MISO "Low" demand and energy forecast used in the EF future.

- **PSCW Variants:** Each of the EF, PR, and AAT futures were modeled with some changes at the request of Commission Staff.

Table 1. Summary of estimated benefits of the Project in each future presented in the Direct Testimony of Tom Dagenais.[4]

	(A) Avoided Reliability and Asset Renewal	(B) Energy Cost Savings	(C) Insurance	(D) Greater of A or B+C	(E) Capacity Loss Savings	TOTAL (D+E)
EF	$87.2	$38.9	$6.0	$87.2	$2.5	$89.7
EFPSCW	$87.2	$33.6	$6.0	$87.2	$2.5	$89.7
PR	$87.2	$164.0	$6.0	$170.0	$2.5	$172.5
PRFoxconn	$87.2	$187.7	$6.0	$193.7	$2.5	$196.2
PRLE	$87.2	$214.6	$6.0	$220.6	$2.5	$223.1
PRPSCW	$87.2	$153.3	$6.0	$159.3	$2.5	$161.8
AAT	$87.2	$407.8	$6.0	$413.8	$2.5	$416.3
AATPSCW	$87.2	$383.6	$6.0	$389.6	$2.5	$392.1

Q. Do the Applicants claim that the benefits of the Project are robust across all futures analyzed?

A. Yes. Applicant witness Tom Dagenais states, "Using these wide variations in assumptions, in every one of the modeling runs—including those requested by the Commission staff—the Project provides net economic benefits to Wisconsin customers."[5]

Q. Do you agree with this conclusion?

A. No. In the EF futures, Energy Cost Savings benefits were much lower than other futures, and when combined with the Insurance and Capacity Loss Savings benefits ($42.1 million-

[4] Direct-Applicants-Dagenais-34, Table 4; Direct-Applicants-Dagenai-36-37, Tables 6-7; Direct-Applicants-Dagenais-43, Table 11.

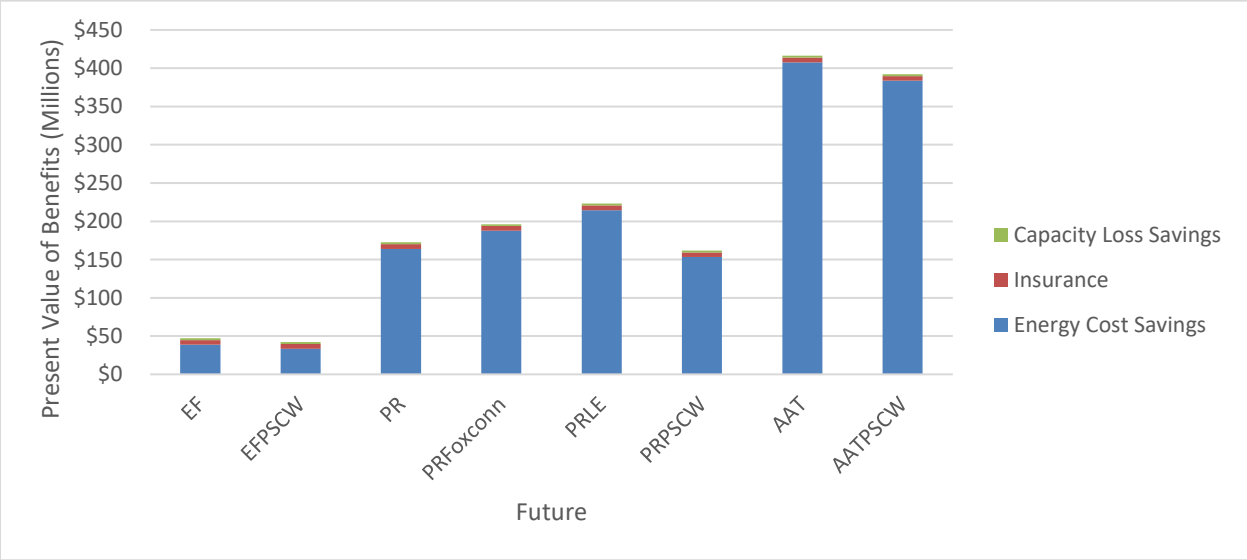
[5] Direct-Applicants-Dagenais-9, lines 2-4.

$47.4 million) would be lower than the estimated cost of the Project borne by Wisconsin ratepayers ($67 million[6]). Thus, for these cases, the Applicants rely on avoided reliability and asset renewal benefits to claim the Project will provide a net benefit to Wisconsin. Those benefits would be the same under all futures analyzed, and do not support the claim that the Project benefits are robust.

Q. Did you perform a detailed review of all the Applicants' benefit calculations?

A. No. I focused my review on the Energy Cost Savings benefits of the Project because that was the majority of the benefit of the Project in most of the futures analyzed, as shown in Figure 1.

Figure 1. Present value of Capacity Loss Savings, Insurance, and Energy Cost Savings benefits of the Project in all futures presented in the Direct Testimony of Tom Dagenais.[7]



Q. How did the Applicants estimate Energy Cost Savings benefits?

A. Applicants used PROMOD modeling software to estimate the Energy Cost Savings benefits. Applicants compared adjusted production costs ("APC") without the Project ("No Action"

[6] Direct-Applicants-Dagenais-45, Table 12.
[7] Direct-Applicants-Dagenais-34, Table 4; Direct-Applicants-Dagenais-36-37, Tables 6-7.

alternative) and with the Project in three Wisconsin zones: ATC, Dairyland Power Cooperative ("DPC"), and Northern States Power ("NSP"). For the ATC zone, they also examined changes in internal congestion costs, external congestion costs, financial transmission rights ("FTR") revenues, and marginal loss charges and refunds. Further detail on the methodology used to estimate Energy Costs Savings benefits is provided in Appendix D-5 to the Application.

Q. Please describe your general approach to evaluating the Energy Cost Savings benefits.

A. I focused my analysis on the following questions:

- How did the benefits vary by zone within Wisconsin?
- Were the benefits mainly APC benefits or were the additional congestion and loss-related benefits estimated for the ATC zone significant? If they were significant, was this result reasonable?
- What was the sensitivity to key input assumptions? Were the benefits robust across the futures analyzed or not?
- How did the Project change the generation dispatch in the upper Midwest? Did the Project enable transfers of wind generation from states west of Wisconsin as Applicants have claimed? Did it change the dispatch of fossil fuel plants?

The remainder of this section of my testimony presents the results of my analysis.

Q. How did the changes in future scenarios impact the Energy Cost Savings benefits and how do these benefits vary by zone?

A. The chart below shows the Wisconsin Energy Cost Savings Benefits broken down by type and geographic zone. Almost all benefits occur in the ATC zone, which would be expected because the Project connects to this zone. Benefits were greatest in the AAT futures, which

have the highest natural gas prices and renewable generation additions. As indicated earlier, benefits were much lower in the EF futures, which have the lowest natural gas prices and renewable generation additions.

Figure 2. Present Value of Energy Cost Savings Benefits of the Project in all futures presented in the Direct Testimony of Tom Dagenais.[8]

[redacted]

Q. What are you concerns with the Applicants' Energy Cost Savings analysis?

A. After completing my investigation of the questions outlined above, I identified the following concerns:

- The Applicants failed to quantify the additional wind generation enabled by the Project. My own analysis indicates that Applicants have greatly overstated the wind-related benefits of the Project and that such benefits are highly speculative.

[8] Att. 1 to 01-DALC-ATC-33, CONFIDENTIAL Category C. The series labeled "ATC APC Savings" in this figure and Figures 8 and 12 refer to the subtotals under "Cost of Generation Supply" in the "Customer Benefit" tabs of the cost-benefit model workpapers. The notes in the "Customer Benefit" tabs indicate this is meant to refer to a production cost.

- In most future scenarios, Energy Cost Savings benefits are comprised mostly of reduced congestion within the ATC zone, but such a benefit is also speculative and may not be reasonable.
- The Applicants only estimated reduced CO_2 emissions within Wisconsin, which is not appropriate and ignores the increased fossil-fired generation outside of Wisconsin enabled by the Project.

I will address each of these concerns below.

Q. Please define what you refer to as "wind-related" benefits of the Project.

A. The most important expected benefit of the Project—as stated in the Application and supporting direct testimony numerous times[9]—is to provide an outlet for wind generation from Iowa and other wind rich areas of the upper Midwest to load centers in Wisconsin. Thus, the expectation is the Project would allow greater wind generation and an associated decrease in fossil fuel burned, and thus a decrease in fuel cost to serve Wisconsin load.

Q. Did the Applicants' Energy Cost Savings analysis quantify the increased wind generation enabled by the Project?

A. No. The Applicants did not perform any specific analysis to show wind generation output increased due to the addition of the Project.[10]

Q. Did you attempt to quantify the expected increase in wind generation due to the Project?

[9] Direct-Applicants-Dagenais, page 7, line 10 to page 8 line 9; page 11, lines 16-23; page 12, line 11 to page 13, line 12; page 14, lines 1-19; page 15, lines 8-12; page 18, lines 5-15; page 20, lines 3-11; page 46, lines 9-11; page 48, line 9 to page 49, line 21; page 53, lines 8-11. Ex.-Applicants-Application, pages 1, 4, 30-32, 35-37, 56-57, 58, 61.

[10] Ex.-CUB-Neal-2: Applicants' response to 3-CUB/Inter-8, part c.

A. Yes. I analyzed the output of all generators in MISO Local Resource Zones ("LRZs") 1, 2, and 3. I compared the total wind output in these regions in the "No Action" case and the case including the Project. To scale the projected increase in wind generation, I converted the total change in MWhs of generation to an equivalent capacity (MW) using an assumed annual capacity factor of 40%. So far, my analysis has been limited to the futures with PSCW Staff modifications because the results for the remaining scenarios were produced too late for me to analyze in time for this testimony. I will supplement my analysis in future testimony in this proceeding.

Q. What were the primary results of your analysis to date of increased wind generation enabled by the Project?

A. The amount of wind generation enabled by the Project varies strongly based on the assumed amount of new renewable generation built in the MISO region. I found no significant increase in wind generation in the EF future, only a small increase in wind generation in the PR future in 2031, and about [redacted] of equivalent wind generation increase in the AAT future in years [redacted]. The chart below shows these findings graphically.

Figure 3. Increase in equivalent wind capacity due to the Project assuming a 40% capacity factor.[11]

[redacted]

Q. How does the increased wind generation enabled by the Project vary by area according to your analysis?

A. As shown in the chart below, the increase is highly concentrated in the [redacted] area.[12] In the AAT case, the wind in other areas actually declines due to the addition of the Project.

[11] Attachment 1 to 3-CUB-RFP-2, CONFIDENTIAL Category D, E.

[12] "Area" as discussed here and shown in Figures 4, 5, and 9, refers to the "Area" label in lists of generating units provided in Att. 1 to 01-DALC-ATC-38. However, because companies own generation outside their service territories, the term "area" should only be considered as an approximate geographic region.

Figure 4. Increase in equivalent wind capacity due to the Project by area.[13]

[redacted]

Q. Is the increased wind output evenly distributed throughout the [redacted] area?

A. No. The vast majority of the increase derives from generic wind additions in the area, especially a unit labeled [redacted] The chart below shows this graphically.

[13] Attachment 1 to 3-CUB-RFP-2, CONFIDENTIAL Category D, E. The ATC area as labeled in this figure and Figure 9 includes all companies listed as the ATC zone in Applicants' response to 3-CUB/Inter-9.

Figure 5. Increase in equivalent wind capacity in the Alliant West area due to the Project.[14]

[redacted]

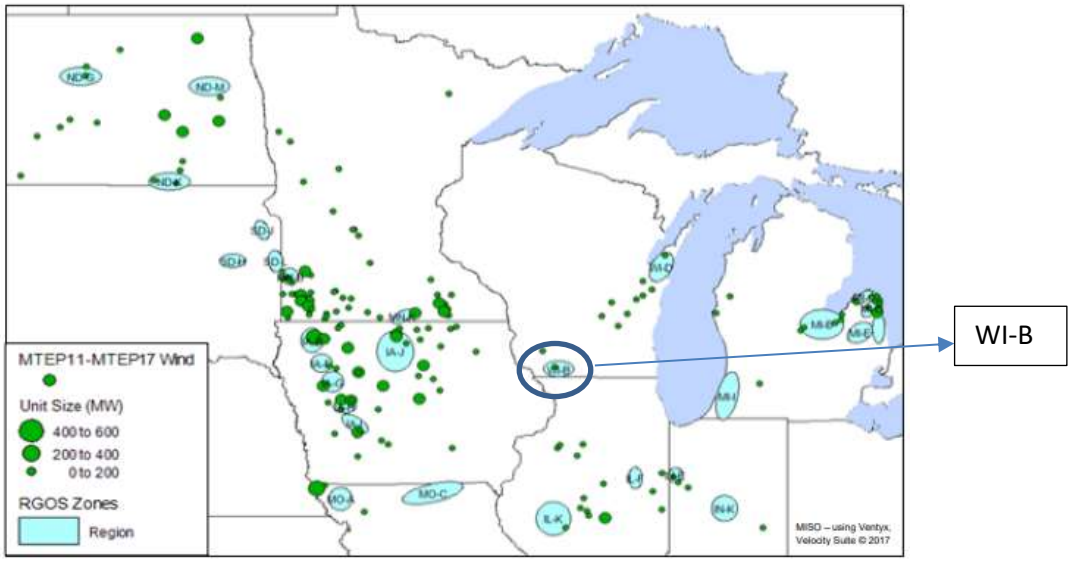
Q. [redacted]

A. [redacted]

RGOS WI-B refers to Renewable Generation Outlet Study ("RGOS") zone Wisconsin-B, which is located in the southwestern corner of the State of Wisconsin as shown in the map below, taken from a MISO report. This area is also local to the Project.

[14] Attachment 1 to 3-CUB-RFP-2, CONFIDENTIAL Category D, E.

Figure 6. MISO RGOS Zones compared to actual wind development.[15]



I have asked Applicants for further information about this generator and how it was modeled, but am still waiting for a response.

Q. Is the location of the increased wind generation important?

A. Yes. The cost of new wind development varies significantly by location, and Figure 6 above shows the RGOS WI-B area has not been subject to as much wind development as other areas in the upper Midwest. I have identified only two wind farms in that area of Wisconsin: Quilt Block Wind Farm (98 MW)[16] and the Montfort Wind Energy Center (30 MW).[17] There is one 65 MW proposed wind farm in Green County, the Sugar River Wind Project,[18] and also about 240 MW of wind in that area actively in the MISO queue. Figure 7 below shows a map of generation in the MISO queue and the 240 MW refers to the wind generation in the circled region in the figure. This 305 MW of potential wind development

[15] Ex.-Applicants-Application, Appendix D, Revised Planning Analysis Appendices, D-10, p. 47.

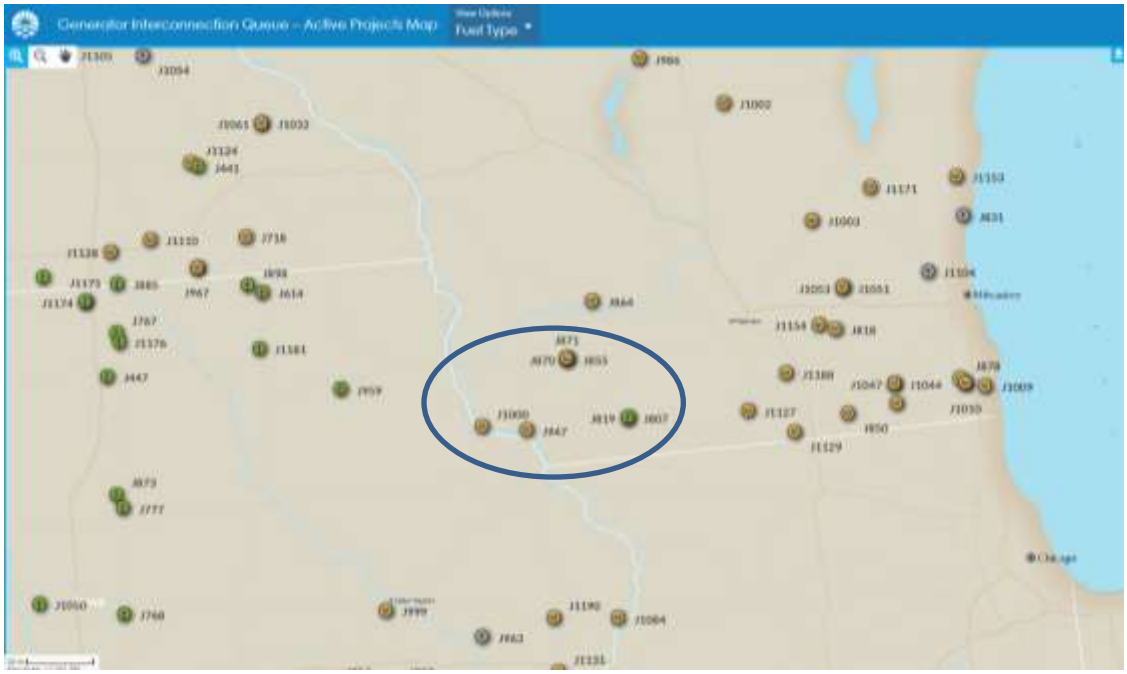
[16] EDP Renewables, *Quilt Block Wind Farm,* https://quiltblockwindfarm.com/.

[17] WE Energies, *Montfort Wind Energy Center,* https://www.we-energies.com/home/montfort-wind-energy-center.htm.

[18] Sugar River Wind Project, https://www.sugarriverwind.com/.

(active queue plus Sugar River Wind) is only about half the assumed capacity of [redacted] [redacted][19]

Figure 7. MISO Interconnection Queue Map showing Approximate Location of RGOS WI-B zone.[20]



Q. What do you conclude regarding your analysis of the Project's wind-related benefits?

A. Wind-related benefits are limited to futures with significant additions of generic renewable resources, which are speculative, especially to the extent the benefits derive from subregions without a strong history of wind development. And while the [redacted] area does have a history of a wind development on the order of 130-430 MW, that is a far cry from the thousands of MW of historical and planned wind development in other states, especially Iowa and Minnesota.

[19] Att. 1 to 01-DALC-ATC-38, CONFIDENTIAL Category D, E.

[20] MISO Interconnection Queue Map, https://api.misoenergy.org/PublicGiQueueMap/index.html, accessed 20 April 2019.

Q. What do you recommend regarding the Project's wind-related benefits?

A. I recommend the Commission not approve the Project on the basis of anticipated wind-related benefits without one of the following:

- Direct evidence the Project is needed to support wind generation outside the area local to the Project such as the Iowa and Southern Minnesota RGOS zones that have the heaviest wind development; or
- An analysis of wind or other generation local to the Project, including
    - Direct evidence this Project is necessary to interconnect this generation
    - Quantification of the costs and benefits of this new generation to Wisconsin customers.

Q. Please define internal congestion savings benefits as shown in Figure 2.

A. Applicants estimated the transmission congestion within the ATC zone by multiplying the zone's load net of imports by the difference in the marginal congestion component of load node locational marginal prices (LMPs) and the marginal congestion component of generation node LMPs. It performed this calculation in all of its runs, and to the extent such congestion was reduced in the case with the Project, it was assumed to be a benefit of the Project. However, 85% of such costs were assumed to be hedged by FTRs, such that only 15% of the benefit would accrue to Wisconsin customers.[21] As Figure 2 shows, this internal congestion savings makes up a large portion of the benefits of the Project in the Applicants' analysis.

Q. Please explain your concern regarding the internal congestion savings benefits generated by the Project.

[21] Ex.-Applicants-Application, Appendix D, Revised Planning Analysis Appendices, D-5.

A. I am concerned that:

- The internal congestion may just be an artifact of PROMOD modeling that may never materialize.
- Even if internal congestion is or becomes a real problem, the Project may not be the most cost-effective way to reduce such congestion, and there is evidence the Project could increase such congestion.

Q. Why could the internal congestion just be an artifact of PROMOD?

A. Internal congestion benefits are much higher in the [redacted] futures than the [redacted] future, possibly because they include more generation development, which could be a source of the congestion. If so, it is possible such congestion could be avoided using a different configuration of generation within the zone than that assumed in PROMOD.

Q. If the internal congestion is not just an artifact of PROMOD, would it be reasonable to support the Project as a means to reduce this congestion?

A. Not without further analysis. It is not intuitive that a line designed with the intent of enabling access to wind generation outside of Wisconsin would be a good solution for decreasing congestion within Wisconsin. In addition, the Applicants provided evidence that the Project could increase congestion east of the Eden substation,[22] which indicates this is not the best solution for reducing internal congestion in the ATC zone. Other transmission investments or the use of more financial hedges could provide congestion reduction benefits at lower cost.

Q. What are the benefits of the Project if consideration of the internal congestion benefits is excluded?

[22] Direct-Applicants-Dagenais-34, lines 3-5.

A. Figure 8 below is a revised version of Figure 2, but without the internal congestion benefits. As the Figure shows, only in [redacted] of the futures would there still be adequate Energy Cost Savings benefits to justify the Project.

Figure 8. Present Value of Energy Cost Savings Benefits of the Project in all futures presented in the Direct Testimony of Tom Dagenais with Internal Congestion Savings excluded.[23]

[redacted]

Q. What do you recommend regarding the estimated internal congestion-related benefits of the Project?

A. I recommend the Commission disregard the estimated internal congestion-related benefits of the Project unless the Applicants can show adequate evidence the internal congestion in PROMOD is not just a modeling artifact and that the Project is a cost-effective way to reduce congestion within the ATC zone.

[23] Att. 1 to 01-DALC-ATC-33, CONFIDENTIAL Category C.

Q. Please explain your concern regarding how Applicants analyzed CO_2 reductions of the Project.

A. Applicants relied on the PROMOD model results to estimate the change in Wisconsin's greenhouse gas emissions due to the Project.[24] However, this is not an appropriate metric to evaluate the environmental benefits of a new transmission line that brings new imports into a region. Such imports could be of renewable energy, such as wind, but could also be from fossil fuel plants in external areas. A more appropriate metric to consider would be the emissions reduction created in the entire MISO region, but Applicants did not perform this analysis.[25]

Q. Is there evidence that the Project increases fossil fuel generation outside of Wisconsin?

A. Yes. In addition to analyzing changes in wind generation due to the Project, I also analyzed changes in coal generation due to the Project. Coal generation outside the ATC zone i[redacted] in all futures for which I have data, and there was a net [redacted] in coal generation in the [redacted]. The chart below summarizes the results of this analysis.

[24] Direct-Applicants-Dagenais-50, lines 3-6.
[25] Ex.-CUB-Neal-3: Applicants' Response to 2-CUB/Inter-8B.

Figure 9. Change in coal generation due to the Project in MISO Zones 1, 2, and 3.[26]

[redacted]

Q. What do you recommend regarding the Applicants' analysis of CO_2 emissions reductions?

A. I recommend the Applicants provide an analysis of the Project's impact on regional greenhouse gas emissions to the Commission prior to its decision whether to approve the Project.

Q. Overall, what do you conclude regarding the Energy Cost Savings benefits of the Project?

A. Based on my analysis to date, contrary to the Applicants' claims that the Project benefits are robust across multiple future scenarios, the Project's benefits are distinctly different in each of the primary futures: EF, PR, and AAT. Below I provide a brief summary of the results of each future:

[26] Attachment 1 to 3-CUB-RFP-2, CONFIDENTIAL Category D, E.

- **EF:** Based strictly on the Applicants' results, the Project provides no significant increase in wind generation, and the Energy Cost Savings benefits are not enough to justify the cost of the Project to Wisconsin ratepayers. In this future, the Project is an oversized reliability Project[27] that only appears cost-effective for Wisconsin ratepayers because of MISO's cost allocation treatment for multi-value projects.
- **PR:** Except in the Low Energy variant, which I have not had the ability to analyze in detail, the Project only provides significantly more Energy Cost Savings benefits than under the EF future due to anticipated decreases in congestion within the ATC zone. Such benefits are highly speculative given the evidence the Project also increases congestion in the ATC zone. The Project also provides very little increased wind generation and a net increase in coal generation in the upper Midwest.
- **AAT:** The Project provides Energy Cost Savings benefits stemming from an increase in wind generation equivalent of about [redacted], which appears to be [redacted]. Whether such wind would provide a net benefit to Wisconsin customers would require further analysis of the cost and likelihood of such wind development.

Q. Overall what do you recommend regarding the Energy Cost Savings benefits of the Project?

A. Based on my analysis to date, I recommend the Commission not approve the Project on the basis of expected Energy Cost Savings benefits without further analysis from Applicants as outlined in my testimony. I will supplement my findings and recommendations when more data becomes available for analysis.

[27] The Project is oversized in the sense that it costs $492 million (Ex.-Applicants-Application, Revised Appendix D, Table 46, page 89), but avoids only $90.7 million in capital costs for reliability projects (Ex.-Applicants-Application, Revised Appendix D, Table 29, page 65).

II. Applicants' Analysis of Alternatives to the Project

A. Non-Transmission Alternative

Q. Please describe the Non-Transmission Alternative ("NTA").

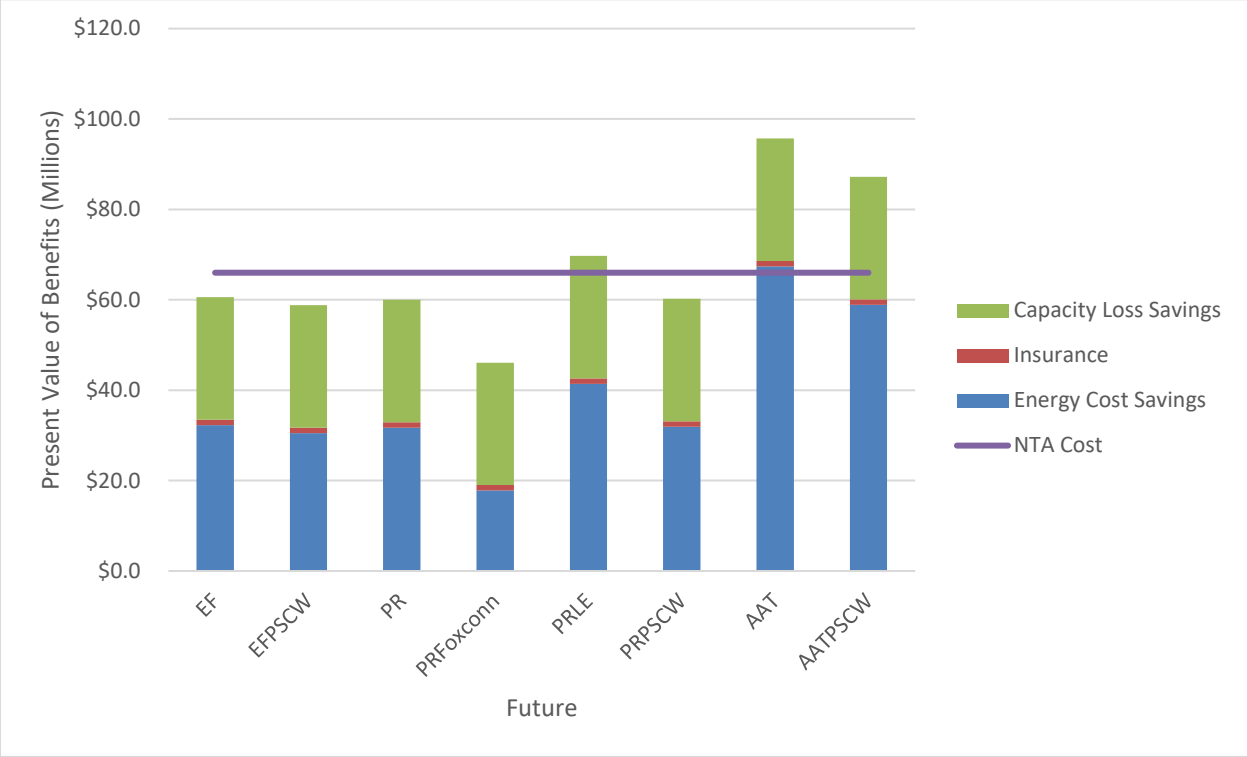
A. The NTA is a portfolio of new generation, including energy efficiency, demand response, utility-scale solar, and residential solar resources. Demand response and utility-scale solar are the primary components of the portfolio. The portfolio is sized to have approximately the same cost to Wisconsin customers as the Project. Further details regarding the NTA can be found in Appendix D to the Application.[28]

Q. What were the benefits of the NTA based on the Applicants' analysis?

A. The figure below summarizes the benefits of the NTA according to the Applicants' analysis. As the chart shows, the NTA is a significant source of both Energy Cost Savings and Capacity Loss Savings benefits. The NTA does not provide avoided reliability or asset renewal benefits, which are limited to transmission alternatives.

[28] Ex.-Applicants-Application, Revised Appendix D, Planning Analysis, pages 29-31.

Figure 10. Present value of Capacity Loss Savings, Insurance, and Energy Cost Savings benefits of the NTA in all futures presented in the Direct Testimony of Tom Dagenais.[29]



Q. What concerns do you have regarding the Applicants' NTA analysis?

A. I am concerned by the following:

- The NTA provides a net cost as opposed to a net benefit in most futures, which is surprising and highly doubtful given the intense and rising interest in new solar development in Wisconsin.
- The reliance on demand response as an alternative to the Project is questionable, given the primary benefit of the Project is Energy Cost Savings, which demand response would not provide.
- The analytical methodology used in the Applicants' analysis is incomplete because it does not provide a full portfolio analysis of new generation resources.

[29] Direct-Applicants-Dagenais-34, Table 4; Direct-Applicants-Dagenais-36-37, Tables 6-7; Direct-Applicants-Dagenais-45, Table 12.

- The costs of new solar development were likely overstated in the analysis.
- The NTA provides a larger increase in total wind and solar generation than the Project in some futures.
- The Applicants ignore the greatest qualitative benefit of the NTA, which is the ability to avoid siting 100 miles of new transmission line through potentially environmentally sensitive areas.

I describe each concern in more detail below.

Q. Please describe your concern regarding the net cost of the NTA compared with your expectations given the ongoing trends in Wisconsin generation development.

A. As Figure 10 shows, the NTA's benefits do not exceed its costs in several futures analyzed by the Applicants. This is a surprising result for an alternative that relies heavily on utility-scale solar because of the intense interest in utility-scale solar development in Wisconsin today. The Commission recently approved the development of Badger Hollow and Two Creeks solar farms. In addition, the MISO interconnection queue currently has over 4,500 MW of solar projects in Wisconsin with Active status.[30]

Q. Please describe your concern regarding the reliance on demand response in the NTA portfolio of resources.

A. The portfolio includes 66.5 MW of generation resources, of which 31.5 MW is demand response. Demand response—essentially interruptible load—is a capacity resource that is not expected to generate much, if any, Energy Cost Savings benefits. Given the Project's primary benefit is Energy Cost Savings, as shown in Figure 1, the heavy reliance on demand

[30] MISO Interconnection Queue, https://www.misoenergy.org/planning/generator-interconnection/GI_Queue/#, accessed 20 April 2019.

response in the NTA portfolio is a questionable decision since it is supposed to represent an alternative to the Project.

Q. Please describe your concern regarding the analytical methodology used to analyze the benefits of the NTA.

A. The Applicants analyzed the NTA based on its ability to reduce fuel costs, improve dispatch efficiency, and avoid market purchases of capacity in MISO's resource adequacy market. Under this analytical framework, the benefits of the NTA depend on certain assumptions regarding market clearing prices for both energy and capacity markets and the technologies that set those prices. What this analysis does not show is what portfolio of resources would be optimal for meeting the demand of Wisconsin customers. Such a portfolio could include new wind farms in Wisconsin, new utility-scale solar such as in the NTA, new gas generation, demand response, or some combination of these or other resources. The Applicants have not provided such an analysis.

Q. Please describe your concern regarding the cost of utility-scale solar relied upon in the Applicants' NTA analysis.

A. The utility-scale solar overnight capital costs used as the basis to cost the NTA were based off the "MISO Utility PV Mid estimate," which was about $1,900/kW for an in-service date of 2023.[31] This is 46% higher than the cost estimate for the recently-approved Badger Hollow and Two Creeks solar farms, which was only $1,299/kW for an in-service date of 2021.[32] It is not reasonable to assume that solar costs will increase such a large amount in two years, especially given recent declines in the capital costs of utility-scale solar

[31] NTA workpapers, Attachment 1 to 01-DALC-ATC-14, Non-Confidential.

[32] *Joint Application of Wisconsin Public Service Corporation and Madison Gas and Electric Company for Approval to Acquire Ownership of Solar Generating Facilities*, Application, pp. 3, 8 (May 31, 2018) (PSC REF#: 343600).

developments. This means the NTA is significantly undersized, and the Applicants have underestimated the benefits of utility-scale solar as an alternative to the Project.

Q. Please describe your finding that the NTA provides a larger increase in total wind and solar generation than the Project in some futures.

A. Using the same PROMOD results as I used to analyze the impact of the Project on wind and coal generation, I analyzed the total increase in wind and solar generation produced by the Project and the NTA and summarized the results in Figure 11. As the Figure shows, the NTA provides a larger increase in renewable energy than the Project in the [redacted] future. In the [redacted] future, it adds more renewable energy in 2021, about the same amount in 2026, but less in 2031. These results indicate that building 32 MW of solar generation (30 MW of utility-scale and 2 MW of residential) within Wisconsin would provide more renewable energy to the grid than the Project unless there are significant additions of new wind capacity in the upper Midwest region as modeled in the AATPSCW future and 2031 of the PRPSCW future.

Figure 11. Comparison of additional renewable generation created by the Project and NTA in EFPSCW and PRPSCW futures.[33]

[redacted]

Q. Please describe your concern regarding the Applicants' lack of consideration for the primary qualitative benefit of the NTA.

A. The Applicants describe a set of qualitative benefits of the Project compared to the alternatives studied in its analysis in Section 7 of Appendix D to the Application. However, the Applicants ignore the main qualitative benefit of the NTA in this discussion, which is the ability to avoid the environmental siting concerns that come with building any long-distance transmission line. This is a significant oversight.

Q. Overall, what do you conclude about the NTA?

A. I conclude the following:

- The Applicants have significantly overstated the costs of new utility-scale solar developments in Wisconsin, and thus understated the potential quantitative benefits of an

[33] Based on generation output in MISO Zones 1, 2, and 3. Attachment 1 to 3-CUB-RFP-2, CONFIDENTIAL Category D, E.

NTA with utility-scale solar generation. The Applicants also understate the qualitative benefits of the NTA because they ignore its main qualitative benefit, which is the ability to avoid the environmental siting concerns that come with building any long-distance transmission line.

- An NTA that relies more on utility-scale solar and less on demand response would be a more appropriate alternative to the Project. Such an NTA, combined with more reasonable utility-scale solar cost assumptions, would be likely to show net benefits to Wisconsin customers as opposed to the Applicants' NTA analysis in this proceeding.
- Even with the issues I noted, the Applicants' NTA is expected to provide a greater total increase in wind and solar generation than the Project absent significant additions of wind generation in the upper Midwest.

Q. Overall, what do you recommend regarding the NTA?

A. I recommend the Commission consider utility-scale solar generation in Wisconsin as a viable alternative to the Project. Utility-scale solar is likely to provide net energy and capacity-related benefits to consumers while avoiding many if not all the environmental siting concerns that accompany the building of any long-distance transmission line.

B. Low Voltage Alternative

Q. Please describe the Low Voltage Alternative ("LVA").

A. The LVA is a transmission line that consists of a 345 kV line from Hickory Creek to Nelson Dewey substation and then a 138 kV line from Nelson Dewey to Cardinal substation along the same route as the Project.[34]

[34] Ex.-Applicants-Application, Revised Appendix D, Planning Analysis, pages 27-29.

Q. What were the differences in benefits of the LVA compared to the Project based on the Applicants' analysis?

A. The LVA and the Project had very similar benefits, except for the Energy Cost Savings benefits. Figure 12 below summarizes the Energy Cost Savings benefits of the LVA compared to the Project based on results from the Applicants' analysis. This chart can be compared to Figure 2 above. The bars above zero in Figure 12 represent benefits of the LVA that exceed those of the Project shown in Figure 2 and vice versa for the bars below zero. As the chart shows the LVA had higher benefits than the Project in five of the futures analyzed. The LVA provided greater internal and external congestion savings than the Project in most futures and also greater APC in the AAT futures.

Figure 12. Present value of Energy Cost Savings benefits of the LVA compared to the Project in all futures presented in the Direct Testimony of Tom Dagenais.[35]

[redacted]

[35] Att. 1 to 01-DALC-ATC-33, CONFIDENTIAL Category C.

Q. Did the LVA increase the amount of wind generation in MISO LRZs 1, 2, and 3?

A. Yes. In the years and futures that the Project increased wind generation, so did the LVA, but not to the same extent. Figure 13 below shows the increased wind generation for the Project—the same increase shown previously in Figure 3—and compares this to the increase in wind from the LVA, calculated using the same methodology.

Figure 13. Increase in equivalent wind capacity due to the Project and LVA assuming a 40% capacity factor.[36]

[redacted]

Q. Overall, what do you conclude about the LVA?

A. The results of the LVA analysis provide further evidence that expected Energy Cost Savings benefits of the Project are speculative. The LVA was able to generate larger Energy Cost Savings than the Project while enabling a lower amount of wind generation. This indicates that the Project's supposed benefits do not derive from access to wind in areas west of Wisconsin, and these benefits should be better understood before the Project is approved because there may be other, more cost-effective ways to generate such benefits.

[36] Attachment 1 to 3-CUB-RFP-2, CONFIDENTIAL Category D, E.

III. Additional Alternatives to the Project

Q. Did you identify any alternatives to the Project that the Applicants did not properly consider?

A. Yes. I identified two additional alternatives that require further consideration by the Applicants prior to the Commission's approval of the Project in this proceeding: a) combining Li-ion or other energy storage technologies with renewable energy to reduce the need for new transmission and b) a transmission line from Hickory Creek to Nelson Dewey substation. I discuss each alternative in more detail below.

A. Li-Ion Battery or Other Energy Storage

Q. How can energy storage technology reduce the need for new transmission lines to integrate renewable energy?

A. Energy storage technology can store wind or other non-dispatchable renewable energy that would otherwise be curtailed and then inject the energy into the grid during a time of lower renewable energy production. Thus, the same amount of transmission transfer capability could transfer higher amounts of renewable energy when that renewable energy is paired with storage.

Q. What other benefits could energy storage provide?

A. Battery storage can also store energy during times of lower market prices and inject energy at times of higher market prices to reduce congestion and lower total production costs.

Q. Why do you recommend Li-ion batteries be considered as opposed to other energy storage technologies?

A. Li-ion batteries are a leading energy storage technology. This technology has benefitted from a large amount of research and development targeted mainly at consumer electronics

applications. Manufacturing of this technology also already exists at scale, which is not true of other energy storage technologies under development for power grid applications. The scale of manufacturing operations is also rapidly increasing to support rising electric vehicle sales, which in turn also reduces the manufacturing costs of the technology. It is also the technology used in the majority of North American large battery projects for grid storage applications both planned and in-service.[37]

Q. Did Applicants consider energy storage as a viable alternative to the Project?

A. No. The Applicants dismissed the use of energy storage, claiming hundreds of megawatts of storage would be needed to provide the same reliability and transfer-capability benefits as the Project and that utility-scale batteries would not be cost-effective.[38]

Q. Why is this analysis inadequate?

A. The Applicants focused on a power flow model analysis of battery storage that would create the same reliability benefits as the Project, but failed to perform any analysis of new storage targeted at the providing the same energy and capacity-related benefits as the Project.[39] They also failed to consider Li-ion battery technology specifically,[40] claiming large batteries are not cost-effective, even though Li-ion battery costs have declined rapidly.[41] There is also currently a 100 MW battery storage project in Wisconsin in the MISO interconnection queue, which indicates large battery storage projects are worth further study.[42]

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[37] Ex.-CUB-Neal-7: U.S. Energy Information Administration, "U.S. Battery Storage Market Trends," May 2018.
[38] Direct-Applicants-Dagenais-27, lines 1-11.
[39] Ex.-CUB-Neal-4: Applicants' response to 3-CUB/Inter-6.
[40] Ex.-CUB-Neal-5: Applicants' response to 2-CUB/Inter-4, part b.
[41] See e.g. Ex.-CUB-Neal-8: Bloomberg New Energy Finance, "Battery Power's Latest Plunge in Costs Threatens Coal, Gas."
[42] See J1104, https://www.misoenergy.org/planning/generator-interconnection/GI_Queue/#, accessed 22 April 2019.

B. Transmission Line from Hickory Creek to Nelson Dewey Substation

Q. What evidence exists to support a transmission line from Hickory Creek to Nelson Dewey as a viable alternative to the Project?

A. There are three pieces of evidence: a) the Applicants' decision to site the utility-scale solar that was part of the NTA at the Nelson Dewey substation, b) the increase in congestion east of the Eden substation created by the Project in some modeling scenarios, and c) the reliability benefits of such a line.

Q. Please explain how the decision to cite the utility-scale solar portion of the NTA at the Nelson Dewey substation indicates a transmission line from Hickory Creek to Nelson Dewey is a viable alternative to the Project.

A. Because the Project is designed to facilitate west to east power flows, I would expect that any generation alternative to the Project would inject energy at or very close to the eastern terminal of the Project, which would be the Cardinal substation. Instead, Applicants sited the utility-scale solar portion of the NTA at the Nelson Dewey substation, which is near the old Nelson Dewey generating station in Cassville, Wisconsin. They did so because it was the "near-optimal location to limit market congestion."[43] This indicates a transmission line terminating at Nelson Dewey bringing new power flows from the west could also be well-situated to limit market congestion.

Q. Please explain how the increase in congestion east of the Eden substation created by the Project indicates a transmission line from Hickory Creek to Nelson Dewey is a viable alternative to the Project.

[43] Ex.-Applicants-Application, Revised Appendix D, Planning Analysis, page 31.

A. The increased congestion east of the Eden substation indicates the Project's design is suboptimal for reducing market congestion. This also suggests a line with a shorter length such as terminating at Nelson Dewey is worth considering since such an injection point was also termed "near-optimal" for reducing market congestion.

Q. Please explain how the reliability benefits of a Hickory Creek-Nelson Dewey line indicates it is a viable alternative to the Project.

A. Applicants' reliability analysis lists a Hickory Creek-Nelson Dewey 345 kV line as a conceptual project to relieve two overloaded branches.[44] Avoiding this line represents $31.9 million out of the estimated $42.2 million of the Project's avoided reliability benefits.[45]

Q. What evidence did Applicants provide that a Hickory Creek to Nelson Dewey line is not a viable alternative to the Project?

A. Applicants stated that even though siting a utility-scale solar development at Nelson Dewey would be near-optimal, it does not mean that such a location would be optimal for locating transmission facilities.[46]

Q. Is the Applicants' argument reasonable?

A. No. The Applicants' statement is not really an argument at all. It provides no evidence the Cardinal termination point is actually superior. The Applicants should provide such evidence or analyze a transmission line from Hickory Creek to Nelson Dewey substation as an alternative to the Project.

IV. Conclusions

Q. Please summarize your conclusions.

[44] Direct-Applicants-Dagenais-40, Table 8.
[45] Direct-Applicants-Dagenais-41, Table 9.
[46] Ex.-CUB-Neal-6: Applicants' response to 3-CUB/Inter-1, part a.

A. I offer the following conclusions:

- Contrary to the Applicants' claims that the Project benefits are robust across multiple future scenarios, the Project's benefits are distinctly different in each of the primary futures: EF, PR, and AAT.
- The Project's wind-related benefits are limited to futures with significant additions of generic renewable resources, which are speculative, especially to the extent the benefits derive from subregions without a strong history of wind development.
- In most future scenarios, Energy Cost Savings benefits are comprised mostly of reduced congestion within the ATC zone, but such a benefit is also speculative and may not be reasonable.
- The Applicants only estimated reduced CO_2 emissions within Wisconsin, which is not appropriate and ignores the increased fossil-fired generation outside of Wisconsin enabled by the Project.
- The Applicants have significantly overstated the costs of new utility-scale solar developments in Wisconsin, and thus understated the potential quantitative benefits of an NTA with utility-scale solar generation. The Applicants also understate the qualitative benefits of the NTA because they ignore its main qualitative benefit, which is the ability to avoid the environmental siting concerns that come with building any long-distance transmission line.
- An NTA that relies more on utility-scale solar and less on demand response would be a more appropriate alternative to the Project. Such an NTA, combined with more reasonable utility-scale solar cost assumptions, would be likely to show net benefits to Wisconsin customers as opposed to the Applicants' NTA analysis in this proceeding.

- Even with the issues I noted, the Applicants' NTA is expected to provide a greater total increase in wind and solar generation than the Project absent significant additions of wind generation in the upper Midwest.
- The LVA was able to generate larger Energy Cost Savings than the Project while enabling a lower amount of wind generation, providing further evidence that expected Energy Cost Savings benefits of the Project are speculative.
- I identified two additional alternatives that require further consideration by the Applicants prior to the Commission's approval of the Project in this proceeding: a) combining Li-ion or other energy storage technologies with renewable energy to reduce the need for new transmission and b) a transmission line from Hickory Creek to Nelson Dewey substation.

Q. Please summarize your recommendations.

A. I recommend:

- The Commission not approve the Project on the basis of anticipated wind-related benefits without one of the following:
    - Direct evidence the Project is needed to support wind generation outside the area local to the Project such as the Iowa and Southern Minnesota RGOS zones that have the heaviest wind development; or
    - An analysis of wind or other generation local to the Project, including
        - Direct evidence this Project is necessary to interconnect this generation
        - Quantification of the costs and benefits of this new generation to Wisconsin customers.
- The Commission disregard the estimated internal congestion-related benefits of the Project unless the Applicants can show adequate evidence the internal congestion in PROMOD is

not just a modeling artifact and that the Project is a cost-effective way to reduce congestion within the ATC zone.

- The Applicants provide an analysis of the Project's impact on regional greenhouse gas emissions to the Commission prior to its decision whether to approve the Project.
- The Commission not approve the Project on the basis of expected Energy Cost Savings benefits without further analysis from Applicants as outlined in my testimony.
- The Commission consider utility-scale solar generation in Wisconsin as a viable alternative to the Project.
- The Applicants analyze the following two alternatives to the Project: a) combining Li-ion or other energy storage technologies with renewable energy to reduce the need for new transmission and b) a transmission line from Hickory Creek to Nelson Dewey substation or provide evidence that such alternatives would be inferior to the Project.

Q. Does that conclude your Direct Testimony?

A. Yes, although I intend to supplement my testimony once the Applicants provide further detailed PROMOD output for analysis.