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A Clean Energy Future for Xcel: Response to Xcel's Alternate Plan

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1 Xcel's Alternate Plan

This supplemental report addresses the updated modeling Xcel performed to develop the Alternate Plan discussed in Xcel's Reply Comments filed on June 25, 2021. In response to the feedback Xcel received from stakeholders, Xcel decided to evaluate an Alternate Plan that looked at the impact of removing the Sherco Combined Cycle ("CC") from Xcel's system. In addition to removing the Sherco CC, Xcel modeled replacement capacity that could utilize existing interconnection rights at the Sherco and King sites. The Alternate Plan also includes the cost of transmission tie-lines to enable renewable resources to replace the Sherco and King capacity and utilize the existing interconnection rights at those sites. Xcel's Alternate Plan also proposes adding dispatchable resources at four sites. Two of the sites involve repowering existing generators and two are greenfield combustion turbines ("CTs"). One of the new CTs would be in Fargo County and the second new CT would be located in Lyon County on the Sherco gen-tie line. Xcel's Alternate Plan does include additional CT capacity beyond the timeline of the repowered units and the Fargo and Lyon County CTs, but Xcel says that "Beyond these near-term additions (which are approximately 1,100 MW), we are not committing to a specific resource type to meet the remaining need (approximately 1,800 MW)."[1]

2 CEO Alternate Plan Modeling

The Clean Energy Organizations' ("CEO") performed EnCompass modeling around Xcel's Alternate Plan to evaluate the impact of adding solar-battery hybrid resources and revising Xcel's battery storage cost assumptions on the selection of resource additions in the Alternate Plan. Xcel argues that the two new CTs in Fargo and Lyon County are needed for reliability purposes. The CEOs' EnCompass modeling examined whether those resources would be economically selected by the model even with the addition of solar-battery hybrid resources and battery pricing that better reflects actual market prices. The CEOs' EnCompass modeling held constant the same repowered capacity assumption that Xcel used in its Alternate Plan. The changes made in producing what we call the CEO Alternate Plan include:

1. Allowing solar-battery hybrids to be selected as a resource option for the King and Sherco replacement resource;
2. Allowing standalone battery storage to be selected as a resource option for the Sherco replacement resource;
3. For the standalone battery storage resources, the battery storage resource is set at 321 MW[2] in size, but with the partial unit setting in EnCompass,[3] which allows the model to choose the optimal project size; and

[1] Xcel 2020-2034 Upper Midwest Resource Plan Reply Comments, p. 9. Docket No. E002/RP-19-368.
[2] 321 MW is the size of the battery storage resources that Xcel modeled in its Supplemental filing.
[3] The partial unit setting in EnCompass allows the model to select any proportion of the modeled unit that is greater than 0 and less than 1.

4. For the standalone battery storage and the battery component of the solar-battery hybrid resources, we assumed project costs and operating life based on Public Service Company of New Mexico ("PNM") battery project pricing as discussed in Section 1.2 of EFG's report filed as an attachment to CEOs' Initial Comments.

2.1 Battery Storage Costs

2.1.1 PNM Project Bids

Section 1.2 of the February EFG report filed with CEOs' Initial Comments discussed several of the changes that the CEOs used to create the "CEO Base Case" scenario of different modeling assumptions.[4] One of the changes was to modify the costs for new battery storage resources. EFG used project pricing information from project bids received by the Public Service Company of New Mexico ("PNM"). Utilizing the PNM bids as a source for modeling battery storage costs in the CEO modeling runs is reasonable since the cost reflects actual bids received for battery projects. We have not seen battery prices submitted in response to Request for Proposals that have significant differences across different regions. As such, we would expect these bid prices to be generally applicable to Minnesota utilities.

Section 5 of the June EFG report filed with CEOs' Reply Comments discussed additional pricing information that PNM received related to battery projects in PNM's service territory. Table 1 below shows the project pricing information with the two new projects for which PNM has received bids. The average cost per kW-month is even lower with the addition of the two new projects than the battery storage pricing. We did not use this additional information to adjust our storage pricing downward; it simply serves as additional support for the conservative nature of our storage pricing assumptions and for the widely held belief that storage costs will continue to decline.

Table 1. PNM Battery Storage Pricing with New Projects provided in EFG's CEO Reply Comment Report

	With ITC $/kW-Mo	No ITC $/kW-Mo
Jicarilla	$9.97	$13.47
Arroyo	$7.46	$10.08
Bidder #5	$7.99	$10.80
Bidder #2	$7.70	$10.41
New Bid	$6.68	$9.03
New Bid	$7.56	$10.22
Avg	**$7.89**	**$10.67**

[4] Section 1.2 of the Initial EFG Report.

2.2 Sherco and King Replacement Resources

Xcel's Alternate Plan includes utilizing gen-tie lines to the Sherco and King plant sites to use those plants' interconnection rights. For the new resources that can be added on those "extension cord" lines, there is a limited and specific sub-set of resources that are available for the model to select. Table 2 shows the resources in this subset, along with the resources available for the rest of the NSP system outside of the Sherco and King replacement.

Table 2. Resources Available for Replacement Capacity in Xcel's Alternate Plan

Gen-Tie Line Capacity Replacement	Solar	Wind	CT	Battery Storage standalone	Solar-Battery Hybrid
Sherco 1*	X	X	X		
Sherco 2*	X				
Sherco 3*	X	X	X		
AS King*	X				
NSP System	X	X	X	X	

** Replacement capacity for the gen-tie lines*
*** Xcel's modeling for the Alternate Plan did not include solar hybrid resources*

Xcel used the Area topology within EnCompass to be able to represent replacement resources that would be added in either the Sherco, King, or NSP system areas. In order to model the replacement capacity of the units retiring at Sherco and King, Xcel used a tie limit that was the same as the amount of replacement capacity at Sherco and King.[5] The CEOs adopted these same assumptions for the CEO Alternate Plan.

The CEOs' modeling evaluated the impact of allowing solar-battery hybrid resources as a resource option for the Sherco and King replacement capacity. In the CEOs' original EnCompass modeling, 4,200 MWs of solar hybrid resources were selected between 2027 and 2034. Given that the results of our initial modeling favored the selection of solar-battery hybrids, we believed that solar-battery hybrid resources should also be available for the model to select in this simulation. Xcel's Alternate Plan also did not allow standalone battery storage resources to be considered as replacement resources for King and Sherco. The CEOs' original EnCompass modeling included 1,227 MWs of standalone battery storage resources between 2028 and 2034. As with hybrids, it made sense to evaluate the economic nature of standalone battery storage as replacement capacity for Sherco. Table 3 shows the resources that were

[5] In the Supplemental Comment report, Xcel noted that "As discussed below, we believe reusing the interconnections in this way will result in customer savings, and we expect nameplate renewable additions can exceed the approximately 2,000 MW of the Company's interconnection rights at Sherco and approximately 600 MW of interconnection rights at King." Xcel 2020-2034 Upper Midwest Resource Plan Reply Comments, p. 16. Docket No. E002/RP-19-368.

available for selection in EnCompass for the CEO Alternate Plan. Since Xcel's modeling only allowed solar resources as a replacement option for the King area we expanded the options only slightly to solar-battery hybrid resources. For the Sherco area, Xcel's assumption was that solar, wind, and a CT were available. We kept this assumption but with the addition of possible standalone battery and solar-battery hybrids to be selected.

Table 3. Resources Available for Replacement Capacity in CEOs' Alternate Plan Compared to Xcel's Alternate Plan

	Resources available in Xcel's Alternate Plan			Additional resources made available in CEOs' Alternate Plan	
Gen-Tie Line Capacity replacement	**Solar**	**Wind**	**CT**	**Battery Storage standalone**	**Solar-Battery Hybrid**
Sherco 1*	X	X	X	X	X
Sherco 2*	X			X	X
Sherco 3*	X	X	X	X	X
AS King*	X				X
NSP System	X	X	X	X	X

** Replacement capacity for the gen-tie lines*

2.3 CEO Capacity Expansion Plan and Present Value of Societal Costs ("PVSC")

Figure 1 shows the capacity expansion plan for the CEO Alternate Plan, which contains no new natural gas resources outside of the repowering assumptions Xcel made in its Alternate Plan. The CEOs' Alternate Plan contains a mix of solar-battery hybrid resources, wind, and standalone storage resources across the Sherco, King, and NSP "areas" modeled in EnCompass.

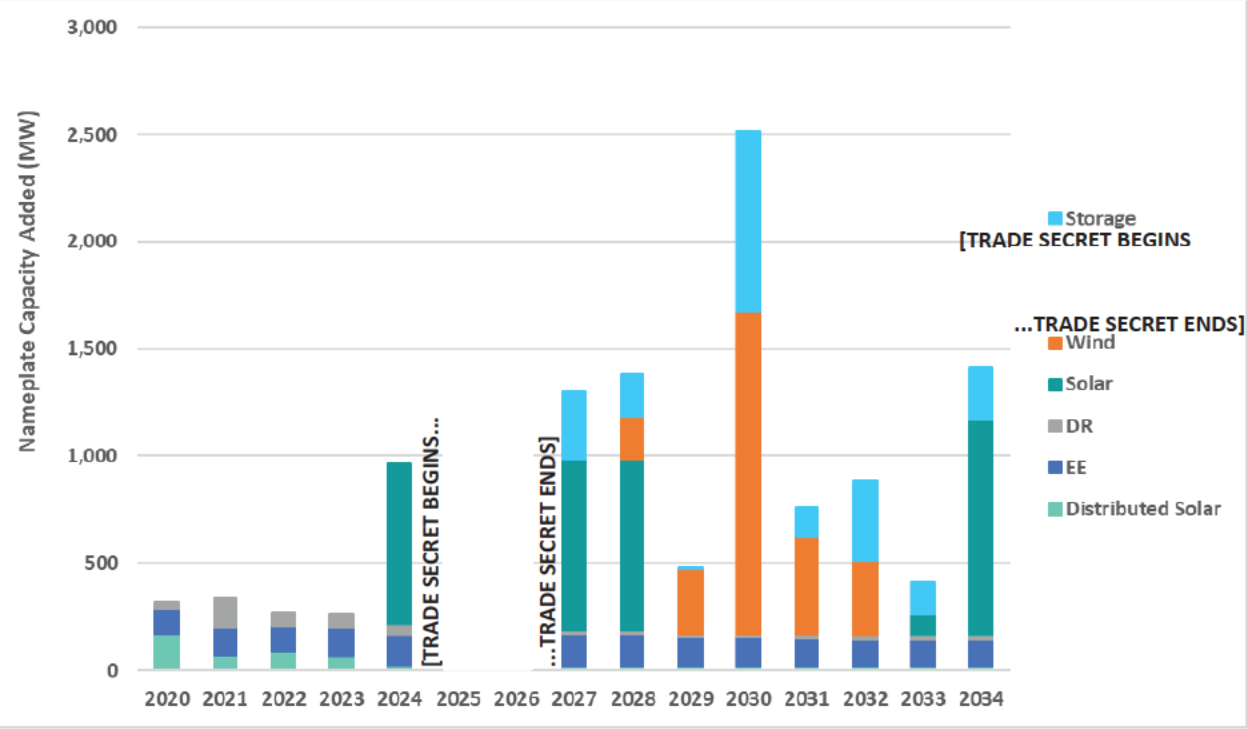

Figure 1. CEO Alternate Plan Capacity Expansion Plan (2020 – 2034)[6]

Table 4 shows the CEOs' Alternate Plan expansion plan by resource type and whether the resource is added to the Sherco, King, or NSP area.

[6] Solar represents the sum of solar plus solar hybrid resources across the King, Sherco, and NSP Areas. Storage represents the sum of standalone storage plus the hybrid storage resources across the King, Sherco, and NSP Areas. The firm peaking resources use the same assumptions Xcel does in its Alternate Plan to model the repowering of existing units. The DR, EE, and Distributed Solar capacity are the same as Xcel's Alternate Plan.

Table 4. CEO Alternate Plan Capacity Expansion Plan (2020 – 2034)

Resource	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Solar (standalone) Sherco tie line	0	0	0	0	750	50	0	0	0	0	0	0	0	0	0
Solar (hybrid) Sherco tie line	0	0	0	0	0	0	0	800	0	0	0	0	0	0	0
Battery (hybrid) Sherco tie line	0	0	0	0	0	0	0	200	0	0	0	0	0	0	0
Battery (standalone) Sherco tie line	0	0	0	0	0	0	0	11	0	4	687	141	5	0	0
Wind Sherco	0	0	0	0	0	0	0	0	200	300	1500	450	350	0	0
Solar (hybrid) King tie line	0	0	0	0	0	0	0	0	800	0	0	0	0	0	0
Battery (hybrid) King tie line	0	0	0	0	0	0	0	0	200	0	0	0	0	0	0
Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar (hybrid) NSP system-wide	0	0	0	0	0	0	0	0	0	0	0	0	0	100	1000
Battery (hybrid) NSP system-wide	0	0	0	0	0	0	0	0	0	0	0	0	0	25	250
Solar (standalone) NSP system-wide	0	0	0	0	0	300	0	0	0	0	0	0	0	0	0
Battery (standalone) NSP system-wide	0	0	0	0	0	0	0	101	0	0	157	0	364	125	0
[TRADE SECRET BEGINS...															
															...TRADE SECRET ENDS]
EE	115	130	116	133	143	145	154	157	155	140	138	136	129	126	126
DR	34	135	68	63	47	42	12	14	15	17	19	20	21	22	24
Distributed Solar	173	71	87	68	25	16	15	15	15	15	15	15	15	15	15

Table 5 provides a comparison of the total amount of each resource added under the CEO and Xcel Alternate Plans between 2020 and 2034. The CEO Alternate Plan contains a larger buildout of standalone storage, wind, and solar, with less gas capacity than what is added in Xcel's Alternate Plan.

Table 5. Capacity Expansion Plan Comparison (2020 – 2034)

Resource	CEOs' Alternate Plan (MW)	Xcel's Alternate Plan (MW)
Battery Storage	2270	250
Wind	2800	2650
Solar	3800	3150
[TRADE SECRET BEGINS.... ....TRADE SECRET ENDS]		
New CT	0	800
Generic Firm Peaking	0	1870

In order to compare the Present Value of Societal Cost ("PVSC") of the CEOs' Alternate Plan to Xcel's Alternate Plan on an apples to apples basis, we fixed the repowered brownfield and greenfield units added in Xcel's plan, and then reoptimized the rest of the capacity expansion plan under the four modeling changes outlined in Section 2. The PVSC for the CEO Alternate Plan and the CEOs' partial reoptimization of Xcel's Alternate Plan[7] are shown in Table 6.

Table 6. PVSC Comparison of Alternate Plans (Millions of Dollars)

	PVSC ($M)
CEO Alternate Plan	$39,179
CEO Partial Reoptimization of Xcel Alternate Plan	$39,240
Xcel Alternate Plan as Filed	$40,461

The CEOs' Alternate Plan, which includes the addition of solar hybrid resources and revised battery cost and operating life assumptions, does not result in the selection of the Fargo and Lyon County CTs. The CEOs' modeling indicates that the model is optimally selecting a mix of solar-battery hybrid, solar, wind, and standalone battery storage resources. Table 7 shows that between 2027 and 2029, the CEO Alternate Plan adds 450 MWs of solar hybrid resources, 116 MWs of standalone battery resources, 400

[7]We retained Xcel's assumptions about the repowering **[TRADE SECRET BEGINS... ...TRADE SECRET ENDS]**, and the two new CTs that would be added in Lyon and Fargo County. We then allowed EnCompass to reoptimize the capacity expansion plan around those hard coded decisions. We used the same assumptions as we did for the CEO Alternate Plan, which includes allowing the model to select solar hybrid resources, modeling standalone battery storage resources as being a replacement resource for the Sherco area; and modeling the standalone battery storage and hybrid battery storage with the PNM project pricing.

MWs of hybrid battery storage, and 100 MWs of wind over and above the capacity of those same types that is in Xcel's Alternate Plan. The CEO Alternate Plan does not include the 800 MW of CT capacity that is included in Xcel's Alternate Plan. Given the economic nature of these resources, it is crucial for Xcel to fully explore the ability of solar-battery hybrid and standalone battery storage resources to provide critical grid services.

Table 7. Resources Added (MW) Between 2027 and 2029

Resource Type	CEO Alternate Plan	Xcel Alternate Plan as Filed
Solar	-	1150
Solar Hybrid	1600	-
Battery Storage	116	-
Battery Storage Hybrid	400	-
Wind	500	400
New CTs	-	800

The CEO Alternate Plan does have a limited amount of unserved energy in the post 2034 timeframe. Table 8 shows the levels of unserved energy (MWH) in the CEO Alternate Plan in 2037, 2038, 2043, and 2044 – all other years had no unserved energy. As a percentage of total energy demand, the amounts are extremely small. The unserved energy ranges from .0008% to .0223% of total energy. These amounts are also only marginally higher than the amount in the CEO Partial Reoptimization of Xcel Alternate Plan in 2043, the year with the highest amount in the CEO Alternate Plan.

Table 8. Unserved Energy (MWH) in CEO Alternate Plan

Year	Unserved Energy (MWH)	Annual Energy (MWH)	Percent of Annual Energy
2037	1,305	56,580,000	.0023%
2038	462	57,143,000	.0008%
2043	13,395	60,200,000	.0223%
2044	1,526	60,975,000	.0025%

Table 9. Unserved Energy in Xcel Alternate Plan Reoptimization

Year	Unserved Energy (MWH)	Annual Energy (MWH)	Percent of Annual Energy
2043	7,318	60,200,000	.0122%

We do not believe these levels of unserved energy are a concern. First, they are so far out in the planning period that there is significant uncertainty about the conditions under which resources will be dispatched, let alone the makeup of Xcel's generation fleet. In addition, as we discussed in the EFG Supplemental Report there are several contributing factors including the significant number of resources retiring between 2040 and 2045, especially the Monticello nuclear unit in 2040, the unrealistic drop-off in energy efficiency savings in Xcel's modeling, and Xcel's artificial limits on imported energy from other

parts of MISO.[8] Finally, long duration and multiday storage is not included in Xcel's modeling or in our modeling for this report, but would certainly have the potential to help address any unserved energy should it actually materialize.[9]

3 Winter Reliability

In the Supplemental Report, Xcel discusses the need for firm, dispatchable resources to be able to operate during periods of extreme weather. Xcel points to the 2019 Polar Vortex and the 2021 Winter Storm Uri (what MISO calls the February Arctic Event) as examples of recent extreme weather events and points to the firm resources on Xcel's system that operated during those events, like the nuclear and CT capacity. Figure 2 shows the hourly weighted average capacity factor of Xcel's existing CTs during the 2021 February Arctic Event, which started on February 14th and ended on February 18th. During this event, six of the CTs did not operate during any hour of the Arctic Event. We are not sure if the units did not operate because of fuel supply interruptions (gas generators throughout ERCOT, SPP, and MISO had difficulty procuring gas) or if there was another reason these units were offline. The weighted average capacity factor suggests that, absent fuel supply constraints, Xcel's existing CT fleet still had capacity to operate at higher levels during this Arctic Event.

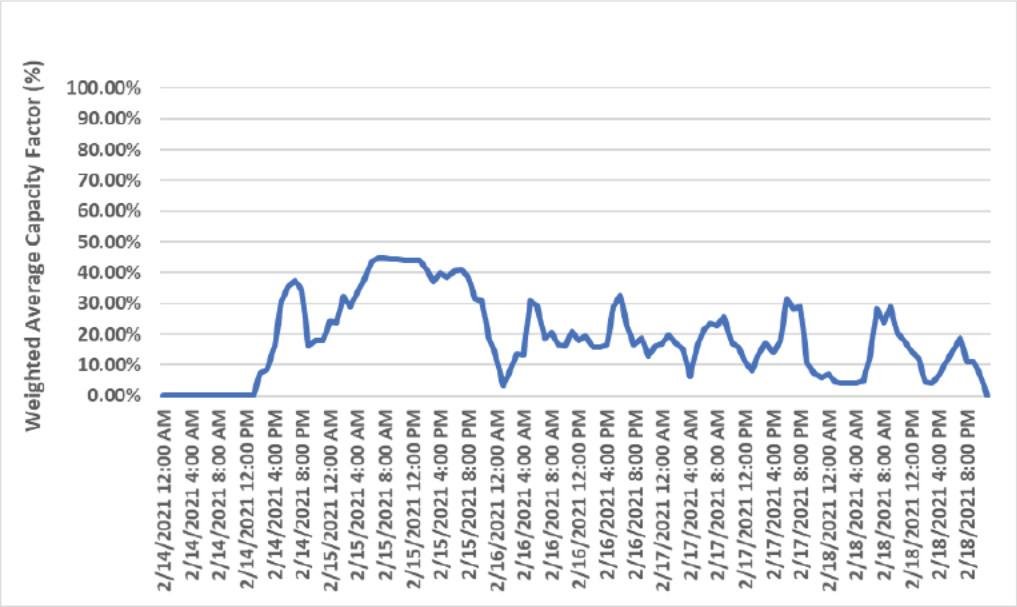

Figure 2. Weighted Average Capacity Factor (%) of Xcel's CTs During Arctic Event[10]

[8] EFG Supplement Report, Section 2.1

[9] In the EFG Initial Report, 6 and 8 hour flow batteries were included in the CEO Preferred Plan to address some of the unserved energy that was in the CEO Preferred Plan between 2040 and 2045. Adding in the 6 and 8 hour flow batteries helped to lower the unserved energy amounts.

[10] This figure is calculated based on gross generation reported at these units to the EPA Air Markets program relative to the net nameplate of the units, therefore the overall weighted average capacity factor will be overstated.

Even if fuel supply were not an issue for Xcel, there no indication that the existing fleet could not operate at higher capacity factors during extreme events. Certainly, these data do not support the notion that new CTs must be added in 2027 and 2029 for reliability reasons. In its Supplemental Report, Xcel states, "As we continue to retire coal and add renewables, our modeling continues to show the need for some firm, dispatchable resources."[11]

The CEO Alternate Plan demonstrates that when the model is offered solar-battery hybrid resources along with updated cost assumptions for standalone battery storage, the model selects less CT capacity and more renewable and storage capacity. Furthermore, Xcel's modeling did not evaluate the possibility for long duration or multiday storage resources.

In its Supplemental Report, Xcel raises numerous concerns about battery storage resources, including:

> *In this Resource Plan, the emergence of new technologies, such as storage, has been an ongoing consideration. We are in favor of utilizing storage for certain circumstances such as peak shaving or extending solar generation's capabilities. However, the ability of storage to provide the same attributes as CTs is not yet economically feasible or fully understood in this climate zone. For example, the capabilities of the storage resource predominantly modeled by parties in Comments – conventional lithium-ion batteries – are currently limited to four hours. Four-hour batteries are simply not sufficient to meet our reliability needs in all cases, particularly when needed in substantial amounts for multi-day contiguous periods.*[12]

Our plan retains the same level of CT capacity as is in Xcel's Alternate Plan and again that capacity did not operate at even close to its full capability during the Arctic Event. We are not suggesting that Xcel rely exclusively on 4-hour battery storage to cover these contingencies, far from it. The point here is that Xcel already has a large CT fleet, **[TRADE SECRET BEGINS…**

…TRADE SECRET ENDS] and that would presumably improve the performance of these units, and that 2027 and 2029 are far enough down the road that we do not know yet what the state of commercialization will be for flow batteries and long-duration storage. During Xcel's last IRP in 2015 we don't believe anyone anticipated how quickly 4-hour batteries would become commercial and affordable and so it makes sense to apply some caution about proceeding with investments so far in the future that a) they may not be needed and b) may be substitutable with other technologies that do not have the same environmental and fuel supply considerations as CTs.

[11] Xcel 2020-2034 Upper Midwest Resource Plan Reply Comments, p. 45. Docket No. E002/RP-19-368.
[12] Xcel 2020-2034 Upper Midwest Resource Plan Reply Comments, p. 46. Docket No. E002/RP-19-368.