414 Nicollet Mall
Minneapolis, MN 55401

August 25, 2020

—Via Electronic Filing—

Will Seuffert
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

RE: ERRATA
2020-2034 UPPER MIDWEST INTEGRATED RESOURCE PLAN
DOCKET NO. E002/RP-19-368

Dear Mr. Seuffert:

Northern States Power Company, doing business as Xcel Energy, submits this Errata to correct analysis provided in the June 30, 2020 Supplement to its 2020-2034 Upper Midwest Integrated Resource Plan to the Minnesota Public Utilities Commission.

The Company provided analysis on the cost-effectiveness of renewables-plus-storage hybrid resources in Section 2.C.4 of the Supplement. Using the EnCompass model, the Company conducted analysis to test the economic viability of replacing some of the wind and solar selected in our Supplement Preferred Plan with hybrid wind-plus-storage or solar-plus-storage resources – together referred to as renewable-plus-storage resources.

In responding to questions from intervenors, we discovered that the solar-plus-storage analysis contained an error in the input for the capacity of the storage portion of the hybrid resource. The analysis provided in the Supplement included an assumption that the storage portion of the solar-plus-storage resource would receive accredited capacity of 45 percent of the installed capacity. We have corrected that input to 100 percent and conducted updated analysis. The wind-plus-storage analysis provided in the Supplement was correct. The methodology used for the updated analysis of the solar-plus-storage resource is the same as we described with our initial analysis, beginning on page 52 of the Supplement and repeated here for reference:

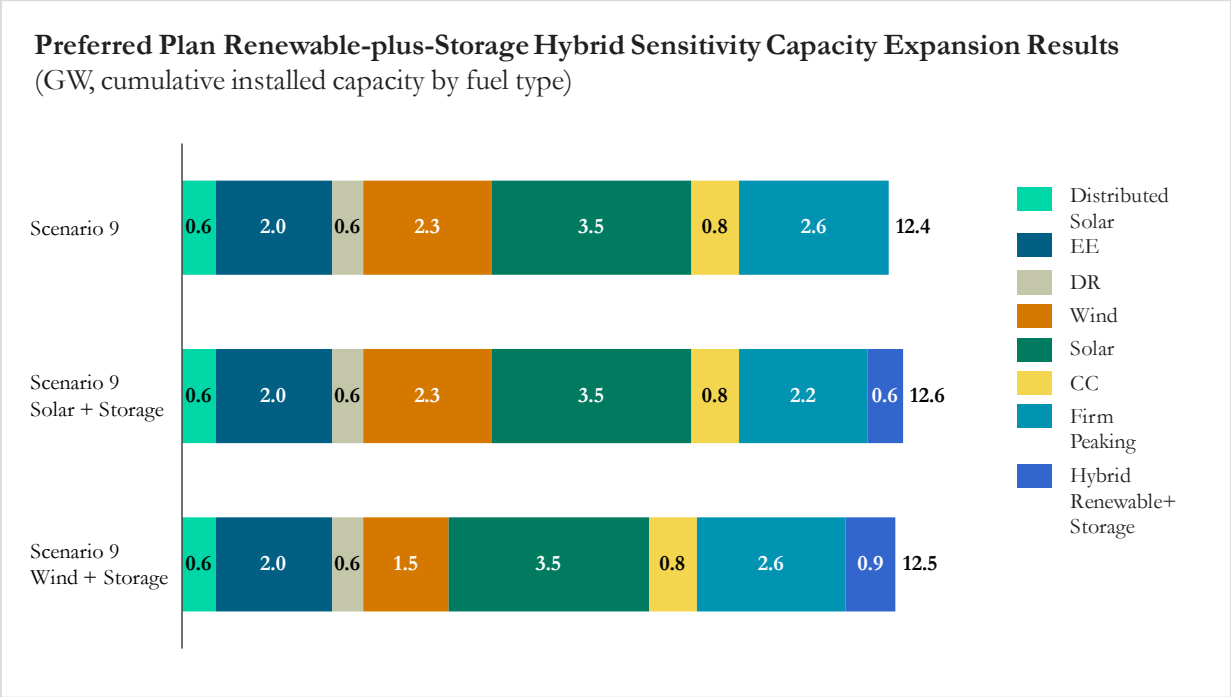
> The Company conducted sensitivities that test the economic viability of replacing some of the wind and solar selected in our Supplement Preferred Plan with hybrid

wind-plus-storage or solar-plus-storage resources. These options are not examined in the initial capacity expansion modeling for process purposes, as adding too many generic resource options to the model optimization slows the modeling process. However, we can evaluate whether a hybrid option is an economic alternative to standalone renewables by manually replacing some of the wind and solar the plan selects with hybrid wind-plus-storage or solar-plus-storage options.

To conduct this test, the Company took the EnCompass optimized expansion plan for Scenario 9 (the Supplement Preferred Plan) and manually replaced the first occurring solar generic resource with a combined solar-plus-storage resource. We then reoptimized the expansion plan around this new, manually included resource.

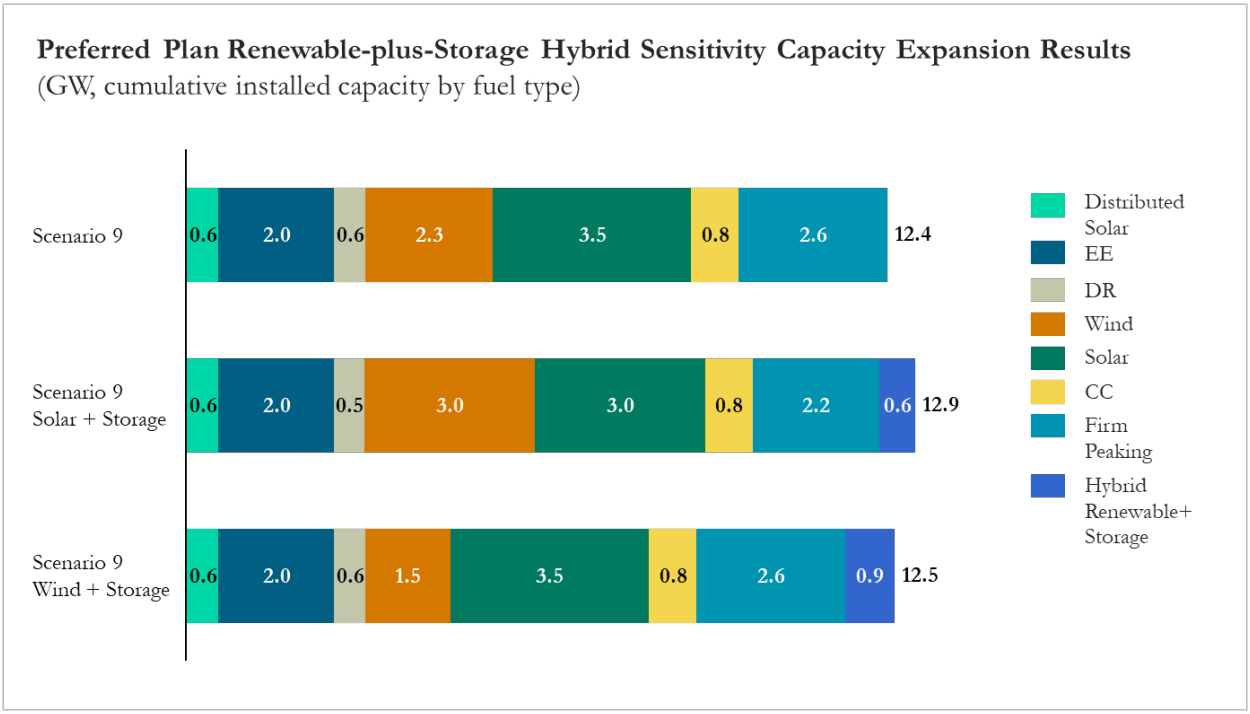
Below we provide Figure 2-21 as provided in the Supplement then updated with the corrected storage capacity.

Figure 2-21: Preferred Plan Sensitivity Testing – Hybrid Renewables-plus-Storage Capacity Expansion Results



Errata

Figure 2-21: Preferred Plan Sensitivity Testing – Hybrid Renewables-plus-Storage Capacity Expansion Results



As discussed in the Supplement:

> After the capacity expansion modeling step, we then conducted a full 8,760 production costing run on this sensitivity just as we did with the baseload study, in order to evaluate the cost and dispatch data and compare to the Supplement Preferred Plan cost outcomes. These analyses show that – given current assumptions regarding technology costs and our system needs – hybrid renewables-plus-storage resources are not expected to be a cost-effective alternative to standalone renewables. These results are driven by the relative forecasted prices for firm peaking, solar, and storage resources. In both hybrid cases, the storage addition replaced either firm peaking (for the solar hybrid) or solar (for the wind hybrid). That said, these results are based on forecasted technology prices that may change in the future. We fully intend to closely monitor developments for hybrid resource options, both in terms of price and performance, and will adapt our solicitations, modeling approaches and resource procurement accordingly as conditions change.

Compared to the analysis provided in the Supplement, the corrected storage capacity offsets stand-alone solar additions and increases additions of wind as shown above. This results in more renewable energy added to the system relative to our initial analysis.

Below we provide Table 2-7 as provided in the Supplement then updated with the corrected storage capacity.

Table 2-7: Supplement Preferred Plan Hybrid Sensitivities PVSC and PVRR Deltas from Scenario 9

Scenario	PVSC Deltas ($2020 millions)	PVRR Deltas ($2020 millions)
Scenario 9 (Supplement Preferred Plan)	--	--
Scenario 9 Solar-plus-Storage	$29	$44
Scenario 9 Wind-plus- Storage	$212	$182

Errata

Table 2-7: Supplement Preferred Plan Hybrid Sensitivities PVSC and PVRR Deltas from Scenario 9

Scenario	PVSC Deltas ($2020 millions)	PVRR Deltas ($2020 millions)
Scenario 9 (Supplement Preferred Plan)	--	--
Scenario 9 Solar-plus-Storage	$8	$62
Scenario 9 Wind-plus- Storage	$212	$182

As shown above, the updated analysis results in reduced costs on a Present Value Societal Cost (PVSC) basis and increased cost on a Present Value Revenue Requirements (PVRR) basis. The costs of emissions are included in the capacity optimization, and, as noted above, more renewable energy is added to the system. Relative to our initial analysis, costs increase when the impact of emissions are excluded. The corrected results show that while solar-plus-storage remains slightly more costly, the costs are similar – and solar-plus-storage could be cost-effective in the near future. In the Supplement, we noted that we intend to closely monitor developments for hybrid resource options, both in terms of price and performance, and will adapt our solicitations, modeling approaches, and resource procurements accordingly as conditions change. The corrected results affirm the importance of considering hybrid resources in future resource acquisitions.

We also provide as Attachment A to this filing, redlined updates to six Tables in the Supplement to reflect three other errors we have discovered since our filing. First, we corrected the Strategist results for the 50 percent solar ELCC scenario in Tables X-11

and X-12.[1] Second, we corrected the gas demand charge in Tables IV-14 and IV-22.[2] Finally, we corrected reliability metrics for one of the scenarios in the reliability analysis in Table 10-2 of the Supplement and Table XI-2 of Attachment A to the Supplement. All updates to these Tables are reflected in blue font. We note that the corrected pages do not contain any Trade Secret information.

Please contact me at (612) 330-6064 or bria.e.shea@xcelenergy.com if you have any questions regarding this filing.

/s/

BRIA SHEA
DIRECTOR
REGULATORY & GOVERNMENT AFFAIRS

Enclosure
c: Service List

[1] The Strategist files previously provided to parties in the discovery process include the correct data.
[2] The modeling inputs previously provided to parties in the discovery process include correct data.

analysis on Scenario 9 and several sensitivity portfolios, to help us understand portfolio performance under actual historical meteorological conditions that reflected more variation than the default planning assumptions used in our capacity expansion models. We tested these sensitivities in EnCompass only, as Strategist is not capable of performing 8,760-hour analysis.

We note that we have not proposed changes to our Supplement Preferred Plan based on these sensitivity results, rather provide them for the Commission's and stakeholders' information.

a. Renewables-plus-storage hybrid resources

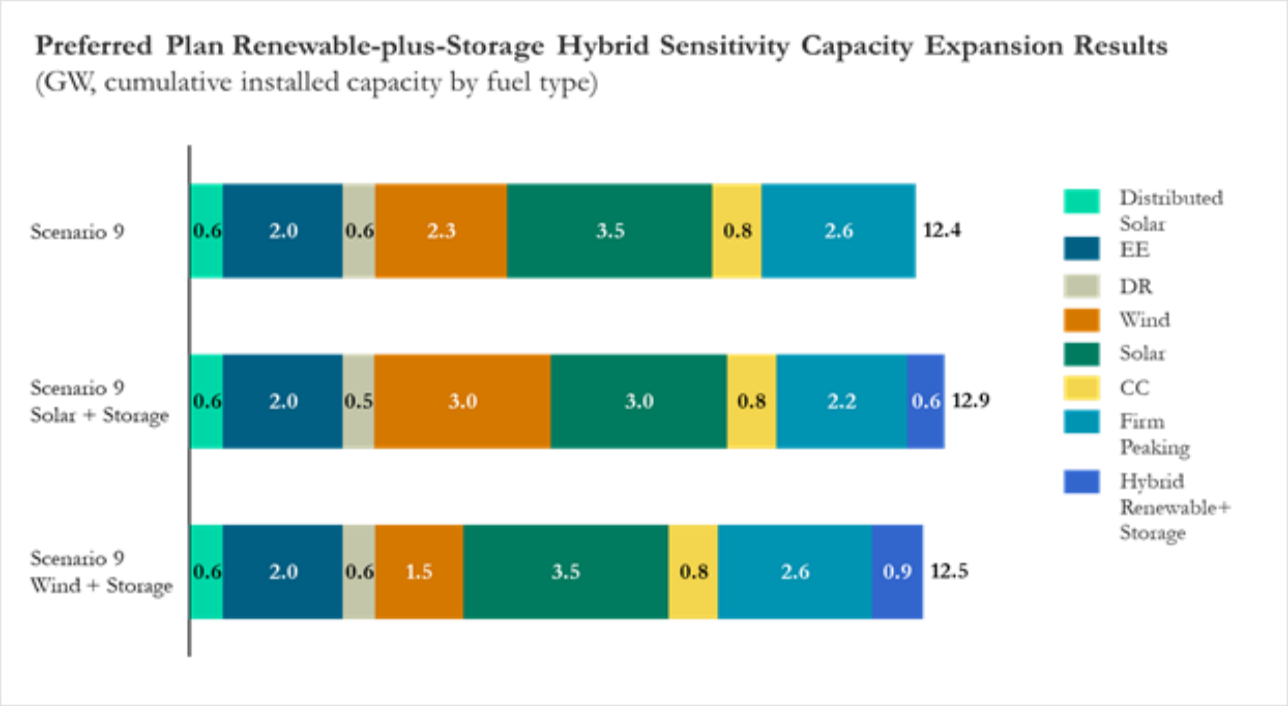
The Company conducted sensitivities that test the economic viability of replacing some of the wind and solar selected in our Supplement Preferred Plan with hybrid wind-plus-storage or solar-plus-storage resources. These options are not examined in the initial capacity expansion modeling for process purposes, as adding too many generic resource options to the model optimization slows the modeling process. However, we can evaluate whether a hybrid option is an economic alternative to standalone renewables by manually replacing some of the wind and solar the plan selects with hybrid wind-plus-storage or solar-plus-storage options.

To conduct this test, the Company took the EnCompass optimized expansion plan for Scenario 9 (the Supplement Preferred Plan) and manually replaced the first occurring solar generic resource with a combined solar-plus-storage resource. We then reoptimized the expansion plan around this new, manually included resource. Following the same process, we tested replacing the first occurring generic wind resource with a combined wind-plus-storage resource. Given the additional capacity associated with the storage component of the hybrid resource, the re-optimized result typically either deferred to a later date, or avoided, ~~firm peaking capacity (modeled as CTs)~~, relative to Scenario 9.

other resource additions

, as shown in Figure 2-21 below

Figure 2-21: Preferred Plan Sensitivity Testing – Hybrid Renewables-plus-Storage Capacity Expansion Results



*

After the capacity expansion modeling step, we then conducted a full 8,760 production costing run on this sensitivity just as we did with the baseload study, in order to evaluate the cost and dispatch data and compare to the Supplement Preferred Plan cost outcomes. These analyses show that – given current assumptions regarding technology costs and our system needs – hybrid renewables-plus-storage resources are not expected to be a cost-effective alternative to standalone renewables. These results are driven by the relative forecasted prices for firm peaking, solar, and storage resources. In both hybrid cases, the storage addition replaced either firm peaking (for the solar hybrid) or solar (for the wind hybrid). That said, these results are based on forecasted technology prices that may change in the future. We fully intend to closely monitor developments for hybrid resource options, both in terms of price and performance, and will adapt our solicitations, modeling approaches and resource procurement accordingly as conditions change.

Table 2-7: Supplement Preferred Plan Hybrid Sensitivities PVSC and PVRR Deltas from Scenario 9

Scenario	PVSC Deltas ($2020 millions)	PVRR Deltas ($2020 millions)
Scenario 9 (Supplement Preferred Plan)	--	--
* Scenario 9 Solar-plus-Storage	$8 ~~$29~~	$62 ~~$44~~
Scenario 9 Wind-plus-Storage	$212	$182

b. Sherco CC Size Sensitivities

Our Supplement Preferred Plan includes a Sherco CC sized at approximately the same capacity as "proposed to the Public Utilities Commission in docket number E-002/RP-15-21[.]"[27] However, in response to Commission direction, we have developed three different size options – two smaller units and one larger one – to examine whether a differently sized and configured unit would be more economically beneficial. The process we use to test these size options is similar to that which we used for the hybrid renewable-plus-storage options. Starting with Scenario 9 we conducted three EnCompass optimization runs that replaced the default Sherco CC with one of the three alternative sizes (and their associated costs and operational specifications) in each run. This process allowed us to examine how the capacity expansion portfolio would respond to each size alternative. We then conducted a full 8,760-hour production costing simulations for each alternative. Specific detailed assumptions associated with the different CC size options are included in Attachment A, Section IV: Modeling Assumptions and Inputs.

[27] Laws of Minnesota 2017, Chapter 5—H.F. No. 113, section 1.

Table 2-10: Summary of Reliability Metrics Analyzed, by Test

	Native Capacity Shortfall Metrics		Flexible Resource Adequacy Metric	Maximum Import Metric
Expansion Plan Tested ***(Test Load and Resource Shapes)***	**Number of Native Capacity Shortfall Events**	**Longest Shortfall Event (hours)**	**Maximum 3 – Hour Upward Ramp and Occurrence Month (MW)**	**Hours >95 Percent of 2,300 MW Import Limit**
Baseline – Scenario 9 *(Default)*	0	0	4,760 (February)	9
Scenario 9 *(2019)*	4	2	5,506 (June)	158
Scenario 9 – High Distributed Solar Future *(2019)*	14	5	7,221 (June)	157
* Scenario 9 - High Electrification Future *(2019)*	~~21~~ 22	6	7,152 (March)	674
Scenario 9 – 50 percent ELCC *(2019)*	159	22	7,239 (January)	311

While we are still working to fully understand all of the EnCompass model's capabilities with respect to reliability analyses, we believe the above findings indicate potential risks associated with portfolios that rely more heavily on variable renewables and use-limited resources. As demonstrated in the table above, the Supplement Preferred Plan exhibits few to no issues under the typical conditions that were used as a default assumption for baseload scenario modeling. When evaluated under the 2019 actual historical conditions, we did encounter more periods in which native capacity is insufficient to serve our customers and our import capabilities were at maximum levels, but these events were still relatively uncommon.

The three other portfolios, however, produce more reliability challenges when evaluated under the 2019 actual shapes, either with the magnitude or length of native capacity shortfalls, 3-hour ramping needs, or others. In particular, the "Scenario 9 – 50 Percent ELCC" portfolio experiences the highest number and duration of native load shortfalls, and a high 3-hour ramp. We believe this evaluation helps to confirm that our use of a declining ELCC metric for solar is appropriate. We also note that the

Table IV-14: Thermal Generic Information (Costs in 2018 Dollars)

Thermal Generic Information					
Resource	**Sherco CC**	**Generic CC**	**Generic CT**	**Generic CT**	**Generic CT**
Technology	7H	7H	7H	7F	7H
Location Type	Brownfield	Greenfield	Brownfield	Brownfield	Greenfield
Cooling Type	Wet	Dry	Dry	Dry	Dry
Book life	40	40	40	40	40
Nameplate Capacity (MW)	835	901	374	232	374
Summer Peak Capacity (MW)	750	856	331	206	331
Capital Cost ($000) 2018$	$837,068	$906,588	$174,700	$114,766	$193,500
Electric Transmission Delivery ($000) 2018$	NA	$410,505	NA	NA	$74,804
Ongoing Capital Expenditures ($000-yr) 2018$	$6,200	$6,200	$1,784	$892	$1,784
* Gas Demand ($000-yr) 2018$	$41,000 ~~$31,725~~	$19,058	$2,165	$1,342	$2,165
Capital Cost ($/kW) 2018$	$1,002	$1,006	$467	$495	$517
Electric Transmission Delivery ($/kW) 2018$	NA	$455	NA	NA	$200
Ongoing Capital Expenditures ($/kW-yr) 2018$	$7.42	$6.88	$4.77	$3.85	$4.77
* Gas Demand ($/kW-yr) 2018$	$49.09 ~~$37.98~~	$21.14	$5.79	$5.79	$5.79
Fixed O&M Cost ($000/yr) 2018$	$6,592	$6,592	$1,253	$1,203	$1,253
Variable O&M Cost ($/MWh) 2018$	$1.04	$1.04	$0.99	$1.03	$0.99
Levelized $/kw-mo (All Fixed Costs) $2018	$15.26	$16.06	$5.91	$6.22	$8.06
Summer Heat Rate 100% Loading (btu/kWh)	6,359	6,848	9,264	10,025	9,264
Summer Heat Rate 75% Loading (btu/kWh)	6,547	6,874	9,738	10,581	9,738
Summer Heat Rate 50% Loading (btu/kWh)	6,985	7,334	11,120	12,515	11,120
Summer Heat Rate 25% Loading (btu/kWh)	8,004	8,404	11,558	13,430	11,558
Forced Outage Rate	3%	3%	3%	3%	3%
Maintenance (weeks/yr)	5	5	2	2	2
CO2 Emissions (lbs/MMBtu)	118	118	118	118	118
SO2 Emissions (lbs/MWh)	0.00	0.00	0.00	0.00	0.00
NOx Emissions (lbs/MWh)	0.05	0.05	0.90	0.32	0.90
PM10 Emissions (lbs/MWh)	0.02	0.02	0.03	0.03	0.03
Mercury Emissions (lbs/MMWh)	0.00	0.00	0.00	0.00	0.00

Table IV-15: Renewable Generic Information (Costs in 2018 Dollars)

Renewable Generic Information				
Resource	**Wind**	**Utility Scale Solar**	**Distributed Solar Commercial**	**Distributed Solar Residential**
ELCC Capacity Credit (%)	16.7%	50% declines to 30%		
Capacity Factor	50.0%	22.0%	18.0%	18.0%
Book life	25	25	25	25
Electric Transmission Delivery ($/kW)	500	200	0	0

Table IV-22: Sherco CC Alternatives

Thermal Generic Information				
Resource	**Sherco CC**	**7HA.01 1x1**	**7HA.02 1x1**	**7HA.02 2x1**
Technology	7H	7H	7H	7F
Location Type	Brownfield	Brownfield	Brownfield	Brownfield
Cooling Type	Wet	Wet	Wet	Wet
Book life	40	40	40	40
Nameplate Capacity (MW)	835	405	592	1202
Summer Peak Capacity (MW)	750	395	576	1170
Capital Cost ($000) 2018$	$837,068	$473,751	$629,206	$941,199
Electric Transmission Delivery ($000) 2018$	NA	NA	NA	NA
Ongoing Capital Expenditures ($000-yr) 2018$	$6,200	$4,190	$4,190	$8,775
* Gas Demand ($000-yr) 2018$	$41,000 ~~$31,723~~	$31,723	$31,723	$31,723
Capital Cost ($/kW) 2018$	$1,002	$1,171	$1,064	$783
Electric Transmission Delivery ($/kW) 2018$	NA	NA	NA	NA
Ongoing Capital Expenditures ($/kW-yr) 2018$	$7.43	$10.35	$7.08	$7.30
* Gas Demand ($/kW-yr) 2018$	$49.09 ~~$37.99~~	$78.41	$53.63	$26.38
Fixed O&M Cost ($000/yr) 2018$	$6,592	$7,150	$7,150	$8,647
Variable O&M Cost ($/MWh) 2018$	$1.04	$1.72	$1.72	$1.09
Levelized $/kw-mo (All Fixed Costs) $2018	$15.26	$18.36	$14.11	$10.95
Summer Heat Rate 100% Loading (btu/kWh)	6,359	6,322	6,208	6,452
Summer Heat Rate 75% Loading (btu/kWh)	6,547	6,419	6,257	6,403
Summer Heat Rate 50% Loading (btu/kWh)	6,985	6,681	6,516	6,812
Summer Heat Rate 25% Loading (btu/kWh)	8,004	7,553	7,388	7,479
Forced Outage Rate	3%	3%	3%	3%
Maintenance (weeks/yr)	5	5	5	5
CO2 Emissions (lbs/MMBtu)	118	118	118	118
SO2 Emissions (lbs/MWh)	0.00	0.00	0.00	0.00
NOx Emissions (lbs/MWh)	0.05	0.05	0.05	0.05
PM10 Emissions (lbs/MWh)	0.02	0.02	0.02	0.02
Mercury Emissions (lbs/MMWh)	0.00	0.00	0.00	0.00

Table X-5: EnCompass Net Present Value Results for North Dakota Scenario and Preferred Plan Sensitivities

Child Runs	Description	Base - PVSC	A-PVRR	I-Low Externality	J-Low Externality, Low Regulatory	K-Mid Externality, Mid Regulatory	L-High Externality	M-No Reg or Externality Costs
Scenario 1	Supplement North Dakota Scenario		$36,750					
Scenario 9	Supplement North Dakota Scenario		$36,949					
Scenario 9	EARLY COAL; EXTEND MONTI	$40,823	$37,563	$38,910	$38,205	$39,526	$44,203	$37,286
Scenario 9	Wind Available 2023 @ $500/kW	$40,812	$37,572					
Scenario 9	Solar @ 50% ELCC Throughout	$40,277	$36,769					
Scenario 9	Unconstrained Sales/Purchase Volume	$40,844	$37,721					
Scenario 9	Sherco CC Alternatives - 7HA01 1x1	$41,015	$37,796	$39,102	$38,444	$39,742	$44,185	$37,534
Scenario 9	Sherco CC Alternatives - 7HA02 1x1	$40,855	$37,600	$38,948	$38,275	$39,577	$44,091	$37,365
Scenario 9	Sherco CC Alternatives - 7HA02 2x1	$40,474	$37,209	$38,610	$37,857	$39,178	$44,077	$36,939
* **Scenario 9**	Solar + Storage: "swap" 1st solar addition	~~$40,851~~ $40,830	~~$37,607~~ $37,624	~~$38,975~~ $38,200	~~$38,270~~ $37,356	~~$39,572~~ $39,127	~~$44,232~~ $44,985	~~$37,360~~ $36,162
Scenario 9	Wind + Storage: "swap" 1st wind addition	$41,034	$37,744	$39,112	$38,401	$39,729	$44,440	$37,477
Scenario 9	DSM/DR - Add DR Bundle 2	$40,860	$37,588	$38,946	$38,243	$39,563	$44,231	$37,323
Scenario 9	DSM/DR - Add EE Bundle 3	$41,491	$38,342	$39,725	$39,021	$40,334	$45,000	$38,108

The numbers above represent 2020-2045 total NPV costs.

Table X-6: EnCompass Net Present Value Deltas for North Dakota Scenario and Preferred Plan Sensitivities

	Child Runs	Description	Base - PVSC	A-PVRR	I-Low Externality	J-Low Externality, Low Regulatory	K-Mid Externality, Mid Regulatory	L-High Externality	M-No Reg or Externality Costs
	Scenario 1	Supplement North Dakota Scenario		$0					
	Scenario 9	Supplement North Dakota Scenario		$199					
	Scenario 9	EARLY COAL; EXTEND MONTI	$0	$0	$0	$0	$0	$0	$0
	Scenario 9	Wind Available 2023 @ $500/kW	($11)	$9					
	Scenario 9	Solar @ 50% ELCC Throughout	($545)	($793)					
	Scenario 9	Unconstrained Sales/Purchase Volume	$21	$159					
	Scenario 9	Sherco CC Alternatives - 7HA01 1x1	$193	$234	$192	$239	$216	($18)	$249
	Scenario 9	Sherco CC Alternatives - 7HA02 1x1	$32	$38	$38	$70	$51	($112)	$79
	Scenario 9	Sherco CC Alternatives - 7HA02 2x1	($349)	($353)	($300)	($348)	($348)	($126)	($347)
*	**Scenario 9**	Solar + Storage: "swap" 1st solar addition	~~$29~~ $8	~~$44~~ $62	~~$65~~ ($710)	~~$65~~ ($848)	~~$46~~ ($399)	~~$29~~ $782	~~$74~~ ($1,124)
	Scenario 9	Wind + Storage: "swap" 1st wind addition	$212	$182	$202	$196	$203	$237	$191
	Scenario 9	DSM/DR - Add DR Bundle 2	$37	$26	$36	$38	$38	$28	$38
	Scenario 9	DSM/DR - Add EE Bundle 3	$668	$780	$815	$816	$808	$797	$822

The Supplement North Dakota Scenario deltas above were derived by comparing the total NPV costs of each scenario to Scenario 1 Supplement North Dakota Scenario. All other deltas were derived by comparing the total NPV costs of each Scenario 9 sensitivity to Scenario 9 – Early Coal; Extend Monti.

Table X-11: Strategist Net Present Value Results for North Dakota Scenario and Preferred Plan Sensitivities

Child Run	Description	Base - PVSC	A-PVRR	I-Low Externality	J-Low Externality, Low Regulatory	K-Mid Externality, Mid Regulatory	L-High Externality	M-No Reg or Externality Costs
Scenario 1	Supplement North Dakota Scenario		$37,061					
Scenario 9	Supplement North Dakota Scenario		$37,373					
Scenario 9	*EARLY COAL; EXTEND MONTI*	$42,818	$37,896	$40,481	$38,687	$40,923	$49,813	$37,706
Scenario 9	Wind Available 2023 @ $500/kW	$42,818	$37,896					
* **Scenario 9**	Solar @ 50% ELCC Throughout	~~$42,806~~ $41,868	~~$37,806~~ $36,588					
Scenario 9	Sherco CC Alternatives - 7HA01 1x1	$42,869	$37,830	$40,299	$38,665	$40,925	$49,219	$37,638
Scenario 9	Sherco CC Alternatives - 7HA02 1x1	$42,772	$37,719	$40,246	$38,558	$40,826	$49,342	$37,537
Scenario 9	Sherco CC Alternatives - 7HA02 2x1	$42,922	$37,917	$40,534	$38,716	$40,994	$50,034	$37,713
Scenario 9	DSM/DR - Add DR Bundle 2	$42,840	$37,862	$40,424	$38,667	$40,921	$49,698	$37,665
Scenario 9	DSM/DR - Add EE Bundle 3	$43,559	$38,678	$41,230	$39,451	$41,676	$50,490	$38,476

The numbers in the table above represent 2020-2045 total NPV costs.

Table X-12: Strategist Net Present Value Deltas for North Dakota Scenario and Preferred Plan Sensitivities

Child Run	Description	Base - PVSC	A-PVRR	I-Low Externality	J-Low Externality, Low Regulatory	K-Mid Externality, Mid Regulatory	L-High Externality	M-No Reg or Externality Costs
Scenario 1	Supplement North Dakota Scenario		$0					
Scenario 9	Supplement North Dakota Scenario		$313					
Scenario 9	*EARLY COAL; EXTEND MONTI*	$0	$0	$0	$0	$0	$0	$0
Scenario 9	Wind Available 2023 @ $500/kW	$0	$0					
* **Scenario 9**	Solar @ 50% ELCC Throughout	~~($11)~~ ($949)	~~($90)~~ ($1,308)					
Scenario 9	Sherco CC Alternatives - 7HA01 1x1	$51	($66)	($183)	($22)	$2	($594)	($68)
Scenario 9	Sherco CC Alternatives - 7HA02 1x1	($45)	($177)	($235)	($129)	($97)	($471)	($170)
Scenario 9	Sherco CC Alternatives - 7HA02 2x1	$105	$21	$53	$29	$71	$220	$6
Scenario 9	DSM/DR - Add DR Bundle 2	$22	($34)	($57)	($20)	($2)	($116)	($41)
Scenario 9	DSM/DR - Add EE Bundle 3	$742	$782	$749	$764	$753	$676	$770

The Supplement North Dakota Scenario deltas above were derived by comparing the total NPV costs of each scenario to Scenario 1 Supplement North Dakota Scenario. All other deltas were derived by comparing the total NPV costs of each Scenario 9 sensitivity to Scenario 9 – Early Coal; Extend Monti.

5. Summary of Findings

Table XI-2 summarizes the results of this analysis from the stress conditions we applied to the capacity expansion Scenarios tested.

Table XI-2: Energy and Capacity Adequacy Metrics for Tested Expansion Plan Scenarios

	Native Capacity Shortfall Metrics					Flexible Resource Adequacy Metric	Maximum Import Metric	Industry Metrics		
Expansion Plan (Test Dataset in Parentheses)	**# of Native Capacity Shortfall Events**	**Average Duration of Shortfall Events (hours)**	**Average Intensity of Capacity Shortfall (MW)**	**Longest Shortfall Event (hours)**	**Peak Capacity Shortfall During 2034 (MW)**	**Maximum 3 – Hour Upward Ramp (MW)**	**# of Hours with High Imports**	**LOLH (Hours)**	**LOLE (Days)**	**EUE (MWH)**
Baseline – Scenario 9 - Supplement Preferred Plan (Default)	0	0	0	0	0	4,760 (February)	9	0	0	0
Scenario 9 - Supplement Preferred Plan (2019)	4	1.75	363	2	615	5,506 (June)	158	0	0	0
Scenario 9 – High Distributed Solar Future (2019)	14	2.57	481	5	1,232	7,221 (June)	157	0	0	0
* Scenario 9 – High Electrification Future (2019)	22 ~~21~~	1.95 ~~2.00~~	376 ~~429~~	6	1,037	7,152 (March)	674	0	0	0
Scenario 9 – 50 percent ELCC (2019)	159	3.97	604	22	2,629	7,239 (January)	311	5 (2 separate events)	2	2,575

Note: *The expansion plan with the greatest shortfall is shown in red font for each metric.*

C. Comparison of Plans for a Stress Week

In addition to comparing the results outlined in Table XI-2 above, we provide, as Figures XI-7 through XI-10, a snapshot of each tested Scenario's capacity expansion plan for a "stress week" over December 5-10, 2034 – again using actual customer load and renewable generation patterns from 2019. Seeing how each capacity expansion portfolio is expected to serve a historically observed load pattern provides additional

CERTIFICATE OF SERVICE

I, Lynnette Sweet, hereby certify that I have this day served copies of the foregoing document on the attached list of persons.

xx by depositing a true and correct copy thereof, properly enveloped with postage paid in the United States mail at Minneapolis, Minnesota

xx electronic filing

Docket No. E002/RP-19-368

Dated this 25th day of August 2020

/s/

Lynnette Sweet
Regulatory Administrator

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
David	Aafedt	daafedt@winthrop.com	Winthrop & Weinstine, P.A.	Suite 3500, 225 South Sixth Street Minneapolis, MN 554024629	Electronic Service	No	OFF_SL_19-368_19-368_Official
Gary	Ambach	Gambach@slipstreaminc.org	Slipstream, Inc.	8973 SW Village Loop Chanhassen, MN 55317	Electronic Service	No	OFF_SL_19-368_19-368_Official
Christopher	Anderson	canderson@allete.com	Minnesota Power	30 W Superior St Duluth, MN 558022191	Electronic Service	No	OFF_SL_19-368_19-368_Official
Alison C	Archer	aarcher@misoenergy.org	MISO	2985 Ames Crossing Rd Eagan, MN 55121	Electronic Service	No	OFF_SL_19-368_19-368_Official
Mara	Ascheman	mara.k.ascheman@xcelenergy.com	Xcel Energy	414 Nicollet Mall Fl 5 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_19-368_19-368_Official
Jessica L	Bayles	Jessica.Bayles@stoel.com	Stoel Rives LLP	1150 18th St NW Ste 325 Washington, DC 20036	Electronic Service	No	OFF_SL_19-368_19-368_Official
David	Bender	dbender@earthjustice.org	Earthjustice	1001 G Street NW Suite 1000 Washington, District of Columbia 20001	Electronic Service	No	OFF_SL_19-368_19-368_Official
Tracy	Bertram	tbertram@ci.becker.mn.us		12060 Sherburne Ave Becker City Hall Becker, MN 55308-4694	Electronic Service	No	OFF_SL_19-368_19-368_Official
James J.	Bertrand	james.bertrand@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Jessica	Beyer	jbeyer@greatermankato.com	Greater Mankato Growth	1961 Premier Dr Ste 100 Mankato, MN 56001	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Melissa E	Birchard	mbirchard@keyesfox.com	KEYES & FOX LLP	18 Loudon Rd PO Box 1391 Concord, NH 03302	Electronic Service	No	OFF_SL_19-368_19-368_Official
Michael J.	Bull	mbull@mncee.org	Center for Energy and Environment	212 Third Ave N Ste 560 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_19-368_19-368_Official
James	Canaday	james.canaday@ag.state.mn.us	Office of the Attorney General-RUD	Suite 1400 445 Minnesota St. St. Paul, MN 55101	Electronic Service	Yes	OFF_SL_19-368_19-368_Official
Thomas	Carlson	thomas.carlson@edf-re.com	EDF Renewable Energy	10 2nd St NE Ste. 400 Minneapolis, Minnesota 55413	Electronic Service	No	OFF_SL_19-368_19-368_Official
John	Coffman	john@johncoffman.net	AARP	871 Tuxedo Blvd. St, Louis, MO 63119-2044	Electronic Service	No	OFF_SL_19-368_19-368_Official
Generic Notice	Commerce Attorneys	commerce.attorneys@ag.state.mn.us	Office of the Attorney General-DOC	445 Minnesota Street Suite 1400 St. Paul, MN 55101	Electronic Service	Yes	OFF_SL_19-368_19-368_Official
Riley	Conlin	riley.conlin@stoel.com	Stoel Rives LLP	33 S. 6th Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
George	Crocker	gwillc@nawo.org	North American Water Office	PO Box 174 Lake Elmo, MN 55042	Electronic Service	No	OFF_SL_19-368_19-368_Official
James	Denniston	james.r.denniston@xcelenergy.com	Xcel Energy Services, Inc.	414 Nicollet Mall, 401-8 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_19-368_19-368_Official
Scott F	Dunbar	sdunbar@keyesfox.com	Keyes & Fox LLP	1580 Lincoln St Ste 880 Denver, CO 80203	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Brian	Edstrom	briane@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota St Ste W1360 Saint Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
John	Farrell	jfarrell@ilsr.org	Institute for Local Self-Reliance	2720 E. 22nd St Institute for Local Self-Reliance Minneapolis, MN 55406	Electronic Service	No	OFF_SL_19-368_19-368_Official
Sharon	Ferguson	sharon.ferguson@state.mn.us	Department of Commerce	85 7th Place E Ste 280 Saint Paul, MN 551012198	Electronic Service	No	OFF_SL_19-368_19-368_Official
Mike	Fiterman	mikefiterman@libertydiversified.com	Liberty Diversified International	5600 N Highway 169 Minneapolis, MN 55428-3096	Electronic Service	No	OFF_SL_19-368_19-368_Official
Edward	Garvey	edward.garvey@AESLconsulting.com	AESL Consulting	32 Lawton St Saint Paul, MN 55102-2617	Electronic Service	No	OFF_SL_19-368_19-368_Official
Janet	Gonzalez	Janet.gonzalez@state.mn.us	Public Utilities Commission	Suite 350 121 7th Place East St. Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
Todd J.	Guerrero	todd.guerrero@kutakrock.com	Kutak Rock LLP	Suite 1750 220 South Sixth Street Minneapolis, MN 554021425	Electronic Service	No	OFF_SL_19-368_19-368_Official
J Drake	Hamilton	hamilton@fresh-energy.org	Fresh Energy	408 St Peter St Saint Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
Kim	Havey	kim.havey@minneapolismn.gov	City of Minneapolis	350 South 5th Street, Suite 315M Minneapolis, MN 55415	Electronic Service	No	OFF_SL_19-368_19-368_Official
Philip	Hayet	phayet@jkenn.com	J. Kennedy and Associates, Inc.	570 Colonial Park Drive Suite 305 Roswell, GA 30075-3770	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Kimberly	Hellwig	kimberly.hellwig@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Annete	Henkel	mui@mnutilityinvestors.org	Minnesota Utility Investors	413 Wacouta Street #230 St.Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
Patrick	Hentges	phentges@mankatomn.gov	City Of Mankato	P.O. Box 3368 Mankato, MN 560023368	Electronic Service	No	OFF_SL_19-368_19-368_Official
Michael	Hoppe	il23@mtn.org	Local Union 23, I.B.E.W.	932 Payne Avenue St. Paul, MN 55130	Electronic Service	No	OFF_SL_19-368_19-368_Official
Alan	Jenkins	aj@jenkinsatlaw.com	Jenkins at Law	2950 Yellowtail Ave. Marathon, FL 33050	Electronic Service	No	OFF_SL_19-368_19-368_Official
Richard	Johnson	Rick.Johnson@lawmoss.com	Moss & Barnett	150 S. 5th Street Suite 1200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Sarah	Johnson Phillips	sarah.phillips@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Mark J.	Kaufman	mkaufman@ibewlocal949.org	IBEW Local Union 949	12908 Nicollet Avenue South Burnsville, MN 55337	Electronic Service	No	OFF_SL_19-368_19-368_Official
William	Kenworthy	will@votesolar.org		18 S. Michigan Ave Ste 1200 Chicago, IL 60603	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Thomas	Koehler	TGK@IBEW160.org	Local Union #160, IBEW	2909 Anthony Ln St Anthony Village, MN 55418-3238	Electronic Service	No	OFF_SL_19-368_19-368_Official
Frank	Kohlasch	frank.kohlasch@state.mn.us	MN Pollution Control Agency	520 Lafayette Rd N. St. Paul, MN 55155	Electronic Service	No	OFF_SL_19-368_19-368_Official
Michael	Krikava	mkrikava@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 S 8th St Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Carmel	Laney	carmel.laney@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Peder	Larson	plarson@larkinhoffman.com	Larkin Hoffman Daly & Lindgren, Ltd.	8300 Norman Center Drive Suite 1000 Bloomington, MN 55437	Electronic Service	No	OFF_SL_19-368_19-368_Official
Douglas	Larson	dlarson@dakotaelectric.com	Dakota Electric Association	4300 220th St W Farmington, MN 55024	Electronic Service	No	OFF_SL_19-368_19-368_Official
Annie	Levenson Falk	annielf@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota Street, Suite W1360 St. Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
Kavita	Maini	kmaini@wi.rr.com	KM Energy Consulting, LLC	961 N Lost Woods Rd Oconomowoc, WI 53066	Electronic Service	No	OFF_SL_19-368_19-368_Official
Pam	Marshall	pam@energycents.org	Energy CENTS Coalition	823 7th St E St. Paul, MN 55106	Electronic Service	No	OFF_SL_19-368_19-368_Official
Emily	Marshall	emarshall@mojlaw.com	Miller O'Brien Jensen, PA	120 S. 6th Street Suite 2400 Minneapolis, Minnesota 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Mary	Martinka	mary.a.martinka@xcelenergy.com	Xcel Energy Inc	414 Nicollet Mall 7th Floor Minneapolis, MN 55401	Electronic Service	No	OFF_SL_19-368_19-368_Official
Daryl	Maxwell	dmaxwell@hydro.mb.ca	Manitoba Hydro	360 Portage Ave FL 16 PO Box 815, Station Main Winnipeg, Manitoba R3C 2P4 Canada	Electronic Service	No	OFF_SL_19-368_19-368_Official
Taylor	McNair	taylor@gridlab.org		668 Capp Street San Francisco, CA 94110	Electronic Service	No	OFF_SL_19-368_19-368_Official
Brian	Meloy	brian.meloy@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Joseph	Meyer	joseph.meyer@ag.state.mn.us	Office of the Attorney General-RUD	Bremer Tower, Suite 1400 445 Minnesota Street St Paul, MN 55101-2131	Electronic Service	No	OFF_SL_19-368_19-368_Official
Stacy	Miller	stacy.miller@minneapolismn.gov	City of Minneapolis	350 S. 5th Street Room M 301 Minneapolis, MN 55415	Electronic Service	No	OFF_SL_19-368_19-368_Official
David	Moeller	dmoeller@allete.com	Minnesota Power	30 W Superior St Duluth, MN 558022093	Electronic Service	No	OFF_SL_19-368_19-368_Official
Andrew	Moratzka	andrew.moratzka@stoel.com	Stoel Rives LLP	33 South Sixth St Ste 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Evan	Mulholland	emulholland@mncenter.org	Minnesota Center for Environmental Advocacy	1919 University Ave W Ste 515 Saint Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Alan	Muller	alan@greendel.org	Energy & Environmental Consulting	1110 West Avenue Red Wing, MN 55066	Electronic Service	No	OFF_SL_19-368_19-368_Official
Carl	Nelson	cnelson@mncee.org	Center for Energy and Environment	212 3rd Ave N Ste 560 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_19-368_19-368_Official
J	Newberger	Jnewberger1@yahoo.com	State Rep	14225 Balsam Blvd Becker, MN 55308	Electronic Service	No	OFF_SL_19-368_19-368_Official
David	Niles	david.niles@avantenergy.com	Minnesota Municipal Power Agency	220 South Sixth Street Suite 1300 Minneapolis, Minnesota 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
M. William	O'Brien	bobrien@mojlaw.com	Miller O'Brien Jensen, P.A.	120 S 6th St Ste 2400 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Ric	O'Connell	ric@gridlab.org	GridLab	2120 University Ave Berkeley, CA 94704	Electronic Service	No	OFF_SL_19-368_19-368_Official
Carol A.	Overland	overland@legalectric.org	Legalectric - Overland Law Office	1110 West Avenue Red Wing, MN 55066	Electronic Service	No	OFF_SL_19-368_19-368_Official
Jessica	Palmer Denig	jessica.palmer-Denig@state.mn.us	Office of Administrative Hearings	600 Robert St N PO Box 64620 St. Paul, MN 55164	Electronic Service	No	OFF_SL_19-368_19-368_Official
J. Gregory	Porter	greg.porter@nngco.com	Northern Natural Gas Company	1111 South 103rd St Omaha, NE 68124	Electronic Service	No	OFF_SL_19-368_19-368_Official
Greg	Pruszinske	gpruszinske@ci.becker.mn.us	City of Becker	PO Box 250 12060 Sherburne Ave Becker, MN 55308	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Peter	Reese	peter@littysolar.com		920 East Lake St Minneapolis, MN 55407	Electronic Service	No	OFF_SL_19-368_19-368_Official
Generic Notice	Residential Utilities Division	residential.utilities@ag.state.mn.us	Office of the Attorney General-RUD	1400 BRM Tower 445 Minnesota St St. Paul, MN 551012131	Electronic Service	Yes	OFF_SL_19-368_19-368_Official
Kevin	Reuther	kreuther@mncenter.org	MN Center for Environmental Advocacy	26 E Exchange St, Ste 206 St. Paul, MN 551011667	Electronic Service	No	OFF_SL_19-368_19-368_Official
Richard	Savelkoul	rsavelkoul@martinsquires.com	Martin & Squires, P.A.	332 Minnesota Street Ste W2750 St. Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
Larry L.	Schedin	Larry@LLSResources.com	LLS Resources, LLC	332 Minnesota St, Ste W1390 St. Paul, MN 55101	Electronic Service	No	OFF_SL_19-368_19-368_Official
Jacob J.	Schlesinger	jschlesinger@keyesfox.com	Keyes & Fox LLP	1580 Lincoln St Ste 880 Denver, CO 80203	Electronic Service	No	OFF_SL_19-368_19-368_Official
Will	Seuffert	Will.Seuffert@state.mn.us	Public Utilities Commission	121 7th Pl E Ste 350 Saint Paul, MN 55101	Electronic Service	Yes	OFF_SL_19-368_19-368_Official
Janet	Shaddix Elling	jshaddix@janetshaddix.com	Shaddix And Associates	7400 Lyndale Ave S Ste 190 Richfield, MN 55423	Electronic Service	Yes	OFF_SL_19-368_19-368_Official
Jessie	Smith	jseim@piic.org	Prairie Island Indian Community	5636 Sturgeon Lake Rd Welch, MN 55089	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Joshua	Smith	joshua.smith@sierraclub.org		85 Second St FL 2 San Francisco, California 94105	Electronic Service	No	OFF_SL_19-368_19-368_Official
Ken	Smith	ken.smith@districtenergy.com	District Energy St. Paul Inc.	76 W Kellogg Blvd St. Paul, MN 55102	Electronic Service	No	OFF_SL_19-368_19-368_Official
Beth H.	Soholt	bsoholt@windonthewires.org	Wind on the Wires	570 Asbury Street Suite 201 St. Paul, MN 55104	Electronic Service	No	OFF_SL_19-368_19-368_Official
Anna	Sommer	ASommer@energyfuturesgroup.com	Energy Futures Group	PO Box 692 Canton, NY 13617	Electronic Service	No	OFF_SL_19-368_19-368_Official
Mark	Spurr	mspurr@fvbenergy.com	International District Energy Association	222 South Ninth St., Suite 825 Minneapolis, Minnesota 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Byron E.	Starns	byron.starns@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
James M	Strommen	jstrommen@kennedy-graven.com	Kennedy & Graven, Chartered	200 S 6th St Ste 470 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Eric	Swanson	eswanson@winthrop.com	Winthrop & Weinstine	225 S 6th St Ste 3500 Capella Tower Minneapolis, MN 554024629	Electronic Service	No	OFF_SL_19-368_19-368_Official
Lynnette	Sweet	Regulatory.records@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 554011993	Electronic Service	No	OFF_SL_19-368_19-368_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Douglas	Tiffany	tiffa002@umn.edu	University of Minnesota	316d Ruttan Hall 1994 Buford Avenue St. Paul, MN 55108	Electronic Service	No	OFF_SL_19-368_19-368_Official
Thomas	Tynes	jjazynka@energyfreedomcoalition.com	Energy Freedom Coalition of America	101 Constitution Ave NW Ste 525 East Washington, DC 20001	Electronic Service	No	OFF_SL_19-368_19-368_Official
Lisa	Veith	lisa.veith@ci.stpaul.mn.us	City of St. Paul	400 City Hall and Courthouse 15 West Kellogg Blvd. St. Paul, MN 55102	Electronic Service	No	OFF_SL_19-368_19-368_Official
Julie	Voeck	julie.voeck@nee.com	NextEra Energy Resources, LLC	700 Universe Blvd Juno Beach, FL 33408	Electronic Service	No	OFF_SL_19-368_19-368_Official
Laurie	Williams	laurie.williams@sierraclub.org	Sierra Club	Environmental Law Program 1536 Wynkoop St Ste 200 Denver, CO 80202	Electronic Service	No	OFF_SL_19-368_19-368_Official
Samantha	Williams	swilliams@nrdc.org	Natural Resources Defense Council	20 N. Wacker Drive Ste 1600 Chicago, IL 60606	Electronic Service	No	OFF_SL_19-368_19-368_Official
Joseph	Windler	jwindler@winthrop.com	Winthrop & Weinstine	225 South Sixth Street, Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official
Patrick	Zomer	Patrick.Zomer@lawmoss.com	Moss & Barnett a Professional Association	150 S. 5th Street, #1200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_19-368_19-368_Official