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Xcel Energy Information Request No. 2
Docket No.: E002/M-14-0065
Response To: MN Public Utilities Commission
Requestor: Susan Mckenzie
Date Received: August 12, 2019

Question:

Please respond to the following information request, within 10 days if possible.

Please explain in detail the rationale and analytical basis for the Deferral Reduction Factor proposed in the Company’s May 1, 2019 filing in Docket No. E-002/M-13-867. In addition, using the Company’s proposal for the calculation of the avoided distribution cost component, please provide the recalculated component for the 2020 VOS, as well as the resulting system-wide levelized 2020 VOS bill credit rate, without applying a Deferral Reduction Factor. Also, please provide the recalculated avoided distribution cost component for the 2020 VOS, as well as the resulting system-wide levelized 2020 VOS bill credit rate, at different levels of the reduction factor including 10, 20, 30, and 40%.

In addition, using the Company’s May 1, 2019 proposal for the avoided distribution cost component, please recalculate and provide this cost component for the 2020 VOS, as well as the resulting system-wide levelized 2020 VOS bill credit rate, using different timeframes for the calculation of the component, including 10 and 15 years, or explain why the use of these extended timeframes is inappropriate or infeasible.

Could you post the Company’s response to this IR in both Docket Nos. E-002/M-13-867 and E-999/M-14-65?

Response:

Since it is not clear if solar could be effectively deployed in specific places on the distribution system or achieve the critical mass such that the distribution projects could be avoided or deferred by the actual solar installed, the Company proposes a 50% reduction factor to share this risk between solar providers and system customers. For example, since there have only been a few Solar*Reward Community projects developed in urban areas, it is unclear if capacity related distribution projects that occur in urban areas would be avoided.

Please see attachments A through J for the requested scenarios. For example, Attachment A contains the 2020 VOS rate that incorporates the Cost per kW with the 40 percent deferral reduction factor. Attachment B contains the Cost per kW calculation that includes the 40 percent deferral reduction factor. The remaining attachments contain the same information for the 30 percent, 20 percent, 10 percent and 0 percent deferral reduction factors.

The Company believes the best estimate of current distribution cost per kW is through the use of two years of actual cost and three years of forecasted data. Given the Company forecast data beyond three years are high level estimates and the dynamic nature of the forecast in those years we believe those projects are not suitable for the cost per kW metric. Historical data beyond the two years is not likely to be representative of current projects.

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Date: August 21, 2019

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Note: Table 1, 2 and 16 were not included as they are not required for the VOS calculation. Table 7 (Losses to be considered) are included in Fig. ES-1

Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value

CURRENT POSITION	Economic Value	Load Match	Distributed Loss Savings	Distributed PV Value
<i>25 Year Levelized Values</i>	(\$/kWh)	(%)	(%)	(\$/kWh)
Avoided Fuel Cost	\$0.0274		9.8%	\$0.0301
Avoided Plant O&M - Fixed	\$0.0027	48.6%	10.8%	\$0.0014
Avoided Plant O&M - Variable	\$0.0012		9.8%	\$0.0014
Avoided Generation Capacity Cost	\$0.0367	48.6%	10.8%	\$0.0197
Avoided Reserve Capacity Cost	\$0.0029	48.6%	10.8%	\$0.0016
Avoided Transmission Capacity Cos	\$0.0325	48.6%	10.8%	\$0.0175
Avoided Distribution Capacity Cost	\$0.0041	54.6%	12.4%	\$0.0025
Avoided Environmental Cost	\$0.0359		9.8%	\$0.0394
Avoided Voltage Control Cost				
<u>Solar Integration Cost</u>				
TOTAL				\$0.1136

Figure ES-2. 1st-Year VOS Rate calculation

Year	Discount Factor	Escalation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1.000	\$0.114	\$0.114	\$0.0927	0.093
2021	0.940	1.022	\$0.114	\$0.107	\$0.0948	0.089
2022	0.884	1.045	\$0.114	\$0.100	\$0.0969	0.086
2023	0.831	1.068	\$0.114	\$0.094	\$0.0991	0.082
2024	0.781	1.092	\$0.114	\$0.089	\$0.1013	0.079
2025	0.735	1.117	\$0.114	\$0.083	\$0.1035	0.076
2026	0.691	1.141	\$0.114	\$0.078	\$0.1058	0.073
2027	0.649	1.167	\$0.114	\$0.074	\$0.1082	0.070
2028	0.611	1.193	\$0.114	\$0.069	\$0.1106	0.068
2029	0.574	1.220	\$0.114	\$0.065	\$0.1131	0.065
2030	0.540	1.247	\$0.114	\$0.061	\$0.1156	0.062
2031	0.508	1.275	\$0.114	\$0.058	\$0.1182	0.060
2032	0.477	1.303	\$0.114	\$0.054	\$0.1208	0.058
2033	0.449	1.332	\$0.114	\$0.051	\$0.1235	0.055
2034	0.422	1.362	\$0.114	\$0.048	\$0.1263	0.053
2035	0.397	1.392	\$0.114	\$0.045	\$0.1291	0.051
2036	0.397	1.423	\$0.114	\$0.045	\$0.1319	0.052
2037	0.351	1.455	\$0.114	\$0.040	\$0.1349	0.047
2038	0.330	1.487	\$0.114	\$0.037	\$0.1379	0.045
2039	0.310	1.521	\$0.114	\$0.035	\$0.1410	0.044
2040	0.291	1.554	\$0.114	\$0.033	\$0.1441	0.042
2041	0.274	1.589	\$0.114	\$0.031	\$0.1473	0.040
2042	0.258	1.625	\$0.114	\$0.029	\$0.1506	0.039
2043	0.242	1.661	\$0.114	\$0.028	\$0.1540	0.037
2044	0.228	1.698	\$0.114	\$0.026	\$0.1574	0.036
				\$1.496		\$1.504

Table 3. Fixed Assumptions to be used for the VOS calculations

Fuel Prices			Environmental Externalities		
Guaranteed NG Fuel Prices			Environmental Discount Rate	5.30%	per year
2020	\$2.671	\$/mmBtu	Environmental Costs	separate table	
2021	\$2.639	\$/mmBtu	Economic Assumptions		
2022	\$2.645	\$/mmBtu	General Escalation Rate	2.23%	per year
2023	\$2.720	\$/mmBtu	Treasury Yields		
2024	\$2.823	\$/mmBtu	1 Year	2.17%	
2025	\$2.935	\$/mmBtu	2 Year	2.05%	
2026	\$3.047	\$/mmBtu	3 Year	2.01%	
2027	\$3.159	\$/mmBtu	5 Year	2.04%	
2028	\$3.271	\$/mmBtu	7 Year	2.14%	
2029	\$3.380	\$/mmBtu	10 Year	2.25%	
2030	\$3.490	\$/mmBtu	20 Year	2.49%	
2031	\$3.596	\$/mmBtu	30 Year	2.68%	
Fuel Price Escalation	2.23%				
PV Assumptions					
PV Degradation Rate	0.50%				
PV Life	25				

Table 4. Environmental costs by year.

Year	Analysis Year	CO2 Cost \$/mmBtu	PM 2.5 Cost \$/mmBtu	CO Cost \$/mmBtu	NOx Cost \$/mmBtu	Pb Cost \$/mmBtu	SO2 Cost \$/mmBtu	Total Cost \$/mmBtu
2020	0	\$2.807	\$0.021	\$0.000	\$0.286	\$0.000	\$0.004	\$3.117
2021	1	\$2.924	\$0.021	\$0.000	\$0.292	\$0.000	\$0.004	\$3.241
2022	2	\$3.045	\$0.021	\$0.000	\$0.299	\$0.000	\$0.004	\$3.369
2023	3	\$3.170	\$0.022	\$0.000	\$0.305	\$0.000	\$0.004	\$3.502
2024	4	\$3.299	\$0.022	\$0.000	\$0.312	\$0.000	\$0.004	\$3.638
2025	5	\$3.433	\$0.023	\$0.000	\$0.319	\$0.000	\$0.004	\$3.779
2026	6	\$3.570	\$0.023	\$0.000	\$0.326	\$0.000	\$0.004	\$3.924
2027	7	\$3.712	\$0.024	\$0.000	\$0.334	\$0.000	\$0.004	\$4.074
2028	8	\$3.859	\$0.025	\$0.000	\$0.341	\$0.000	\$0.004	\$4.229
2029	9	\$4.010	\$0.025	\$0.000	\$0.349	\$0.000	\$0.004	\$4.388
2030	10	\$4.166	\$0.026	\$0.000	\$0.356	\$0.000	\$0.004	\$4.553
2031	11	\$4.344	\$0.026	\$0.000	\$0.364	\$0.000	\$0.004	\$4.740
2032	12	\$4.528	\$0.027	\$0.000	\$0.373	\$0.000	\$0.005	\$4.932
2033	13	\$4.718	\$0.027	\$0.000	\$0.381	\$0.000	\$0.005	\$5.131
2034	14	\$4.915	\$0.028	\$0.000	\$0.389	\$0.000	\$0.005	\$5.337
2035	15	\$5.117	\$0.029	\$0.000	\$0.398	\$0.000	\$0.005	\$5.549
2036	16	\$5.326	\$0.029	\$0.000	\$0.407	\$0.000	\$0.005	\$5.768
2037	17	\$5.542	\$0.030	\$0.000	\$0.416	\$0.000	\$0.005	\$5.993
2038	18	\$5.765	\$0.031	\$0.000	\$0.425	\$0.000	\$0.005	\$6.227
2039	19	\$5.996	\$0.031	\$0.000	\$0.435	\$0.000	\$0.005	\$6.467
2040	20	\$6.233	\$0.032	\$0.000	\$0.444	\$0.000	\$0.005	\$6.715
2041	21	\$6.457	\$0.033	\$0.000	\$0.454	\$0.000	\$0.006	\$6.950
2042	22	\$6.688	\$0.033	\$0.000	\$0.464	\$0.000	\$0.006	\$7.192
2043	23	\$6.926	\$0.034	\$0.000	\$0.475	\$0.000	\$0.006	\$7.441
2044	24	\$7.171	\$0.035	\$0.000	\$0.485	\$0.000	\$0.006	\$7.698

Table 5. VOS Data table -- required format showing assumptions used in the VOS calculation.

	Input Data	Units		Input Data	Units
Economic Factors			Power Generation - Continued		
Start Year for VOS applicability	2020	Year	Other		
Discount Rate (After-tax WACC)	6.36%	Percentage	Solar weighted Heat Rate	7,742	BTU per kWh
Load Match Analysis			Fuel Price Overhead	\$0.004	\$ per MMBtu
ELCC (no loss)	48.6%	% of rating	Generation life	40	years
PLR (no loss)	54.6%	% of rating	Heat Rate degradation	0.10%	per year
Loss Savings - Energy	9.8%	% of PV output	O&M cost (first year) - Fixed	\$3.42	per kW-yr
Loss Savings - PLR	12.4%	% of PV output	O&M cost (first year) - Variable	\$0.0010	\$ per kWh
Loss Savings - ELCC	10.8%	% of PV output	O&M cost escalation rate	2.00%	per year
			Reserve planning margin	7.9%	
			Years until new Generation is needed	0	
PV Energy			Distribution		
Simulated - First year annual energy	1,452	kWh per kW-AC	Capacity-related distribution capital costs -System	\$96	\$ per kW
year annual energy		kWh per kW-AC	Capacity-related distribution capital costs - Mpls	N/A	\$ per kW
Actual- First year annual energy	1,563		Capacity-related distribution capital costs - Mtka	N/A	\$ per kW
			Capacity-related distribution capital costs -Edina	N/A	\$ per kW
Transmission			Capacity-related distribution capital costs - SE	N/A	\$ per kW
Capacity-related transmission capital cost	\$50.33	\$ per kW	Capacity-related distribution capital costs -MG	N/A	\$ per kW
Power Generation			Capacity-related distribution capital costs - Newport	N/A	\$ per kW
Peaking CT, simple cycle			Capacity-related distribution capital costs - St. Paul	N/A	\$ per kW
Installed Cost	\$476	\$/kW	Capacity-related distribution capital costs - NW	N/A	\$ per kW
Heat Rate	9,738	BTU/kWh	Capacity-related distribution capital costs - WBL	N/A	\$ per kW
Intermediate CCGT			Distribution capital cost escalation	2.00%	per year
Installed Cost	\$1,022	\$/kW	Peak Load (Weather Normalized)	6,420	MW
Heat Rate	6,547	BTU/kWh	Peak Load Growth	0.43%	per year

Table 6. Azimuth and Tilt Angles

	Array KW	% of Total	Azimuth	Tilt	
1	3,209	4.9%	52	25	
2	2,974	4.5%	140	21	
3	2,906	4.4%	167	19	
4	18,979	28.9%	180	12	
5	3,939	6.0%	180	21	
6	7,997	12.2%	180	26	
7	6,676	10.2%	180	30	
8	3,296	5.0%	180	35	
9	947	1.4%	180	42	
10	5,453	8.3%	180	48	
11	2,769	4.2%	184	19	
12	964	1.5%	197	26	
13	2,816	4.3%	212	18	
14	1,207	1.8%	237	24	
15	1,577	2.4%	271	22	
TOTAL	65,709	100%	176.4	23.2	Weighted Average

Table 8. Economic Value of Avoided Fuel Costs.

Year				Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Utility	VOS		Utility	VOS		Utility	VOS
	\$/mmBtu	\$/mmBtu	mmBtu/kWh	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$2.67	\$2.67	7,742	\$0.021	\$0.0274	1,563	\$32	\$43	1.000	\$32	\$43
2021	\$2.64	\$2.64	7,750	\$0.020	\$0.0274	1,555	\$32	\$43	0.979	\$31	\$42
2022	\$2.64	\$2.65	7,757	\$0.021	\$0.0274	1,547	\$32	\$42	0.960	\$31	\$41
2023	\$2.72	\$2.72	7,765	\$0.021	\$0.0274	1,540	\$33	\$42	0.942	\$31	\$40
2024	\$2.82	\$2.83	7,773	\$0.022	\$0.0274	1,532	\$34	\$42	0.923	\$31	\$39
2025	\$2.93	\$2.94	7,781	\$0.023	\$0.0274	1,524	\$35	\$42	0.904	\$32	\$38
2026	\$3.05	\$3.05	7,789	\$0.024	\$0.0274	1,517	\$36	\$42	0.883	\$32	\$37
2027	\$3.16	\$3.16	7,796	\$0.025	\$0.0274	1,509	\$37	\$41	0.863	\$32	\$36
2028	\$3.27	\$3.28	7,804	\$0.026	\$0.0274	1,502	\$38	\$41	0.842	\$32	\$35
2029	\$3.38	\$3.38	7,812	\$0.026	\$0.0274	1,494	\$40	\$41	0.822	\$32	\$34
2030	\$3.49	\$3.49	7,820	\$0.027	\$0.0274	1,487	\$41	\$41	0.801	\$33	\$33
2031	\$3.60	\$3.60	7,828	\$0.028	\$0.0274	1,479	\$42	\$41	0.781	\$33	\$32
2032	\$3.68	\$3.68	7,835	\$0.029	\$0.0274	1,472	\$42	\$40	0.762	\$32	\$31
2033	\$3.76	\$3.76	7,843	\$0.030	\$0.0274	1,464	\$43	\$40	0.742	\$32	\$30
2034	\$3.84	\$3.85	7,851	\$0.030	\$0.0274	1,457	\$44	\$40	0.723	\$32	\$29
2035	\$3.93	\$3.93	7,859	\$0.031	\$0.0274	1,450	\$45	\$40	0.704	\$32	\$28
2036	\$4.01	\$4.02	7,867	\$0.032	\$0.0274	1,443	\$46	\$40	0.685	\$31	\$27
2037	\$4.10	\$4.11	7,875	\$0.032	\$0.0274	1,435	\$46	\$39	0.666	\$31	\$26
2038	\$4.20	\$4.20	7,883	\$0.033	\$0.0274	1,428	\$47	\$39	0.648	\$31	\$25
2039	\$4.29	\$4.30	7,890	\$0.034	\$0.0274	1,421	\$48	\$39	0.629	\$30	\$25
2040	\$4.39	\$4.39	7,898	\$0.035	\$0.0274	1,414	\$49	\$39	0.611	\$30	\$24
2041	\$4.48	\$4.49	7,906	\$0.035	\$0.0274	1,407	\$50	\$39	0.594	\$30	\$23
2042	\$4.58	\$4.59	7,914	\$0.036	\$0.0274	1,400	\$51	\$38	0.577	\$29	\$22
2043	\$4.69	\$4.69	7,922	\$0.037	\$0.0274	1,393	\$52	\$38	0.561	\$29	\$21
2044	\$4.79	\$4.80	7,930	\$0.038	\$0.0274	1,386	\$53	\$38	0.544	\$29	\$21

Validation: Present Value	\$779	\$779
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Table 9. Economic value of avoided plant O&M - fixed

Year	O&M Fixed	Utility Capacity	PV Capacity	Prices		p.u. PV Production	Costs		Discount Factor	Disc. Costs	
				Utility	VOS		Utility	VOS		Utility	VOS
				\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$3.42	1.00	1.00	\$0.0022	\$0.0027	1,563	\$3.42	\$4.14	1.000	\$3.42	\$4.14
2021	\$3.49	0.999	0.995	\$0.0022	\$0.0027	1,555	\$3.48	\$4.12	0.940	\$3.27	\$3.88
2022	\$3.56	0.998	0.990	\$0.0023	\$0.0027	1,547	\$3.53	\$4.10	0.884	\$3.12	\$3.63
2023	\$3.63	0.997	0.985	\$0.0024	\$0.0027	1,540	\$3.59	\$4.08	0.831	\$2.98	\$3.39
2024	\$3.71	0.996	0.980	\$0.0024	\$0.0027	1,532	\$3.65	\$4.06	0.781	\$2.85	\$3.17
2025	\$3.78	0.995	0.975	\$0.0025	\$0.0027	1,524	\$3.71	\$4.04	0.735	\$2.72	\$2.97
2026	\$3.86	0.994	0.970	\$0.0025	\$0.0027	1,517	\$3.76	\$4.02	0.691	\$2.60	\$2.78
2027	\$3.93	0.993	0.966	\$0.0026	\$0.0027	1,509	\$3.82	\$4.00	0.649	\$2.48	\$2.60
2028	\$4.01	0.992	0.961	\$0.0027	\$0.0027	1,502	\$3.89	\$3.98	0.611	\$2.37	\$2.43
2029	\$4.09	0.991	0.956	\$0.0027	\$0.0027	1,494	\$3.95	\$3.96	0.574	\$2.27	\$2.27
2030	\$4.17	0.990	0.951	\$0.0028	\$0.0027	1,487	\$4.01	\$3.94	0.540	\$2.16	\$2.13
2031	\$4.26	0.989	0.946	\$0.0028	\$0.0027	1,479	\$4.07	\$3.92	0.508	\$2.07	\$1.99
2032	\$4.34	0.988	0.942	\$0.0029	\$0.0027	1,472	\$4.14	\$3.90	0.477	\$1.97	\$1.86
2033	\$4.43	0.987	0.937	\$0.0030	\$0.0027	1,464	\$4.20	\$3.88	0.449	\$1.89	\$1.74
2034	\$4.52	0.986	0.932	\$0.0031	\$0.0027	1,457	\$4.27	\$3.86	0.422	\$1.80	\$1.63
2035	\$4.52	0.985	0.928	\$0.0031	\$0.0027	1,450	\$4.25	\$3.84	0.397	\$1.69	\$1.52
2036	\$4.70	0.984	0.923	\$0.0032	\$0.0027	1,443	\$4.41	\$3.82	0.397	\$1.75	\$1.52
2037	\$4.79	0.983	0.918	\$0.0033	\$0.0027	1,435	\$4.48	\$3.80	0.351	\$1.57	\$1.33
2038	\$4.89	0.982	0.914	\$0.0034	\$0.0027	1,428	\$4.55	\$3.78	0.330	\$1.50	\$1.25
2039	\$4.99	0.981	0.909	\$0.0034	\$0.0027	1,421	\$4.62	\$3.77	0.310	\$1.43	\$1.17
2040	\$5.09	0.980	0.905	\$0.0035	\$0.0027	1,414	\$4.70	\$3.75	0.291	\$1.37	\$1.09
2041	\$5.19	0.979	0.900	\$0.0036	\$0.0027	1,407	\$4.77	\$3.73	0.274	\$1.31	\$1.02
2042	\$5.29	0.978	0.896	\$0.0037	\$0.0027	1,400	\$4.85	\$3.71	0.258	\$1.25	\$0.96
2043	\$5.40	0.977	0.891	\$0.0038	\$0.0027	1,393	\$4.92	\$3.69	0.242	\$1.19	\$0.89
2044	\$5.51	0.976	0.887	\$0.0039	\$0.0027	1,386	\$5.00	\$3.67	0.228	\$1.14	\$0.84

\$0.0027

Validation: Present Value	\$52	\$52
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Table 10. Economic value of avoided plant O&M - variable

Year	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$0.0010	\$0.0012	1,563	\$2	\$2	1.000	\$2	\$2
2021	\$0.0011	\$0.0012	1,555	\$2	\$2	0.940	\$2	\$2
2022	\$0.0011	\$0.0012	1,547	\$2	\$2	0.884	\$1	\$2
2023	\$0.0011	\$0.0012	1,540	\$2	\$2	0.831	\$1	\$2
2024	\$0.0011	\$0.0012	1,532	\$2	\$2	0.781	\$1	\$1
2025	\$0.0011	\$0.0012	1,524	\$2	\$2	0.735	\$1	\$1
2026	\$0.0012	\$0.0012	1,517	\$2	\$2	0.691	\$1	\$1
2027	\$0.0012	\$0.0012	1,509	\$2	\$2	0.649	\$1	\$1
2028	\$0.0012	\$0.0012	1,502	\$2	\$2	0.611	\$1	\$1
2029	\$0.0012	\$0.0012	1,494	\$2	\$2	0.574	\$1	\$1
2030	\$0.0013	\$0.0012	1,487	\$2	\$2	0.540	\$1	\$1
2031	\$0.0013	\$0.0012	1,479	\$2	\$2	0.508	\$1	\$1
2032	\$0.0013	\$0.0012	1,472	\$2	\$2	0.477	\$1	\$1
2033	\$0.0013	\$0.0012	1,464	\$2	\$2	0.449	\$1	\$1
2034	\$0.0014	\$0.0012	1,457	\$2	\$2	0.422	\$1	\$1
2035	\$0.0014	\$0.0012	1,450	\$2	\$2	0.397	\$1	\$1
2036	\$0.0014	\$0.0012	1,443	\$2	\$2	0.373	\$1	\$1
2037	\$0.0014	\$0.0012	1,435	\$2	\$2	0.351	\$1	\$1
2038	\$0.0015	\$0.0012	1,428	\$2	\$2	0.330	\$1	\$1
2039	\$0.0015	\$0.0012	1,421	\$2	\$2	0.310	\$1	\$1
2040	\$0.0015	\$0.0012	1,414	\$2	\$2	0.291	\$1	\$1
2041	\$0.0016	\$0.0012	1,407	\$2	\$2	0.274	\$1	\$0
2042	\$0.0016	\$0.0012	1,400	\$2	\$2	0.258	\$1	\$0
2043	\$0.0016	\$0.0012	1,393	\$2	\$2	0.242	\$1	\$0
2044	\$0.0017	\$0.0012	1,386	\$2	\$2	0.228	\$1	\$0

Validation: Present Value	\$24	\$24
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Table 11. Economic value of avoided generation capacity cost.

Year	Capacity Cost	Utility Capacity	PV Capacity	Prices		PV Production	Costs		Discount Factor	Disc. Costs	
				Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$57	1.00	1.00	\$0.036	\$0.0367	1,563	\$57	\$57	1.000	\$57	\$57
2021	\$57	0.999	0.995	\$0.036	\$0.0367	1,555	\$57	\$57	0.940	\$53	\$54
2022	\$57	0.998	0.990	\$0.036	\$0.0367	1,547	\$56	\$57	0.884	\$50	\$50
2023	\$57	0.997	0.985	\$0.036	\$0.0367	1,540	\$56	\$56	0.831	\$47	\$47
2024	\$57	0.996	0.980	\$0.036	\$0.0367	1,532	\$56	\$56	0.781	\$44	\$44
2025	\$57	0.995	0.975	\$0.037	\$0.0367	1,524	\$56	\$56	0.735	\$41	\$41
2026	\$57	0.994	0.970	\$0.037	\$0.0367	1,517	\$55	\$56	0.691	\$38	\$38
2027	\$57	0.993	0.966	\$0.037	\$0.0367	1,509	\$55	\$55	0.649	\$36	\$36
2028	\$57	0.992	0.961	\$0.037	\$0.0367	1,502	\$55	\$55	0.611	\$34	\$34
2029	\$57	0.991	0.956	\$0.037	\$0.0367	1,494	\$55	\$55	0.574	\$31	\$31
2030	\$57	0.990	0.951	\$0.037	\$0.0367	1,487	\$55	\$55	0.540	\$29	\$29
2031	\$57	0.989	0.946	\$0.037	\$0.0367	1,479	\$54	\$54	0.508	\$28	\$28
2032	\$57	0.988	0.942	\$0.037	\$0.0367	1,472	\$54	\$54	0.477	\$26	\$26
2033	\$57	0.987	0.937	\$0.037	\$0.0367	1,464	\$54	\$54	0.449	\$24	\$24
2034	\$57	0.986	0.932	\$0.037	\$0.0367	1,457	\$54	\$53	0.422	\$23	\$23
2035	\$57	0.985	0.928	\$0.037	\$0.0367	1,450	\$53	\$53	0.397	\$21	\$21
2036	\$57	0.984	0.923	\$0.037	\$0.0367	1,443	\$53	\$53	0.373	\$20	\$20
2037	\$57	0.983	0.918	\$0.037	\$0.0367	1,435	\$53	\$53	0.351	\$19	\$18
2038	\$57	0.982	0.914	\$0.037	\$0.0367	1,428	\$53	\$52	0.330	\$17	\$17
2039	\$57	0.981	0.909	\$0.037	\$0.0367	1,421	\$53	\$52	0.310	\$16	\$16
2040	\$57	0.980	0.905	\$0.037	\$0.0367	1,414	\$52	\$52	0.291	\$15	\$15
2041	\$57	0.979	0.900	\$0.037	\$0.0367	1,407	\$52	\$52	0.274	\$14	\$14
2042	\$57	0.978	0.896	\$0.037	\$0.0367	1,400	\$52	\$51	0.258	\$13	\$13
2043	\$57	0.977	0.891	\$0.037	\$0.0367	1,393	\$52	\$51	0.242	\$13	\$12
2044	\$57	0.976	0.887	\$0.037	\$0.0367	1,386	\$52	\$51	0.228	\$12	\$12
					\$0.0367						
Validation: Present Value										\$721	\$721

Table 12. Economic value of avoided reserve capacity cost.

Year					Prices					Disc. Costs		
	Capacity Cost	Reserve Margin	Utility Capacity	PV Capacity	Utility	VOS	PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/kW-yr	%	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$57	7.9%	1.00	1.00	\$0.003	\$0.0029	1,563	\$4	\$5	1.000	\$4	\$5
2021	\$57	7.9%	0.999	0.995	\$0.003	\$0.0029	1,555	\$4	\$5	0.940	\$4	\$4
2022	\$57	7.9%	0.998	0.990	\$0.003	\$0.0029	1,547	\$4	\$4	0.884	\$4	\$4
2023	\$57	7.9%	0.997	0.985	\$0.003	\$0.0029	1,540	\$4	\$4	0.831	\$4	\$4
2024	\$57	7.9%	0.996	0.980	\$0.003	\$0.0029	1,532	\$4	\$4	0.781	\$3	\$3
2025	\$57	7.9%	0.995	0.975	\$0.003	\$0.0029	1,524	\$4	\$4	0.735	\$3	\$3
2026	\$57	7.9%	0.994	0.970	\$0.003	\$0.0029	1,517	\$4	\$4	0.691	\$3	\$3
2027	\$57	7.9%	0.993	0.966	\$0.003	\$0.0029	1,509	\$4	\$4	0.649	\$3	\$3
2028	\$57	7.9%	0.992	0.961	\$0.003	\$0.0029	1,502	\$4	\$4	0.611	\$3	\$3
2029	\$57	7.9%	0.991	0.956	\$0.003	\$0.0029	1,494	\$4	\$4	0.574	\$2	\$2
2030	\$57	7.9%	0.990	0.951	\$0.003	\$0.0029	1,487	\$4	\$4	0.540	\$2	\$2
2031	\$57	7.9%	0.989	0.946	\$0.003	\$0.0029	1,479	\$4	\$4	0.508	\$2	\$2
2032	\$57	7.9%	0.988	0.942	\$0.003	\$0.0029	1,472	\$4	\$4	0.477	\$2	\$2
2033	\$57	7.9%	0.987	0.937	\$0.003	\$0.0029	1,464	\$4	\$4	0.449	\$2	\$2
2034	\$57	7.9%	0.986	0.932	\$0.003	\$0.0029	1,457	\$4	\$4	0.422	\$2	\$2
2035	\$57	7.9%	0.985	0.928	\$0.003	\$0.0029	1,450	\$4	\$4	0.397	\$2	\$2
2036	\$57	7.9%	0.984	0.923	\$0.003	\$0.0029	1,443	\$4	\$4	0.373	\$2	\$2
2037	\$57	7.9%	0.983	0.918	\$0.003	\$0.0029	1,435	\$4	\$4	0.351	\$1	\$1
2038	\$57	7.9%	0.982	0.914	\$0.003	\$0.0029	1,428	\$4	\$4	0.330	\$1	\$1
2039	\$57	7.9%	0.981	0.909	\$0.003	\$0.0029	1,421	\$4	\$4	0.310	\$1	\$1
2040	\$57	7.9%	0.980	0.905	\$0.003	\$0.0029	1,414	\$4	\$4	0.291	\$1	\$1
2041	\$57	7.9%	0.979	0.900	\$0.003	\$0.0029	1,407	\$4	\$4	0.274	\$1	\$1
2042	\$57	7.9%	0.978	0.896	\$0.003	\$0.0029	1,400	\$4	\$4	0.258	\$1	\$1
2043	\$57	7.9%	0.977	0.891	\$0.003	\$0.0029	1,393	\$4	\$4	0.242	\$1	\$1
2044	\$57	7.9%	0.976	0.887	\$0.003	\$0.0029	1,386	\$4	\$4	0.228	\$1	\$1

\$0.0029

Validation: Present Value	\$57	\$57
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Table 13. Economic value of avoided transmission capacity cost.

Year	Capacity Cost \$/kW-yr	Utility Capacity pu.	PV Capacity kW	Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
				Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
				2020	\$50		1.00	1.00		\$0.032	\$0.0325
2021	\$50	0.999	0.995	\$0.032	\$0.0325	1,555	\$50	\$51	0.940	\$47	\$47
2022	\$50	0.998	0.990	\$0.032	\$0.0325	1,547	\$50	\$50	0.884	\$44	\$44
2023	\$50	0.997	0.985	\$0.032	\$0.0325	1,540	\$50	\$50	0.831	\$41	\$42
2024	\$50	0.996	0.980	\$0.032	\$0.0325	1,532	\$50	\$50	0.781	\$39	\$39
2025	\$50	0.995	0.975	\$0.032	\$0.0325	1,524	\$49	\$50	0.735	\$36	\$36
2026	\$50	0.994	0.970	\$0.032	\$0.0325	1,517	\$49	\$49	0.691	\$34	\$34
2027	\$50	0.993	0.966	\$0.032	\$0.0325	1,509	\$49	\$49	0.649	\$32	\$32
2028	\$50	0.992	0.961	\$0.032	\$0.0325	1,502	\$49	\$49	0.611	\$30	\$30
2029	\$50	0.991	0.956	\$0.032	\$0.0325	1,494	\$49	\$49	0.574	\$28	\$28
2030	\$50	0.990	0.951	\$0.033	\$0.0325	1,487	\$48	\$48	0.540	\$26	\$26
2031	\$50	0.989	0.946	\$0.033	\$0.0325	1,479	\$48	\$48	0.508	\$24	\$24
2032	\$50	0.988	0.942	\$0.033	\$0.0325	1,472	\$48	\$48	0.477	\$23	\$23
2033	\$50	0.987	0.937	\$0.033	\$0.0325	1,464	\$48	\$48	0.449	\$21	\$21
2034	\$50	0.986	0.932	\$0.033	\$0.0325	1,457	\$48	\$47	0.422	\$20	\$20
2035	\$50	0.985	0.928	\$0.033	\$0.0325	1,450	\$47	\$47	0.397	\$19	\$19
2036	\$50	0.984	0.923	\$0.033	\$0.0325	1,443	\$47	\$47	0.373	\$18	\$17
2037	\$50	0.983	0.918	\$0.033	\$0.0325	1,435	\$47	\$47	0.351	\$16	\$16
2038	\$50	0.982	0.914	\$0.033	\$0.0325	1,428	\$47	\$46	0.330	\$15	\$15
2039	\$50	0.981	0.909	\$0.033	\$0.0325	1,421	\$47	\$46	0.310	\$14	\$14
2040	\$50	0.980	0.905	\$0.033	\$0.0325	1,414	\$46	\$46	0.291	\$14	\$13
2041	\$50	0.979	0.900	\$0.033	\$0.0325	1,407	\$46	\$46	0.274	\$13	\$13
2042	\$50	0.978	0.896	\$0.033	\$0.0325	1,400	\$46	\$45	0.258	\$12	\$12
2043	\$50	0.977	0.891	\$0.033	\$0.0325	1,393	\$46	\$45	0.242	\$11	\$11
2044	\$50	0.976	0.887	\$0.033	\$0.0325	1,386	\$46	\$45	0.228	\$10	\$10

\$0.0325

Validation: Present Value	\$639	\$639
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Table 14. Determination of deferrable distribution costs.

Year	Distribution Project Costs	% Capacity Related	Capacity Related		
	\$	%	\$		
2018	175,490,525	4.5%	7,812,185		
2017	155,018,178	6.6%	10,270,204		
2016	165,929,956	9.6%	15,936,132		
2015	134,867,264	12.1%	16,309,114		
2014	129,899,465	16.3%	21,147,768		
2013	142,118,822	20.3%	28,825,462		
2012	109,286,058	20.8%	22,683,879		
2011	100,102,075	7.5%	7,502,291		
2010	98,267,667	11.0%	10,823,959		
2009	82,821,606	10.6%	8,749,417		
TOTAL 10-YEAR PERIOD	1,293,801,616		150,060,411		

Table 15. Economic value of avoided distribution capacity cost.

Year	Conventional Distribution Planning					Deferred Distribution Planning			
	Distribution Cost	New Dist. Capacity	Capital Cost	Disc Capital Cost	Amortized	Def. Dist. Capacity	Def. Capital Cost	Disc Capital Cost	Amortized
	\$/kW-yr	(MW)	(\$M)	(\$M)	\$/yr	(MW)	(\$M)	(\$M)	\$/yr
2020	\$115	50	\$6	\$6	\$8				\$7
2021	\$117	50	\$6	\$6	\$8	50	\$5.9	\$5.5	\$7
2022	\$119	50	\$6	\$5	\$8	50	\$6.0	\$5.3	\$7
2023	\$122	51	\$6	\$5	\$8	50	\$6.1	\$5.1	\$7
2024	\$124	51	\$6	\$5	\$8	51	\$6.3	\$4.9	\$7
2025	\$127	51	\$6	\$5	\$8	51	\$6.4	\$4.7	\$7
2026	\$129	51	\$7	\$5	\$8	51	\$6.6	\$4.6	\$7
2027	\$132	52	\$7	\$4	\$8	51	\$6.8	\$4.4	\$7
2028	\$135	52	\$7	\$4	\$8	52	\$6.9	\$4.2	\$7
2029	\$137	52	\$7	\$4	\$8	52	\$7.1	\$4.1	\$7
2030	\$140	52	\$7	\$4	\$8	52	\$7.3	\$3.9	\$7
2031	\$143	52	\$7	\$4	\$8	52	\$7.5	\$3.8	\$7
2032	\$146	53	\$8	\$4	\$8	52	\$7.6	\$3.6	\$7
2033	\$149	53	\$8	\$4	\$8	53	\$7.8	\$3.5	\$7
2034	\$152	53	\$8	\$3	\$8	53	\$8.0	\$3.4	\$7
2035	\$155	53	\$8	\$3	\$8	53	\$8.2	\$3.3	\$7
2036	\$158	54	\$8	\$3	\$8	53	\$8.4	\$3.1	\$7
2037	\$161	54	\$9	\$3	\$8	54	\$8.6	\$3.0	\$7
2038	\$164	54	\$9	\$3	\$8	54	\$8.8	\$2.9	\$7
2039	\$167	54	\$9	\$3	\$8	54	\$9.0	\$2.8	\$7
2040	\$171	54	\$9	\$3	\$8	54	\$9.3	\$2.7	\$7
2041	\$174	55	\$10	\$3	\$8	54	\$9.5	\$2.6	\$7
2042	\$178	55	\$10	\$3	\$8	55	\$9.7	\$2.5	\$7
2043	\$181	55	\$10	\$2	\$8	55	\$9.9	\$2.4	\$7
2044	\$185	55	\$10	\$2	\$8	55	\$10.2	\$2.3	\$7
2039	\$188					55	\$10.4	\$2.2	
					\$95				\$91

Continued - Table 15. Economic value of avoided distribution capacity cost. *EXAMPLE*

Prices		PV Production	Costs		Discount Factor	Disc. Costs	
Utility	VOS		Utility	VOS		Utility	VOS
\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
\$0.00403	\$0.0041	1,563	\$6	\$6	1.000	\$6	\$6
\$0.00403	\$0.0041	1,555	\$6	\$6	0.940	\$6	\$6
\$0.00403	\$0.0041	1,547	\$6	\$6	0.884	\$6	\$6
\$0.00403	\$0.0041	1,540	\$6	\$6	0.831	\$5	\$5
\$0.00404	\$0.0041	1,532	\$6	\$6	0.781	\$5	\$5
\$0.00404	\$0.0041	1,524	\$6	\$6	0.735	\$5	\$5
\$0.00404	\$0.0041	1,517	\$6	\$6	0.691	\$4	\$4
\$0.00405	\$0.0041	1,509	\$6	\$6	0.649	\$4	\$4
\$0.00405	\$0.0041	1,502	\$6	\$6	0.611	\$4	\$4
\$0.00405	\$0.0041	1,494	\$6	\$6	0.574	\$3	\$3
\$0.00406	\$0.0041	1,487	\$6	\$6	0.540	\$3	\$3
\$0.00406	\$0.0041	1,479	\$6	\$6	0.508	\$3	\$3
\$0.00406	\$0.0041	1,472	\$6	\$6	0.477	\$3	\$3
\$0.00407	\$0.0041	1,464	\$6	\$6	0.449	\$3	\$3
\$0.00407	\$0.0041	1,457	\$6	\$6	0.422	\$3	\$2
\$0.00407	\$0.0041	1,450	\$6	\$6	0.397	\$2	\$2
\$0.00407	\$0.0041	1,443	\$6	\$6	0.373	\$2	\$2
\$0.00408	\$0.0041	1,435	\$6	\$6	0.351	\$2	\$2
\$0.00408	\$0.0041	1,428	\$6	\$6	0.330	\$2	\$2
\$0.00408	\$0.0041	1,421	\$6	\$6	0.310	\$2	\$2
\$0.00409	\$0.0041	1,414	\$6	\$6	0.291	\$2	\$2
\$0.00409	\$0.0041	1,407	\$6	\$6	0.274	\$2	\$2
\$0.00409	\$0.0041	1,400	\$6	\$6	0.258	\$1	\$1
\$0.00410	\$0.0041	1,393	\$6	\$6	0.242	\$1	\$1
\$0.00410	\$0.0041	1,386	\$6	\$6	0.228	\$1	\$1
					-		
	\$0.0041		Validation: Present Value			\$80	\$80

Table 17. Economic value of avoided environmental costs

Environmental Discount Rate 5.30%

Year	Env. Cost \$/mmBtu	Solar Weighted Heat Rate mmBtu/MWh	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
			Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
2020	\$3.12	7,742	\$0.024	\$0.0359	1,563	\$38	\$56	1.000	\$38	\$56
2021	\$3.24	7,750	\$0.025	\$0.0359	1,555	\$39	\$56	0.950	\$37	\$53
2022	\$3.37	7,757	\$0.026	\$0.0359	1,547	\$40	\$56	0.902	\$36	\$50
2023	\$3.50	7,765	\$0.027	\$0.0359	1,540	\$42	\$55	0.857	\$36	\$47
2024	\$3.64	7,773	\$0.028	\$0.0359	1,532	\$43	\$55	0.813	\$35	\$45
2025	\$3.78	7,781	\$0.029	\$0.0359	1,524	\$45	\$55	0.773	\$35	\$42
2026	\$3.92	7,789	\$0.031	\$0.0359	1,517	\$46	\$54	0.734	\$34	\$40
2027	\$4.07	7,796	\$0.032	\$0.0359	1,509	\$48	\$54	0.697	\$33	\$38
2028	\$4.23	7,804	\$0.033	\$0.0359	1,502	\$50	\$54	0.662	\$33	\$36
2029	\$4.39	7,812	\$0.034	\$0.0359	1,494	\$51	\$54	0.628	\$32	\$34
2030	\$4.55	7,820	\$0.036	\$0.0359	1,487	\$53	\$53	0.597	\$32	\$32
2031	\$4.74	7,828	\$0.037	\$0.0359	1,479	\$55	\$53	0.567	\$31	\$30
2032	\$4.93	7,835	\$0.039	\$0.0359	1,472	\$57	\$53	0.538	\$31	\$28
2033	\$5.13	7,843	\$0.040	\$0.0359	1,464	\$59	\$53	0.511	\$30	\$27
2034	\$5.34	7,851	\$0.042	\$0.0359	1,457	\$61	\$52	0.485	\$30	\$25
2035	\$5.55	7,859	\$0.044	\$0.0359	1,450	\$63	\$52	0.461	\$29	\$24
2036	\$5.77	7,867	\$0.045	\$0.0359	1,443	\$65	\$52	0.438	\$29	\$23
2037	\$5.99	7,875	\$0.047	\$0.0359	1,435	\$68	\$51	0.416	\$28	\$21
2038	\$6.23	7,883	\$0.049	\$0.0359	1,428	\$70	\$51	0.395	\$28	\$20
2039	\$6.47	7,890	\$0.051	\$0.0359	1,421	\$73	\$51	0.375	\$27	\$19
2040	\$6.72	7,898	\$0.053	\$0.0359	1,414	\$75	\$51	0.356	\$27	\$18
2041	\$6.95	7,906	\$0.055	\$0.0359	1,407	\$77	\$50	0.338	\$26	\$17
2042	\$7.19	7,914	\$0.057	\$0.0359	1,400	\$80	\$50	0.321	\$26	\$16
2043	\$7.44	7,922	\$0.059	\$0.0359	1,393	\$82	\$50	0.305	\$25	\$15
2044	\$7.70	7,930	\$0.061	\$0.0359	1,386	\$85	\$50	0.290	\$25	\$14

Validation: Present Value	\$771	\$771
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Table 18. Calculation of inflation-adjusted VOS

Year	Discount Factor	PV Production	Escallation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1563	1.000	\$0.114	\$178	\$0.0927	144.912
2021	0.940	1555	1.022	\$0.114	\$166	\$0.0948	138.588
2022	0.884	1547	1.045	\$0.114	\$155	\$0.0969	132.541
2023	0.831	1540	1.068	\$0.114	\$145	\$0.0991	126.757
2024	0.781	1532	1.092	\$0.114	\$136	\$0.1013	121.226
2025	0.735	1524	1.117	\$0.114	\$127	\$0.1035	115.936
2026	0.691	1517	1.141	\$0.114	\$119	\$0.1058	110.877
2027	0.649	1509	1.167	\$0.114	\$111	\$0.1082	106.039
2028	0.611	1502	1.193	\$0.114	\$104	\$0.1106	101.412
2029	0.574	1494	1.220	\$0.114	\$97	\$0.1131	96.987
2030	0.540	1487	1.247	\$0.114	\$91	\$0.1156	92.754
2031	0.508	1479	1.275	\$0.114	\$85	\$0.1182	88.707
2032	0.477	1472	1.303	\$0.114	\$80	\$0.1208	84.836
2033	0.449	1464	1.332	\$0.114	\$75	\$0.1235	81.134
2034	0.422	1457	1.362	\$0.114	\$70	\$0.1263	77.594
2035	0.397	1450	1.392	\$0.114	\$65	\$0.1291	74.208
2036	0.397	1443	1.423	\$0.114	\$65	\$0.1319	75.483
2037	0.351	1435	1.455	\$0.114	\$57	\$0.1349	67.873
2038	0.330	1428	1.487	\$0.114	\$53	\$0.1379	64.911
2039	0.310	1421	1.521	\$0.114	\$50	\$0.1410	62.079
2040	0.291	1414	1.554	\$0.114	\$47	\$0.1441	59.370
2041	0.274	1407	1.589	\$0.114	\$44	\$0.1473	56.779
2042	0.258	1400	1.625	\$0.114	\$41	\$0.1506	54.302
2043	0.242	1393	1.661	\$0.114	\$38	\$0.1540	51.932
2044	0.228	1386	1.698	\$0.114	\$36	\$0.1574	49.666
					\$2,237		\$2,237

VOS Distribution Capacity Cost per kW

(A) System actual cost per KWH

Year	New Dist. Capacity (MW)	Capital Cost - Capacity projects (\$M)
2017	43.3	\$10.270
2018	26.0	\$7.812
2019	72.8	\$5.862
2020	71.0	\$15.380
2021	75.9	\$16.000
Total	289.0	\$55.324
Cost per kW		\$191.43

Line			
1	Full Project Deferral		100%
2	Deferral Reduction Factor		40%
3	Deferral Reduction		60% (1 - 2)
4	Distibution Capacity Cost per kW	<u>\$191.43</u>	
5	Avoided Distibution Capacity Cost per kW	\$114.86	(3 x 4)

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Table 13. Economic value of avoided transmission capacity cost.

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Note: Table 1, 2 and 16 were not included as they are not required for the VOS calculation. Table 7 (Losses to be considered) are included in Fig. ES-1

Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value

CURRENT POSITION	Economic Value	Load Match	Distributed Loss Savings	Distributed PV Value
<i>25 Year Levelized Values</i>	(\$/kWh)	(%)	(%)	(\$/kWh)
Avoided Fuel Cost	\$0.0274		9.8%	\$0.0301
Avoided Plant O&M - Fixed	\$0.0027	48.6%	10.8%	\$0.0014
Avoided Plant O&M - Variable	\$0.0012		9.8%	\$0.0014
Avoided Generation Capacity Cost	\$0.0367	48.6%	10.8%	\$0.0197
Avoided Reserve Capacity Cost	\$0.0029	48.6%	10.8%	\$0.0016
Avoided Transmission Capacity Cos	\$0.0325	48.6%	10.8%	\$0.0175
Avoided Distribution Capacity Cost	\$0.0047	54.6%	12.4%	\$0.0029
Avoided Environmental Cost	\$0.0359		9.8%	\$0.0394
Avoided Voltage Control Cost				
<u>Solar Integration Cost</u>				
TOTAL				\$0.1140

Figure ES-2. 1st-Year VOS Rate calculation

Year	Discount Factor	Escalation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1.000	\$0.114	\$0.114	\$0.0930	0.093
2021	0.940	1.022	\$0.114	\$0.107	\$0.0951	0.089
2022	0.884	1.045	\$0.114	\$0.101	\$0.0972	0.086
2023	0.831	1.068	\$0.114	\$0.095	\$0.0994	0.083
2024	0.781	1.092	\$0.114	\$0.089	\$0.1016	0.079
2025	0.735	1.117	\$0.114	\$0.084	\$0.1039	0.076
2026	0.691	1.141	\$0.114	\$0.079	\$0.1062	0.073
2027	0.649	1.167	\$0.114	\$0.074	\$0.1086	0.071
2028	0.611	1.193	\$0.114	\$0.070	\$0.1110	0.068
2029	0.574	1.220	\$0.114	\$0.065	\$0.1135	0.065
2030	0.540	1.247	\$0.114	\$0.062	\$0.1160	0.063
2031	0.508	1.275	\$0.114	\$0.058	\$0.1186	0.060
2032	0.477	1.303	\$0.114	\$0.054	\$0.1212	0.058
2033	0.449	1.332	\$0.114	\$0.051	\$0.1239	0.056
2034	0.422	1.362	\$0.114	\$0.048	\$0.1267	0.053
2035	0.397	1.392	\$0.114	\$0.045	\$0.1295	0.051
2036	0.397	1.423	\$0.114	\$0.045	\$0.1324	0.053
2037	0.351	1.455	\$0.114	\$0.040	\$0.1354	0.047
2038	0.330	1.487	\$0.114	\$0.038	\$0.1384	0.046
2039	0.310	1.521	\$0.114	\$0.035	\$0.1415	0.044
2040	0.291	1.554	\$0.114	\$0.033	\$0.1446	0.042
2041	0.274	1.589	\$0.114	\$0.031	\$0.1478	0.041
2042	0.258	1.625	\$0.114	\$0.029	\$0.1511	0.039
2043	0.242	1.661	\$0.114	\$0.028	\$0.1545	0.037
2044	0.228	1.698	\$0.114	\$0.026	\$0.1580	0.036
				\$1.501		\$1.509

Table 3. Fixed Assumptions to be used for the VOS calculations

Fuel Prices			Environmental Externalities		
Guaranteed NG Fuel Prices			Environmental Discount Rate	5.30%	per year
2020	\$2.671	\$/mmBtu	Environmental Costs	separate table	
2021	\$2.639	\$/mmBtu	Economic Assumptions		
2022	\$2.645	\$/mmBtu	General Escalation Rate	2.23%	per year
2023	\$2.720	\$/mmBtu	Treasury Yields		
2024	\$2.823	\$/mmBtu	1 Year	2.17%	
2025	\$2.935	\$/mmBtu	2 Year	2.05%	
2026	\$3.047	\$/mmBtu	3 Year	2.01%	
2027	\$3.159	\$/mmBtu	5 Year	2.04%	
2028	\$3.271	\$/mmBtu	7 Year	2.14%	
2029	\$3.380	\$/mmBtu	10 Year	2.25%	
2030	\$3.490	\$/mmBtu	20 Year	2.49%	
2031	\$3.596	\$/mmBtu	30 Year	2.68%	
Fuel Price Escalation	2.23%				
PV Assumptions					
PV Degradation Rate	0.50%				
PV Life	25				

Table 4. Environmental costs by year.

Year	Analysis Year	CO2 Cost \$/mmBtu	PM 2.5 Cost \$/mmBtu	CO Cost \$/mmBtu	NOx Cost \$/mmBtu	Pb Cost \$/mmBtu	SO2 Cost \$/mmBtu	Total Cost \$/mmBtu
2020	0	\$2.807	\$0.021	\$0.000	\$0.286	\$0.000	\$0.004	\$3.117
2021	1	\$2.924	\$0.021	\$0.000	\$0.292	\$0.000	\$0.004	\$3.241
2022	2	\$3.045	\$0.021	\$0.000	\$0.299	\$0.000	\$0.004	\$3.369
2023	3	\$3.170	\$0.022	\$0.000	\$0.305	\$0.000	\$0.004	\$3.502
2024	4	\$3.299	\$0.022	\$0.000	\$0.312	\$0.000	\$0.004	\$3.638
2025	5	\$3.433	\$0.023	\$0.000	\$0.319	\$0.000	\$0.004	\$3.779
2026	6	\$3.570	\$0.023	\$0.000	\$0.326	\$0.000	\$0.004	\$3.924
2027	7	\$3.712	\$0.024	\$0.000	\$0.334	\$0.000	\$0.004	\$4.074
2028	8	\$3.859	\$0.025	\$0.000	\$0.341	\$0.000	\$0.004	\$4.229
2029	9	\$4.010	\$0.025	\$0.000	\$0.349	\$0.000	\$0.004	\$4.388
2030	10	\$4.166	\$0.026	\$0.000	\$0.356	\$0.000	\$0.004	\$4.553
2031	11	\$4.344	\$0.026	\$0.000	\$0.364	\$0.000	\$0.004	\$4.740
2032	12	\$4.528	\$0.027	\$0.000	\$0.373	\$0.000	\$0.005	\$4.932
2033	13	\$4.718	\$0.027	\$0.000	\$0.381	\$0.000	\$0.005	\$5.131
2034	14	\$4.915	\$0.028	\$0.000	\$0.389	\$0.000	\$0.005	\$5.337
2035	15	\$5.117	\$0.029	\$0.000	\$0.398	\$0.000	\$0.005	\$5.549
2036	16	\$5.326	\$0.029	\$0.000	\$0.407	\$0.000	\$0.005	\$5.768
2037	17	\$5.542	\$0.030	\$0.000	\$0.416	\$0.000	\$0.005	\$5.993
2038	18	\$5.765	\$0.031	\$0.000	\$0.425	\$0.000	\$0.005	\$6.227
2039	19	\$5.996	\$0.031	\$0.000	\$0.435	\$0.000	\$0.005	\$6.467
2040	20	\$6.233	\$0.032	\$0.000	\$0.444	\$0.000	\$0.005	\$6.715
2041	21	\$6.457	\$0.033	\$0.000	\$0.454	\$0.000	\$0.006	\$6.950
2042	22	\$6.688	\$0.033	\$0.000	\$0.464	\$0.000	\$0.006	\$7.192
2043	23	\$6.926	\$0.034	\$0.000	\$0.475	\$0.000	\$0.006	\$7.441
2044	24	\$7.171	\$0.035	\$0.000	\$0.485	\$0.000	\$0.006	\$7.698

Table 5. VOS Data table -- required format showing assumptions used in the VOS calculation.

	Input Data	Units		Input Data	Units
Economic Factors			Power Generation - Continued		
Start Year for VOS applicability	2020	Year	Other		
Discount Rate (After-tax WACC)	6.36%	Percentage	Solar weighted Heat Rate	7,742	BTU per kWh
Load Match Analysis			Fuel Price Overhead	\$0.004	\$ per MMBtu
ELCC (no loss)	48.6%	% of rating	Generation life	40	years
PLR (no loss)	54.6%	% of rating	Heat Rate degradation	0.10%	per year
Loss Savings - Energy	9.8%	% of PV output	O&M cost (first year) - Fixed	\$3.42	per kW-yr
Loss Savings - PLR	12.4%	% of PV output	O&M cost (first year) - Variable	\$0.0010	\$ per kWh
Loss Savings - ELCC	10.8%	% of PV output	O&M cost escalation rate	2.00%	per year
			Reserve planning margin	7.9%	
			Years until new Generation is needed	0	
PV Energy			Distribution		
Simulated - First year annual energy	1,452	kWh per kW-AC	Capacity-related distribution capital costs -System	\$96	\$ per kW
year annual energy		kWh per kW-AC	Capacity-related distribution capital costs - Mpls	N/A	\$ per kW
Actual- First year annual energy	1,563		Capacity-related distribution capital costs - Mtka	N/A	\$ per kW
			Capacity-related distribution capital costs -Edina	N/A	\$ per kW
Transmission			Capacity-related distribution capital costs - SE	N/A	\$ per kW
Capacity-related transmission capital cost	\$50.33	\$ per kW	Capacity-related distribution capital costs -MG	N/A	\$ per kW
Power Generation			Capacity-related distribution capital costs - Newport	N/A	\$ per kW
Peaking CT, simple cycle			Capacity-related distribution capital costs - St. Paul	N/A	\$ per kW
Installed Cost	\$476	\$/kW	Capacity-related distribution capital costs - NW	N/A	\$ per kW
Heat Rate	9,738	BTU/kWh	Capacity-related distribution capital costs - WBL	N/A	\$ per kW
Intermediate CCGT			Distribution capital cost escalation	2.00%	per year
Installed Cost	\$1,022	\$/kW	Peak Load (Weather Normalized)	6,420	MW
Heat Rate	6,547	BTU/kWh	Peak Load Growth	0.43%	per year

Table 6. Azimuth and Tilt Angles

	Array KW	% of Total	Azimuth	Tilt	
1	3,209	4.9%	52	25	
2	2,974	4.5%	140	21	
3	2,906	4.4%	167	19	
4	18,979	28.9%	180	12	
5	3,939	6.0%	180	21	
6	7,997	12.2%	180	26	
7	6,676	10.2%	180	30	
8	3,296	5.0%	180	35	
9	947	1.4%	180	42	
10	5,453	8.3%	180	48	
11	2,769	4.2%	184	19	
12	964	1.5%	197	26	
13	2,816	4.3%	212	18	
14	1,207	1.8%	237	24	
15	1,577	2.4%	271	22	
TOTAL	65,709	100%	176.4	23.2	Weighted Average

Table 8. Economic Value of Avoided Fuel Costs.

Year				Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Utility	VOS		Utility	VOS		Utility	VOS
	\$/mmBtu	\$/mmBtu	mmBtu/kWh	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$2.67	\$2.67	7,742	\$0.021	\$0.0274	1,563	\$32	\$43	1.000	\$32	\$43
2021	\$2.64	\$2.64	7,750	\$0.020	\$0.0274	1,555	\$32	\$43	0.979	\$31	\$42
2022	\$2.64	\$2.65	7,757	\$0.021	\$0.0274	1,547	\$32	\$42	0.960	\$31	\$41
2023	\$2.72	\$2.72	7,765	\$0.021	\$0.0274	1,540	\$33	\$42	0.942	\$31	\$40
2024	\$2.82	\$2.83	7,773	\$0.022	\$0.0274	1,532	\$34	\$42	0.923	\$31	\$39
2025	\$2.93	\$2.94	7,781	\$0.023	\$0.0274	1,524	\$35	\$42	0.904	\$32	\$38
2026	\$3.05	\$3.05	7,789	\$0.024	\$0.0274	1,517	\$36	\$42	0.883	\$32	\$37
2027	\$3.16	\$3.16	7,796	\$0.025	\$0.0274	1,509	\$37	\$41	0.863	\$32	\$36
2028	\$3.27	\$3.28	7,804	\$0.026	\$0.0274	1,502	\$38	\$41	0.842	\$32	\$35
2029	\$3.38	\$3.38	7,812	\$0.026	\$0.0274	1,494	\$40	\$41	0.822	\$32	\$34
2030	\$3.49	\$3.49	7,820	\$0.027	\$0.0274	1,487	\$41	\$41	0.801	\$33	\$33
2031	\$3.60	\$3.60	7,828	\$0.028	\$0.0274	1,479	\$42	\$41	0.781	\$33	\$32
2032	\$3.68	\$3.68	7,835	\$0.029	\$0.0274	1,472	\$42	\$40	0.762	\$32	\$31
2033	\$3.76	\$3.76	7,843	\$0.030	\$0.0274	1,464	\$43	\$40	0.742	\$32	\$30
2034	\$3.84	\$3.85	7,851	\$0.030	\$0.0274	1,457	\$44	\$40	0.723	\$32	\$29
2035	\$3.93	\$3.93	7,859	\$0.031	\$0.0274	1,450	\$45	\$40	0.704	\$32	\$28
2036	\$4.01	\$4.02	7,867	\$0.032	\$0.0274	1,443	\$46	\$40	0.685	\$31	\$27
2037	\$4.10	\$4.11	7,875	\$0.032	\$0.0274	1,435	\$46	\$39	0.666	\$31	\$26
2038	\$4.20	\$4.20	7,883	\$0.033	\$0.0274	1,428	\$47	\$39	0.648	\$31	\$25
2039	\$4.29	\$4.30	7,890	\$0.034	\$0.0274	1,421	\$48	\$39	0.629	\$30	\$25
2040	\$4.39	\$4.39	7,898	\$0.035	\$0.0274	1,414	\$49	\$39	0.611	\$30	\$24
2041	\$4.48	\$4.49	7,906	\$0.035	\$0.0274	1,407	\$50	\$39	0.594	\$30	\$23
2042	\$4.58	\$4.59	7,914	\$0.036	\$0.0274	1,400	\$51	\$38	0.577	\$29	\$22
2043	\$4.69	\$4.69	7,922	\$0.037	\$0.0274	1,393	\$52	\$38	0.561	\$29	\$21
2044	\$4.79	\$4.80	7,930	\$0.038	\$0.0274	1,386	\$53	\$38	0.544	\$29	\$21

Validation: Present Value	\$779	\$779
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Table 9. Economic value of avoided plant O&M - fixed

Year				Prices		p.u. PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	O&M Fixed	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW	per unit		\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$3.42	1.00	1.00	\$0.0022	\$0.0027	1,563	\$3.42	\$4.14	1.000	\$3.42	\$4.14
2021	\$3.49	0.999	0.995	\$0.0022	\$0.0027	1,555	\$3.48	\$4.12	0.940	\$3.27	\$3.88
2022	\$3.56	0.998	0.990	\$0.0023	\$0.0027	1,547	\$3.53	\$4.10	0.884	\$3.12	\$3.63
2023	\$3.63	0.997	0.985	\$0.0024	\$0.0027	1,540	\$3.59	\$4.08	0.831	\$2.98	\$3.39
2024	\$3.71	0.996	0.980	\$0.0024	\$0.0027	1,532	\$3.65	\$4.06	0.781	\$2.85	\$3.17
2025	\$3.78	0.995	0.975	\$0.0025	\$0.0027	1,524	\$3.71	\$4.04	0.735	\$2.72	\$2.97
2026	\$3.86	0.994	0.970	\$0.0025	\$0.0027	1,517	\$3.76	\$4.02	0.691	\$2.60	\$2.78
2027	\$3.93	0.993	0.966	\$0.0026	\$0.0027	1,509	\$3.82	\$4.00	0.649	\$2.48	\$2.60
2028	\$4.01	0.992	0.961	\$0.0027	\$0.0027	1,502	\$3.89	\$3.98	0.611	\$2.37	\$2.43
2029	\$4.09	0.991	0.956	\$0.0027	\$0.0027	1,494	\$3.95	\$3.96	0.574	\$2.27	\$2.27
2030	\$4.17	0.990	0.951	\$0.0028	\$0.0027	1,487	\$4.01	\$3.94	0.540	\$2.16	\$2.13
2031	\$4.26	0.989	0.946	\$0.0028	\$0.0027	1,479	\$4.07	\$3.92	0.508	\$2.07	\$1.99
2032	\$4.34	0.988	0.942	\$0.0029	\$0.0027	1,472	\$4.14	\$3.90	0.477	\$1.97	\$1.86
2033	\$4.43	0.987	0.937	\$0.0030	\$0.0027	1,464	\$4.20	\$3.88	0.449	\$1.89	\$1.74
2034	\$4.52	0.986	0.932	\$0.0031	\$0.0027	1,457	\$4.27	\$3.86	0.422	\$1.80	\$1.63
2035	\$4.52	0.985	0.928	\$0.0031	\$0.0027	1,450	\$4.25	\$3.84	0.397	\$1.69	\$1.52
2036	\$4.70	0.984	0.923	\$0.0032	\$0.0027	1,443	\$4.41	\$3.82	0.397	\$1.75	\$1.52
2037	\$4.79	0.983	0.918	\$0.0033	\$0.0027	1,435	\$4.48	\$3.80	0.351	\$1.57	\$1.33
2038	\$4.89	0.982	0.914	\$0.0034	\$0.0027	1,428	\$4.55	\$3.78	0.330	\$1.50	\$1.25
2039	\$4.99	0.981	0.909	\$0.0034	\$0.0027	1,421	\$4.62	\$3.77	0.310	\$1.43	\$1.17
2040	\$5.09	0.980	0.905	\$0.0035	\$0.0027	1,414	\$4.70	\$3.75	0.291	\$1.37	\$1.09
2041	\$5.19	0.979	0.900	\$0.0036	\$0.0027	1,407	\$4.77	\$3.73	0.274	\$1.31	\$1.02
2042	\$5.29	0.978	0.896	\$0.0037	\$0.0027	1,400	\$4.85	\$3.71	0.258	\$1.25	\$0.96
2043	\$5.40	0.977	0.891	\$0.0038	\$0.0027	1,393	\$4.92	\$3.69	0.242	\$1.19	\$0.89
2044	\$5.51	0.976	0.887	\$0.0039	\$0.0027	1,386	\$5.00	\$3.67	0.228	\$1.14	\$0.84

\$0.0027

Validation: Present Value

\$52

\$52

Table 10. Economic value of avoided plant O&M - variable

Year	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$0.0010	\$0.0012	1,563	\$2	\$2	1.000	\$2	\$2
2021	\$0.0011	\$0.0012	1,555	\$2	\$2	0.940	\$2	\$2
2022	\$0.0011	\$0.0012	1,547	\$2	\$2	0.884	\$1	\$2
2023	\$0.0011	\$0.0012	1,540	\$2	\$2	0.831	\$1	\$2
2024	\$0.0011	\$0.0012	1,532	\$2	\$2	0.781	\$1	\$1
2025	\$0.0011	\$0.0012	1,524	\$2	\$2	0.735	\$1	\$1
2026	\$0.0012	\$0.0012	1,517	\$2	\$2	0.691	\$1	\$1
2027	\$0.0012	\$0.0012	1,509	\$2	\$2	0.649	\$1	\$1
2028	\$0.0012	\$0.0012	1,502	\$2	\$2	0.611	\$1	\$1
2029	\$0.0012	\$0.0012	1,494	\$2	\$2	0.574	\$1	\$1
2030	\$0.0013	\$0.0012	1,487	\$2	\$2	0.540	\$1	\$1
2031	\$0.0013	\$0.0012	1,479	\$2	\$2	0.508	\$1	\$1
2032	\$0.0013	\$0.0012	1,472	\$2	\$2	0.477	\$1	\$1
2033	\$0.0013	\$0.0012	1,464	\$2	\$2	0.449	\$1	\$1
2034	\$0.0014	\$0.0012	1,457	\$2	\$2	0.422	\$1	\$1
2035	\$0.0014	\$0.0012	1,450	\$2	\$2	0.397	\$1	\$1
2036	\$0.0014	\$0.0012	1,443	\$2	\$2	0.373	\$1	\$1
2037	\$0.0014	\$0.0012	1,435	\$2	\$2	0.351	\$1	\$1
2038	\$0.0015	\$0.0012	1,428	\$2	\$2	0.330	\$1	\$1
2039	\$0.0015	\$0.0012	1,421	\$2	\$2	0.310	\$1	\$1
2040	\$0.0015	\$0.0012	1,414	\$2	\$2	0.291	\$1	\$1
2041	\$0.0016	\$0.0012	1,407	\$2	\$2	0.274	\$1	\$0
2042	\$0.0016	\$0.0012	1,400	\$2	\$2	0.258	\$1	\$0
2043	\$0.0016	\$0.0012	1,393	\$2	\$2	0.242	\$1	\$0
2044	\$0.0017	\$0.0012	1,386	\$2	\$2	0.228	\$1	\$0

Validation: Present Value	\$24	\$24
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Table 11. Economic value of avoided generation capacity cost.

Year	Capacity Cost \$/kW-yr	Utility Capacity pu.	PV Capacity kW	Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
				Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
2020	\$57	1.00	1.00	\$0.036	\$0.0367	1,563	\$57	\$57	1.000	\$57	\$57
2021	\$57	0.999	0.995	\$0.036	\$0.0367	1,555	\$57	\$57	0.940	\$53	\$54
2022	\$57	0.998	0.990	\$0.036	\$0.0367	1,547	\$56	\$57	0.884	\$50	\$50
2023	\$57	0.997	0.985	\$0.036	\$0.0367	1,540	\$56	\$56	0.831	\$47	\$47
2024	\$57	0.996	0.980	\$0.036	\$0.0367	1,532	\$56	\$56	0.781	\$44	\$44
2025	\$57	0.995	0.975	\$0.037	\$0.0367	1,524	\$56	\$56	0.735	\$41	\$41
2026	\$57	0.994	0.970	\$0.037	\$0.0367	1,517	\$55	\$56	0.691	\$38	\$38
2027	\$57	0.993	0.966	\$0.037	\$0.0367	1,509	\$55	\$55	0.649	\$36	\$36
2028	\$57	0.992	0.961	\$0.037	\$0.0367	1,502	\$55	\$55	0.611	\$34	\$34
2029	\$57	0.991	0.956	\$0.037	\$0.0367	1,494	\$55	\$55	0.574	\$31	\$31
2030	\$57	0.990	0.951	\$0.037	\$0.0367	1,487	\$55	\$55	0.540	\$29	\$29
2031	\$57	0.989	0.946	\$0.037	\$0.0367	1,479	\$54	\$54	0.508	\$28	\$28
2032	\$57	0.988	0.942	\$0.037	\$0.0367	1,472	\$54	\$54	0.477	\$26	\$26
2033	\$57	0.987	0.937	\$0.037	\$0.0367	1,464	\$54	\$54	0.449	\$24	\$24
2034	\$57	0.986	0.932	\$0.037	\$0.0367	1,457	\$54	\$53	0.422	\$23	\$23
2035	\$57	0.985	0.928	\$0.037	\$0.0367	1,450	\$53	\$53	0.397	\$21	\$21
2036	\$57	0.984	0.923	\$0.037	\$0.0367	1,443	\$53	\$53	0.373	\$20	\$20
2037	\$57	0.983	0.918	\$0.037	\$0.0367	1,435	\$53	\$53	0.351	\$19	\$18
2038	\$57	0.982	0.914	\$0.037	\$0.0367	1,428	\$53	\$52	0.330	\$17	\$17
2039	\$57	0.981	0.909	\$0.037	\$0.0367	1,421	\$53	\$52	0.310	\$16	\$16
2040	\$57	0.980	0.905	\$0.037	\$0.0367	1,414	\$52	\$52	0.291	\$15	\$15
2041	\$57	0.979	0.900	\$0.037	\$0.0367	1,407	\$52	\$52	0.274	\$14	\$14
2042	\$57	0.978	0.896	\$0.037	\$0.0367	1,400	\$52	\$51	0.258	\$13	\$13
2043	\$57	0.977	0.891	\$0.037	\$0.0367	1,393	\$52	\$51	0.242	\$13	\$12
2044	\$57	0.976	0.887	\$0.037	\$0.0367	1,386	\$52	\$51	0.228	\$12	\$12
					\$0.0367						
Validation: Present Value										\$721	\$721

Table 12. Economic value of avoided reserve capacity cost.

Year					Prices					Disc. Costs		
	Capacity Cost	Reserve Margin	Utility Capacity	PV Capacity	Utility	VOS	PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/kW-yr	%	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$57	7.9%	1.00	1.00	\$0.003	\$0.0029	1,563	\$4	\$5	1.000	\$4	\$5
2021	\$57	7.9%	0.999	0.995	\$0.003	\$0.0029	1,555	\$4	\$5	0.940	\$4	\$4
2022	\$57	7.9%	0.998	0.990	\$0.003	\$0.0029	1,547	\$4	\$4	0.884	\$4	\$4
2023	\$57	7.9%	0.997	0.985	\$0.003	\$0.0029	1,540	\$4	\$4	0.831	\$4	\$4
2024	\$57	7.9%	0.996	0.980	\$0.003	\$0.0029	1,532	\$4	\$4	0.781	\$3	\$3
2025	\$57	7.9%	0.995	0.975	\$0.003	\$0.0029	1,524	\$4	\$4	0.735	\$3	\$3
2026	\$57	7.9%	0.994	0.970	\$0.003	\$0.0029	1,517	\$4	\$4	0.691	\$3	\$3
2027	\$57	7.9%	0.993	0.966	\$0.003	\$0.0029	1,509	\$4	\$4	0.649	\$3	\$3
2028	\$57	7.9%	0.992	0.961	\$0.003	\$0.0029	1,502	\$4	\$4	0.611	\$3	\$3
2029	\$57	7.9%	0.991	0.956	\$0.003	\$0.0029	1,494	\$4	\$4	0.574	\$2	\$2
2030	\$57	7.9%	0.990	0.951	\$0.003	\$0.0029	1,487	\$4	\$4	0.540	\$2	\$2
2031	\$57	7.9%	0.989	0.946	\$0.003	\$0.0029	1,479	\$4	\$4	0.508	\$2	\$2
2032	\$57	7.9%	0.988	0.942	\$0.003	\$0.0029	1,472	\$4	\$4	0.477	\$2	\$2
2033	\$57	7.9%	0.987	0.937	\$0.003	\$0.0029	1,464	\$4	\$4	0.449	\$2	\$2
2034	\$57	7.9%	0.986	0.932	\$0.003	\$0.0029	1,457	\$4	\$4	0.422	\$2	\$2
2035	\$57	7.9%	0.985	0.928	\$0.003	\$0.0029	1,450	\$4	\$4	0.397	\$2	\$2
2036	\$57	7.9%	0.984	0.923	\$0.003	\$0.0029	1,443	\$4	\$4	0.373	\$2	\$2
2037	\$57	7.9%	0.983	0.918	\$0.003	\$0.0029	1,435	\$4	\$4	0.351	\$1	\$1
2038	\$57	7.9%	0.982	0.914	\$0.003	\$0.0029	1,428	\$4	\$4	0.330	\$1	\$1
2039	\$57	7.9%	0.981	0.909	\$0.003	\$0.0029	1,421	\$4	\$4	0.310	\$1	\$1
2040	\$57	7.9%	0.980	0.905	\$0.003	\$0.0029	1,414	\$4	\$4	0.291	\$1	\$1
2041	\$57	7.9%	0.979	0.900	\$0.003	\$0.0029	1,407	\$4	\$4	0.274	\$1	\$1
2042	\$57	7.9%	0.978	0.896	\$0.003	\$0.0029	1,400	\$4	\$4	0.258	\$1	\$1
2043	\$57	7.9%	0.977	0.891	\$0.003	\$0.0029	1,393	\$4	\$4	0.242	\$1	\$1
2044	\$57	7.9%	0.976	0.887	\$0.003	\$0.0029	1,386	\$4	\$4	0.228	\$1	\$1
						\$0.0029						
Validation: Present Value											\$57	\$57

Table 14. Determination of deferrable distribution costs.

Year	Distribution Project Costs	% Capacity Related	Capacity Related		
	\$	%	\$		
2018	175,490,525	4.5%	7,812,185		
2017	155,018,178	6.6%	10,270,204		
2016	165,929,956	9.6%	15,936,132		
2015	134,867,264	12.1%	16,309,114		
2014	129,899,465	16.3%	21,147,768		
2013	142,118,822	20.3%	28,825,462		
2012	109,286,058	20.8%	22,683,879		
2011	100,102,075	7.5%	7,502,291		
2010	98,267,667	11.0%	10,823,959		
2009	82,821,606	10.6%	8,749,417		
TOTAL 10-YEAR PERIOD	1,293,801,616		150,060,411		

Table 15. Economic value of avoided distribution capacity cost.

Year	Conventional Distribution Planning					Deferred Distribution Planning			
	Distribution Cost	New Dist. Capacity	Capital Cost	Disc Capital Cost	Amortized	Def. Dist. Capacity	Def. Capital Cost	Disc Capital Cost	Amortized
	\$/kW-yr	(MW)	(\$M)	(\$M)	\$M/yr	(MW)	(\$M)	(\$M)	\$M/yr
2020	\$134	50	\$7	\$7	\$9				\$9
2021	\$137	50	\$7	\$6	\$9	50	\$6.8	\$6.4	\$9
2022	\$139	50	\$7	\$6	\$9	50	\$7.0	\$6.2	\$9
2023	\$142	51	\$7	\$6	\$9	50	\$7.2	\$6.0	\$9
2024	\$145	51	\$7	\$6	\$9	51	\$7.3	\$5.7	\$9
2025	\$148	51	\$8	\$6	\$9	51	\$7.5	\$5.5	\$9
2026	\$151	51	\$8	\$5	\$9	51	\$7.7	\$5.3	\$9
2027	\$154	52	\$8	\$5	\$9	51	\$7.9	\$5.1	\$9
2028	\$157	52	\$8	\$5	\$9	52	\$8.1	\$4.9	\$9
2029	\$160	52	\$8	\$5	\$9	52	\$8.3	\$4.8	\$9
2030	\$163	52	\$9	\$5	\$9	52	\$8.5	\$4.6	\$9
2031	\$167	52	\$9	\$4	\$9	52	\$8.7	\$4.4	\$9
2032	\$170	53	\$9	\$4	\$9	52	\$8.9	\$4.2	\$9
2033	\$173	53	\$9	\$4	\$9	53	\$9.1	\$4.1	\$9
2034	\$177	53	\$9	\$4	\$9	53	\$9.3	\$3.9	\$9
2035	\$180	53	\$10	\$4	\$9	53	\$9.6	\$3.8	\$9
2036	\$184	54	\$10	\$4	\$9	53	\$9.8	\$3.7	\$9
2037	\$188	54	\$10	\$4	\$9	54	\$10.0	\$3.5	\$9
2038	\$191	54	\$10	\$3	\$9	54	\$10.3	\$3.4	\$9
2039	\$195	54	\$11	\$3	\$9	54	\$10.5	\$3.3	\$9
2040	\$199	54	\$11	\$3	\$9	54	\$10.8	\$3.1	\$9
2041	\$203	55	\$11	\$3	\$9	54	\$11.1	\$3.0	\$9
2042	\$207	55	\$11	\$3	\$9	55	\$11.3	\$2.9	\$9
2043	\$211	55	\$12	\$3	\$9	55	\$11.6	\$2.8	\$9
2044	\$216	55	\$12	\$3	\$9	55	\$11.9	\$2.7	\$9
2039	\$220					55	\$12.2	\$2.6	
					\$111				\$106

Continued - Table 15. Economic value of avoided distribution capacity cost. *EXAMPLE*

Prices		PV Production	Costs		Discount Factor	Disc. Costs	
Utility	VOS		Utility	VOS		Utility	VOS
\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
\$0.00470	\$0.0047	1,563	\$7	\$7	1.000	\$7	\$7
\$0.00470	\$0.0047	1,555	\$7	\$7	0.940	\$7	\$7
\$0.00470	\$0.0047	1,547	\$7	\$7	0.884	\$6	\$6
\$0.00471	\$0.0047	1,540	\$7	\$7	0.831	\$6	\$6
\$0.00471	\$0.0047	1,532	\$7	\$7	0.781	\$6	\$6
\$0.00471	\$0.0047	1,524	\$7	\$7	0.735	\$5	\$5
\$0.00472	\$0.0047	1,517	\$7	\$7	0.691	\$5	\$5
\$0.00472	\$0.0047	1,509	\$7	\$7	0.649	\$5	\$5
\$0.00472	\$0.0047	1,502	\$7	\$7	0.611	\$4	\$4
\$0.00473	\$0.0047	1,494	\$7	\$7	0.574	\$4	\$4
\$0.00473	\$0.0047	1,487	\$7	\$7	0.540	\$4	\$4
\$0.00474	\$0.0047	1,479	\$7	\$7	0.508	\$4	\$4
\$0.00474	\$0.0047	1,472	\$7	\$7	0.477	\$3	\$3
\$0.00474	\$0.0047	1,464	\$7	\$7	0.449	\$3	\$3
\$0.00475	\$0.0047	1,457	\$7	\$7	0.422	\$3	\$3
\$0.00475	\$0.0047	1,450	\$7	\$7	0.397	\$3	\$3
\$0.00475	\$0.0047	1,443	\$7	\$7	0.373	\$3	\$3
\$0.00476	\$0.0047	1,435	\$7	\$7	0.351	\$2	\$2
\$0.00476	\$0.0047	1,428	\$7	\$7	0.330	\$2	\$2
\$0.00476	\$0.0047	1,421	\$7	\$7	0.310	\$2	\$2
\$0.00477	\$0.0047	1,414	\$7	\$7	0.291	\$2	\$2
\$0.00477	\$0.0047	1,407	\$7	\$7	0.274	\$2	\$2
\$0.00477	\$0.0047	1,400	\$7	\$7	0.258	\$2	\$2
\$0.00478	\$0.0047	1,393	\$7	\$7	0.242	\$2	\$2
\$0.00478	\$0.0047	1,386	\$7	\$7	0.228	\$2	\$1
					-		
	\$0.0047		Validation: Present Value			\$93	\$93

Table 17. Economic value of avoided environmental costs

Environmental Discount Rate 5.30%

Year	Env. Cost \$/mmBtu	Solar Weighted Heat Rate mmBtu/MWh	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
			Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
2020	\$3.12	7,742	\$0.024	\$0.0359	1,563	\$38	\$56	1.000	\$38	\$56
2021	\$3.24	7,750	\$0.025	\$0.0359	1,555	\$39	\$56	0.950	\$37	\$53
2022	\$3.37	7,757	\$0.026	\$0.0359	1,547	\$40	\$56	0.902	\$36	\$50
2023	\$3.50	7,765	\$0.027	\$0.0359	1,540	\$42	\$55	0.857	\$36	\$47
2024	\$3.64	7,773	\$0.028	\$0.0359	1,532	\$43	\$55	0.813	\$35	\$45
2025	\$3.78	7,781	\$0.029	\$0.0359	1,524	\$45	\$55	0.773	\$35	\$42
2026	\$3.92	7,789	\$0.031	\$0.0359	1,517	\$46	\$54	0.734	\$34	\$40
2027	\$4.07	7,796	\$0.032	\$0.0359	1,509	\$48	\$54	0.697	\$33	\$38
2028	\$4.23	7,804	\$0.033	\$0.0359	1,502	\$50	\$54	0.662	\$33	\$36
2029	\$4.39	7,812	\$0.034	\$0.0359	1,494	\$51	\$54	0.628	\$32	\$34
2030	\$4.55	7,820	\$0.036	\$0.0359	1,487	\$53	\$53	0.597	\$32	\$32
2031	\$4.74	7,828	\$0.037	\$0.0359	1,479	\$55	\$53	0.567	\$31	\$30
2032	\$4.93	7,835	\$0.039	\$0.0359	1,472	\$57	\$53	0.538	\$31	\$28
2033	\$5.13	7,843	\$0.040	\$0.0359	1,464	\$59	\$53	0.511	\$30	\$27
2034	\$5.34	7,851	\$0.042	\$0.0359	1,457	\$61	\$52	0.485	\$30	\$25
2035	\$5.55	7,859	\$0.044	\$0.0359	1,450	\$63	\$52	0.461	\$29	\$24
2036	\$5.77	7,867	\$0.045	\$0.0359	1,443	\$65	\$52	0.438	\$29	\$23
2037	\$5.99	7,875	\$0.047	\$0.0359	1,435	\$68	\$51	0.416	\$28	\$21
2038	\$6.23	7,883	\$0.049	\$0.0359	1,428	\$70	\$51	0.395	\$28	\$20
2039	\$6.47	7,890	\$0.051	\$0.0359	1,421	\$73	\$51	0.375	\$27	\$19
2040	\$6.72	7,898	\$0.053	\$0.0359	1,414	\$75	\$51	0.356	\$27	\$18
2041	\$6.95	7,906	\$0.055	\$0.0359	1,407	\$77	\$50	0.338	\$26	\$17
2042	\$7.19	7,914	\$0.057	\$0.0359	1,400	\$80	\$50	0.321	\$26	\$16
2043	\$7.44	7,922	\$0.059	\$0.0359	1,393	\$82	\$50	0.305	\$25	\$15
2044	\$7.70	7,930	\$0.061	\$0.0359	1,386	\$85	\$50	0.290	\$25	\$14

Validation: Present Value	\$771	\$771
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Table 18. Calculation of inflation-adjusted VOS

Year	Discount Factor	PV Production	Escallation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1563	1.000	\$0.114	\$178	\$0.0930	145.422
2021	0.940	1555	1.022	\$0.114	\$167	\$0.0951	139.076
2022	0.884	1547	1.045	\$0.114	\$156	\$0.0972	133.008
2023	0.831	1540	1.068	\$0.114	\$146	\$0.0994	127.204
2024	0.781	1532	1.092	\$0.114	\$136	\$0.1016	121.653
2025	0.735	1524	1.117	\$0.114	\$128	\$0.1039	116.345
2026	0.691	1517	1.141	\$0.114	\$119	\$0.1062	111.268
2027	0.649	1509	1.167	\$0.114	\$112	\$0.1086	106.412
2028	0.611	1502	1.193	\$0.114	\$105	\$0.1110	101.769
2029	0.574	1494	1.220	\$0.114	\$98	\$0.1135	97.328
2030	0.540	1487	1.247	\$0.114	\$91	\$0.1160	93.081
2031	0.508	1479	1.275	\$0.114	\$86	\$0.1186	89.019
2032	0.477	1472	1.303	\$0.114	\$80	\$0.1212	85.135
2033	0.449	1464	1.332	\$0.114	\$75	\$0.1239	81.420
2034	0.422	1457	1.362	\$0.114	\$70	\$0.1267	77.867
2035	0.397	1450	1.392	\$0.114	\$66	\$0.1295	74.469
2036	0.397	1443	1.423	\$0.114	\$65	\$0.1324	75.749
2037	0.351	1435	1.455	\$0.114	\$57	\$0.1354	68.112
2038	0.330	1428	1.487	\$0.114	\$54	\$0.1384	65.140
2039	0.310	1421	1.521	\$0.114	\$50	\$0.1415	62.297
2040	0.291	1414	1.554	\$0.114	\$47	\$0.1446	59.579
2041	0.274	1407	1.589	\$0.114	\$44	\$0.1478	56.979
2042	0.258	1400	1.625	\$0.114	\$41	\$0.1511	54.493
2043	0.242	1393	1.661	\$0.114	\$38	\$0.1545	52.115
2044	0.228	1386	1.698	\$0.114	\$36	\$0.1580	49.841
					\$2,245		\$2,245

VOS Distribution Capacity Cost per kW

(A) System actual cost per KWH

Year	New Dist. Capacity (MW)	Capital Cost - Capacity projects (\$M)
2017	43.3	\$10.270
2018	26.0	\$7.812
2019	72.8	\$5.862
2020	71.0	\$15.380
2021	75.9	\$16.000
Total	289.0	\$55.324
Cost per kW		\$191.43

Line			
1	Full Project Deferral		100%
2	Deferral Reduction Factor		30%
3	Deferral Reduction		70% (1 - 2)
4	Distibution Capacity Cost per kW	<u>\$191.43</u>	
5	Avoided Distibution Capacity Cost per kW	\$134.00	(3 x 4)

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Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value - System Wide & Each Planning Area

Figure ES-2. VOS Rate Table: Calculation of the inflation-adjusted VOS - System Wide & Each Planning Area

Table 3. Fixed assumptions used in the methodology

Table 4. Environmental costs by year

Table 5. VOS Data table --required format showing example parameters used in the example calculation.

Table 6. Azimuth and tilt angle

Table 7. Losses to be considered

Table 8. Economic value of avoided fuel costs

Table 9. Economic value of avoided plant O&M - fixed

Table 10. Economic value of avoided plant O&M - variable

Table 11. Economic value of avoided generation capacity cost.

Table 12. Economic value of avoided reserve capacity cost.

Table 13. Economic value of avoided transmission capacity cost.

Table 13. Economic value of avoided transmission capacity cost.

Table 14. Determination of deferrable costs.

Table 15. Economic value of avoided distribution capacity cost. (two pages) - System Wide & Each Planning Area

Table 17. Economic value of avoided environmental costs

Table 18. Calculation of the inflation-adjusted VOS

Note: Table 1, 2 and 16 were not included as they are not required for the VOS calculation. Table 7 (Losses to be considered) are included in Fig. ES-1

Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value

CURRENT POSITION	Economic Value	Load Match	Distributed Loss Savings	Distributed PV Value
<i>25 Year Levelized Values</i>	(\$/kWh)	(%)	(%)	(\$/kWh)
Avoided Fuel Cost	\$0.0274		9.8%	\$0.0301
Avoided Plant O&M - Fixed	\$0.0027	48.6%	10.8%	\$0.0014
Avoided Plant O&M - Variable	\$0.0012		9.8%	\$0.0014
Avoided Generation Capacity Cost	\$0.0367	48.6%	10.8%	\$0.0197
Avoided Reserve Capacity Cost	\$0.0029	48.6%	10.8%	\$0.0016
Avoided Transmission Capacity Cos	\$0.0325	48.6%	10.8%	\$0.0175
Avoided Distribution Capacity Cost	\$0.0054	54.6%	12.4%	\$0.0033
Avoided Environmental Cost	\$0.0359		9.8%	\$0.0394
Avoided Voltage Control Cost				
<u>Solar Integration Cost</u>				
TOTAL				\$0.1144

Figure ES-2. 1st-Year VOS Rate calculation

Year	Discount Factor	Escalation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1.000	\$0.114	\$0.114	\$0.0934	0.093
2021	0.940	1.022	\$0.114	\$0.108	\$0.0954	0.090
2022	0.884	1.045	\$0.114	\$0.101	\$0.0976	0.086
2023	0.831	1.068	\$0.114	\$0.095	\$0.0998	0.083
2024	0.781	1.092	\$0.114	\$0.089	\$0.1020	0.080
2025	0.735	1.117	\$0.114	\$0.084	\$0.1043	0.077
2026	0.691	1.141	\$0.114	\$0.079	\$0.1066	0.074
2027	0.649	1.167	\$0.114	\$0.074	\$0.1090	0.071
2028	0.611	1.193	\$0.114	\$0.070	\$0.1114	0.068
2029	0.574	1.220	\$0.114	\$0.066	\$0.1139	0.065
2030	0.540	1.247	\$0.114	\$0.062	\$0.1164	0.063
2031	0.508	1.275	\$0.114	\$0.058	\$0.1190	0.060
2032	0.477	1.303	\$0.114	\$0.055	\$0.1217	0.058
2033	0.449	1.332	\$0.114	\$0.051	\$0.1244	0.056
2034	0.422	1.362	\$0.114	\$0.048	\$0.1271	0.054
2035	0.397	1.392	\$0.114	\$0.045	\$0.1300	0.052
2036	0.397	1.423	\$0.114	\$0.045	\$0.1329	0.053
2037	0.351	1.455	\$0.114	\$0.040	\$0.1358	0.048
2038	0.330	1.487	\$0.114	\$0.038	\$0.1389	0.046
2039	0.310	1.521	\$0.114	\$0.035	\$0.1420	0.044
2040	0.291	1.554	\$0.114	\$0.033	\$0.1451	0.042
2041	0.274	1.589	\$0.114	\$0.031	\$0.1484	0.041
2042	0.258	1.625	\$0.114	\$0.029	\$0.1517	0.039
2043	0.242	1.661	\$0.114	\$0.028	\$0.1551	0.038
2044	0.228	1.698	\$0.114	\$0.026	\$0.1585	0.036
				\$1.506		\$1.514

Table 3. Fixed Assumptions to be used for the VOS calculations

Fuel Prices			Environmental Externalities		
Guaranteed NG Fuel Prices			Environmental Discount Rate	5.30%	per year
2020	\$2.671	\$/mmBtu	Environmental Costs	separate table	
2021	\$2.639	\$/mmBtu	Economic Assumptions		
2022	\$2.645	\$/mmBtu	General Escalation Rate	2.23%	per year
2023	\$2.720	\$/mmBtu	Treasury Yields		
2024	\$2.823	\$/mmBtu	1 Year	2.17%	
2025	\$2.935	\$/mmBtu	2 Year	2.05%	
2026	\$3.047	\$/mmBtu	3 Year	2.01%	
2027	\$3.159	\$/mmBtu	5 Year	2.04%	
2028	\$3.271	\$/mmBtu	7 Year	2.14%	
2029	\$3.380	\$/mmBtu	10 Year	2.25%	
2030	\$3.490	\$/mmBtu	20 Year	2.49%	
2031	\$3.596	\$/mmBtu	30 Year	2.68%	
Fuel Price Escalation	2.23%				
PV Assumptions					
PV Degradation Rate	0.50%				
PV Life	25				

Table 4. Environmental costs by year.

Year	Analysis Year	CO2 Cost \$/mmBtu	PM 2.5 Cost \$/mmBtu	CO Cost \$/mmBtu	NOx Cost \$/mmBtu	Pb Cost \$/mmBtu	SO2 Cost \$/mmBtu	Total Cost \$/mmBtu
2020	0	\$2.807	\$0.021	\$0.000	\$0.286	\$0.000	\$0.004	\$3.117
2021	1	\$2.924	\$0.021	\$0.000	\$0.292	\$0.000	\$0.004	\$3.241
2022	2	\$3.045	\$0.021	\$0.000	\$0.299	\$0.000	\$0.004	\$3.369
2023	3	\$3.170	\$0.022	\$0.000	\$0.305	\$0.000	\$0.004	\$3.502
2024	4	\$3.299	\$0.022	\$0.000	\$0.312	\$0.000	\$0.004	\$3.638
2025	5	\$3.433	\$0.023	\$0.000	\$0.319	\$0.000	\$0.004	\$3.779
2026	6	\$3.570	\$0.023	\$0.000	\$0.326	\$0.000	\$0.004	\$3.924
2027	7	\$3.712	\$0.024	\$0.000	\$0.334	\$0.000	\$0.004	\$4.074
2028	8	\$3.859	\$0.025	\$0.000	\$0.341	\$0.000	\$0.004	\$4.229
2029	9	\$4.010	\$0.025	\$0.000	\$0.349	\$0.000	\$0.004	\$4.388
2030	10	\$4.166	\$0.026	\$0.000	\$0.356	\$0.000	\$0.004	\$4.553
2031	11	\$4.344	\$0.026	\$0.000	\$0.364	\$0.000	\$0.004	\$4.740
2032	12	\$4.528	\$0.027	\$0.000	\$0.373	\$0.000	\$0.005	\$4.932
2033	13	\$4.718	\$0.027	\$0.000	\$0.381	\$0.000	\$0.005	\$5.131
2034	14	\$4.915	\$0.028	\$0.000	\$0.389	\$0.000	\$0.005	\$5.337
2035	15	\$5.117	\$0.029	\$0.000	\$0.398	\$0.000	\$0.005	\$5.549
2036	16	\$5.326	\$0.029	\$0.000	\$0.407	\$0.000	\$0.005	\$5.768
2037	17	\$5.542	\$0.030	\$0.000	\$0.416	\$0.000	\$0.005	\$5.993
2038	18	\$5.765	\$0.031	\$0.000	\$0.425	\$0.000	\$0.005	\$6.227
2039	19	\$5.996	\$0.031	\$0.000	\$0.435	\$0.000	\$0.005	\$6.467
2040	20	\$6.233	\$0.032	\$0.000	\$0.444	\$0.000	\$0.005	\$6.715
2041	21	\$6.457	\$0.033	\$0.000	\$0.454	\$0.000	\$0.006	\$6.950
2042	22	\$6.688	\$0.033	\$0.000	\$0.464	\$0.000	\$0.006	\$7.192
2043	23	\$6.926	\$0.034	\$0.000	\$0.475	\$0.000	\$0.006	\$7.441
2044	24	\$7.171	\$0.035	\$0.000	\$0.485	\$0.000	\$0.006	\$7.698

Table 5. VOS Data table -- required format showing assumptions used in the VOS calculation.

	Input Data	Units		Input Data	Units
Economic Factors			Power Generation - Continued		
Start Year for VOS applicability	2020	Year	Other		
Discount Rate (After-tax WACC)	6.36%	Percentage	Solar weighted Heat Rate	7,742	BTU per kWh
Load Match Analysis			Fuel Price Overhead	\$0.004	\$ per MMBtu
ELCC (no loss)	48.6%	% of rating	Generation life	40	years
PLR (no loss)	54.6%	% of rating	Heat Rate degradation	0.10%	per year
Loss Savings - Energy	9.8%	% of PV output	O&M cost (first year) - Fixed	\$3.42	per kW-yr
Loss Savings - PLR	12.4%	% of PV output	O&M cost (first year) - Variable	\$0.0010	\$ per kWh
Loss Savings - ELCC	10.8%	% of PV output	O&M cost escalation rate	2.00%	per year
			Reserve planning margin	7.9%	
			Years until new Generation is needed	0	
PV Energy			Distribution		
Simulated - First year annual energy	1,452	kWh per kW-AC	Capacity-related distribution capital costs -System	\$96	\$ per kW
year annual energy		kWh per kW-AC	Capacity-related distribution capital costs - Mpls	N/A	\$ per kW
Actual- First year annual energy	1,563		Capacity-related distribution capital costs - Mtka	N/A	\$ per kW
			Capacity-related distribution capital costs -Edina	N/A	\$ per kW
Transmission			Capacity-related distribution capital costs - SE	N/A	\$ per kW
Capacity-related transmission capital cost	\$50.33	\$ per kW	Capacity-related distribution capital costs -MG	N/A	\$ per kW
Power Generation			Capacity-related distribution capital costs - Newport	N/A	\$ per kW
Peaking CT, simple cycle			Capacity-related distribution capital costs - St. Paul	N/A	\$ per kW
Installed Cost	\$476	\$/kW	Capacity-related distribution capital costs - NW	N/A	\$ per kW
Heat Rate	9,738	BTU/kWh	Capacity-related distribution capital costs - WBL	N/A	\$ per kW
Intermediate CCGT			Distribution capital cost escalation	2.00%	per year
Installed Cost	\$1,022	\$/kW	Peak Load (Weather Normalized)	6,420	MW
Heat Rate	6,547	BTU/kWh	Peak Load Growth	0.43%	per year

Table 6. Azimuth and Tilt Angles

	Array KW	% of Total	Azimuth	Tilt	
1	3,209	4.9%	52	25	
2	2,974	4.5%	140	21	
3	2,906	4.4%	167	19	
4	18,979	28.9%	180	12	
5	3,939	6.0%	180	21	
6	7,997	12.2%	180	26	
7	6,676	10.2%	180	30	
8	3,296	5.0%	180	35	
9	947	1.4%	180	42	
10	5,453	8.3%	180	48	
11	2,769	4.2%	184	19	
12	964	1.5%	197	26	
13	2,816	4.3%	212	18	
14	1,207	1.8%	237	24	
15	1,577	2.4%	271	22	
TOTAL	65,709	100%	176.4	23.2	Weighted Average

Table 8. Economic Value of Avoided Fuel Costs.

Year				Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Utility	VOS		Utility	VOS		Utility	VOS
	\$/mmBtu	\$/mmBtu	mmBtu/kWh	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$2.67	\$2.67	7,742	\$0.021	\$0.0274	1,563	\$32	\$43	1.000	\$32	\$43
2021	\$2.64	\$2.64	7,750	\$0.020	\$0.0274	1,555	\$32	\$43	0.979	\$31	\$42
2022	\$2.64	\$2.65	7,757	\$0.021	\$0.0274	1,547	\$32	\$42	0.960	\$31	\$41
2023	\$2.72	\$2.72	7,765	\$0.021	\$0.0274	1,540	\$33	\$42	0.942	\$31	\$40
2024	\$2.82	\$2.83	7,773	\$0.022	\$0.0274	1,532	\$34	\$42	0.923	\$31	\$39
2025	\$2.93	\$2.94	7,781	\$0.023	\$0.0274	1,524	\$35	\$42	0.904	\$32	\$38
2026	\$3.05	\$3.05	7,789	\$0.024	\$0.0274	1,517	\$36	\$42	0.883	\$32	\$37
2027	\$3.16	\$3.16	7,796	\$0.025	\$0.0274	1,509	\$37	\$41	0.863	\$32	\$36
2028	\$3.27	\$3.28	7,804	\$0.026	\$0.0274	1,502	\$38	\$41	0.842	\$32	\$35
2029	\$3.38	\$3.38	7,812	\$0.026	\$0.0274	1,494	\$40	\$41	0.822	\$32	\$34
2030	\$3.49	\$3.49	7,820	\$0.027	\$0.0274	1,487	\$41	\$41	0.801	\$33	\$33
2031	\$3.60	\$3.60	7,828	\$0.028	\$0.0274	1,479	\$42	\$41	0.781	\$33	\$32
2032	\$3.68	\$3.68	7,835	\$0.029	\$0.0274	1,472	\$42	\$40	0.762	\$32	\$31
2033	\$3.76	\$3.76	7,843	\$0.030	\$0.0274	1,464	\$43	\$40	0.742	\$32	\$30
2034	\$3.84	\$3.85	7,851	\$0.030	\$0.0274	1,457	\$44	\$40	0.723	\$32	\$29
2035	\$3.93	\$3.93	7,859	\$0.031	\$0.0274	1,450	\$45	\$40	0.704	\$32	\$28
2036	\$4.01	\$4.02	7,867	\$0.032	\$0.0274	1,443	\$46	\$40	0.685	\$31	\$27
2037	\$4.10	\$4.11	7,875	\$0.032	\$0.0274	1,435	\$46	\$39	0.666	\$31	\$26
2038	\$4.20	\$4.20	7,883	\$0.033	\$0.0274	1,428	\$47	\$39	0.648	\$31	\$25
2039	\$4.29	\$4.30	7,890	\$0.034	\$0.0274	1,421	\$48	\$39	0.629	\$30	\$25
2040	\$4.39	\$4.39	7,898	\$0.035	\$0.0274	1,414	\$49	\$39	0.611	\$30	\$24
2041	\$4.48	\$4.49	7,906	\$0.035	\$0.0274	1,407	\$50	\$39	0.594	\$30	\$23
2042	\$4.58	\$4.59	7,914	\$0.036	\$0.0274	1,400	\$51	\$38	0.577	\$29	\$22
2043	\$4.69	\$4.69	7,922	\$0.037	\$0.0274	1,393	\$52	\$38	0.561	\$29	\$21
2044	\$4.79	\$4.80	7,930	\$0.038	\$0.0274	1,386	\$53	\$38	0.544	\$29	\$21

Validation: Present Value	\$779	\$779
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Table 9. Economic value of avoided plant O&M - fixed

Year	O&M Fixed	Utility Capacity	PV Capacity	Prices		p.u. PV Production	Costs		Discount Factor	Disc. Costs	
				Utility	VOS		Utility	VOS		Utility	VOS
				\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$3.42	1.00	1.00	\$0.0022	\$0.0027	1,563	\$3.42	\$4.14	1.000	\$3.42	\$4.14
2021	\$3.49	0.999	0.995	\$0.0022	\$0.0027	1,555	\$3.48	\$4.12	0.940	\$3.27	\$3.88
2022	\$3.56	0.998	0.990	\$0.0023	\$0.0027	1,547	\$3.53	\$4.10	0.884	\$3.12	\$3.63
2023	\$3.63	0.997	0.985	\$0.0024	\$0.0027	1,540	\$3.59	\$4.08	0.831	\$2.98	\$3.39
2024	\$3.71	0.996	0.980	\$0.0024	\$0.0027	1,532	\$3.65	\$4.06	0.781	\$2.85	\$3.17
2025	\$3.78	0.995	0.975	\$0.0025	\$0.0027	1,524	\$3.71	\$4.04	0.735	\$2.72	\$2.97
2026	\$3.86	0.994	0.970	\$0.0025	\$0.0027	1,517	\$3.76	\$4.02	0.691	\$2.60	\$2.78
2027	\$3.93	0.993	0.966	\$0.0026	\$0.0027	1,509	\$3.82	\$4.00	0.649	\$2.48	\$2.60
2028	\$4.01	0.992	0.961	\$0.0027	\$0.0027	1,502	\$3.89	\$3.98	0.611	\$2.37	\$2.43
2029	\$4.09	0.991	0.956	\$0.0027	\$0.0027	1,494	\$3.95	\$3.96	0.574	\$2.27	\$2.27
2030	\$4.17	0.990	0.951	\$0.0028	\$0.0027	1,487	\$4.01	\$3.94	0.540	\$2.16	\$2.13
2031	\$4.26	0.989	0.946	\$0.0028	\$0.0027	1,479	\$4.07	\$3.92	0.508	\$2.07	\$1.99
2032	\$4.34	0.988	0.942	\$0.0029	\$0.0027	1,472	\$4.14	\$3.90	0.477	\$1.97	\$1.86
2033	\$4.43	0.987	0.937	\$0.0030	\$0.0027	1,464	\$4.20	\$3.88	0.449	\$1.89	\$1.74
2034	\$4.52	0.986	0.932	\$0.0031	\$0.0027	1,457	\$4.27	\$3.86	0.422	\$1.80	\$1.63
2035	\$4.52	0.985	0.928	\$0.0031	\$0.0027	1,450	\$4.25	\$3.84	0.397	\$1.69	\$1.52
2036	\$4.70	0.984	0.923	\$0.0032	\$0.0027	1,443	\$4.41	\$3.82	0.397	\$1.75	\$1.52
2037	\$4.79	0.983	0.918	\$0.0033	\$0.0027	1,435	\$4.48	\$3.80	0.351	\$1.57	\$1.33
2038	\$4.89	0.982	0.914	\$0.0034	\$0.0027	1,428	\$4.55	\$3.78	0.330	\$1.50	\$1.25
2039	\$4.99	0.981	0.909	\$0.0034	\$0.0027	1,421	\$4.62	\$3.77	0.310	\$1.43	\$1.17
2040	\$5.09	0.980	0.905	\$0.0035	\$0.0027	1,414	\$4.70	\$3.75	0.291	\$1.37	\$1.09
2041	\$5.19	0.979	0.900	\$0.0036	\$0.0027	1,407	\$4.77	\$3.73	0.274	\$1.31	\$1.02
2042	\$5.29	0.978	0.896	\$0.0037	\$0.0027	1,400	\$4.85	\$3.71	0.258	\$1.25	\$0.96
2043	\$5.40	0.977	0.891	\$0.0038	\$0.0027	1,393	\$4.92	\$3.69	0.242	\$1.19	\$0.89
2044	\$5.51	0.976	0.887	\$0.0039	\$0.0027	1,386	\$5.00	\$3.67	0.228	\$1.14	\$0.84

\$0.0027

Validation: Present Value

\$52

\$52

Table 10. Economic value of avoided plant O&M - variable

Year	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$0.0010	\$0.0012	1,563	\$2	\$2	1.000	\$2	\$2
2021	\$0.0011	\$0.0012	1,555	\$2	\$2	0.940	\$2	\$2
2022	\$0.0011	\$0.0012	1,547	\$2	\$2	0.884	\$1	\$2
2023	\$0.0011	\$0.0012	1,540	\$2	\$2	0.831	\$1	\$2
2024	\$0.0011	\$0.0012	1,532	\$2	\$2	0.781	\$1	\$1
2025	\$0.0011	\$0.0012	1,524	\$2	\$2	0.735	\$1	\$1
2026	\$0.0012	\$0.0012	1,517	\$2	\$2	0.691	\$1	\$1
2027	\$0.0012	\$0.0012	1,509	\$2	\$2	0.649	\$1	\$1
2028	\$0.0012	\$0.0012	1,502	\$2	\$2	0.611	\$1	\$1
2029	\$0.0012	\$0.0012	1,494	\$2	\$2	0.574	\$1	\$1
2030	\$0.0013	\$0.0012	1,487	\$2	\$2	0.540	\$1	\$1
2031	\$0.0013	\$0.0012	1,479	\$2	\$2	0.508	\$1	\$1
2032	\$0.0013	\$0.0012	1,472	\$2	\$2	0.477	\$1	\$1
2033	\$0.0013	\$0.0012	1,464	\$2	\$2	0.449	\$1	\$1
2034	\$0.0014	\$0.0012	1,457	\$2	\$2	0.422	\$1	\$1
2035	\$0.0014	\$0.0012	1,450	\$2	\$2	0.397	\$1	\$1
2036	\$0.0014	\$0.0012	1,443	\$2	\$2	0.373	\$1	\$1
2037	\$0.0014	\$0.0012	1,435	\$2	\$2	0.351	\$1	\$1
2038	\$0.0015	\$0.0012	1,428	\$2	\$2	0.330	\$1	\$1
2039	\$0.0015	\$0.0012	1,421	\$2	\$2	0.310	\$1	\$1
2040	\$0.0015	\$0.0012	1,414	\$2	\$2	0.291	\$1	\$1
2041	\$0.0016	\$0.0012	1,407	\$2	\$2	0.274	\$1	\$0
2042	\$0.0016	\$0.0012	1,400	\$2	\$2	0.258	\$1	\$0
2043	\$0.0016	\$0.0012	1,393	\$2	\$2	0.242	\$1	\$0
2044	\$0.0017	\$0.0012	1,386	\$2	\$2	0.228	\$1	\$0
Validation: Present Value							\$24	\$24

Table 11. Economic value of avoided generation capacity cost.

Year				Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	Capacity Cost	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$57	1.00	1.00	\$0.036	\$0.0367	1,563	\$57	\$57	1.000	\$57	\$57
2021	\$57	0.999	0.995	\$0.036	\$0.0367	1,555	\$57	\$57	0.940	\$53	\$54
2022	\$57	0.998	0.990	\$0.036	\$0.0367	1,547	\$56	\$57	0.884	\$50	\$50
2023	\$57	0.997	0.985	\$0.036	\$0.0367	1,540	\$56	\$56	0.831	\$47	\$47
2024	\$57	0.996	0.980	\$0.036	\$0.0367	1,532	\$56	\$56	0.781	\$44	\$44
2025	\$57	0.995	0.975	\$0.037	\$0.0367	1,524	\$56	\$56	0.735	\$41	\$41
2026	\$57	0.994	0.970	\$0.037	\$0.0367	1,517	\$55	\$56	0.691	\$38	\$38
2027	\$57	0.993	0.966	\$0.037	\$0.0367	1,509	\$55	\$55	0.649	\$36	\$36
2028	\$57	0.992	0.961	\$0.037	\$0.0367	1,502	\$55	\$55	0.611	\$34	\$34
2029	\$57	0.991	0.956	\$0.037	\$0.0367	1,494	\$55	\$55	0.574	\$31	\$31
2030	\$57	0.990	0.951	\$0.037	\$0.0367	1,487	\$55	\$55	0.540	\$29	\$29
2031	\$57	0.989	0.946	\$0.037	\$0.0367	1,479	\$54	\$54	0.508	\$28	\$28
2032	\$57	0.988	0.942	\$0.037	\$0.0367	1,472	\$54	\$54	0.477	\$26	\$26
2033	\$57	0.987	0.937	\$0.037	\$0.0367	1,464	\$54	\$54	0.449	\$24	\$24
2034	\$57	0.986	0.932	\$0.037	\$0.0367	1,457	\$54	\$53	0.422	\$23	\$23
2035	\$57	0.985	0.928	\$0.037	\$0.0367	1,450	\$53	\$53	0.397	\$21	\$21
2036	\$57	0.984	0.923	\$0.037	\$0.0367	1,443	\$53	\$53	0.373	\$20	\$20
2037	\$57	0.983	0.918	\$0.037	\$0.0367	1,435	\$53	\$53	0.351	\$19	\$18
2038	\$57	0.982	0.914	\$0.037	\$0.0367	1,428	\$53	\$52	0.330	\$17	\$17
2039	\$57	0.981	0.909	\$0.037	\$0.0367	1,421	\$53	\$52	0.310	\$16	\$16
2040	\$57	0.980	0.905	\$0.037	\$0.0367	1,414	\$52	\$52	0.291	\$15	\$15
2041	\$57	0.979	0.900	\$0.037	\$0.0367	1,407	\$52	\$52	0.274	\$14	\$14
2042	\$57	0.978	0.896	\$0.037	\$0.0367	1,400	\$52	\$51	0.258	\$13	\$13
2043	\$57	0.977	0.891	\$0.037	\$0.0367	1,393	\$52	\$51	0.242	\$13	\$12
2044	\$57	0.976	0.887	\$0.037	\$0.0367	1,386	\$52	\$51	0.228	\$12	\$12
					\$0.0367						
Validation: Present Value										\$721	\$721

Table 12. Economic value of avoided reserve capacity cost.

Year					Prices					Disc. Costs		
	Capacity Cost	Reserve Margin	Utility Capacity	PV Capacity	Utility	VOS	PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/kW-yr	%	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$57	7.9%	1.00	1.00	\$0.003	\$0.0029	1,563	\$4	\$5	1.000	\$4	\$5
2021	\$57	7.9%	0.999	0.995	\$0.003	\$0.0029	1,555	\$4	\$5	0.940	\$4	\$4
2022	\$57	7.9%	0.998	0.990	\$0.003	\$0.0029	1,547	\$4	\$4	0.884	\$4	\$4
2023	\$57	7.9%	0.997	0.985	\$0.003	\$0.0029	1,540	\$4	\$4	0.831	\$4	\$4
2024	\$57	7.9%	0.996	0.980	\$0.003	\$0.0029	1,532	\$4	\$4	0.781	\$3	\$3
2025	\$57	7.9%	0.995	0.975	\$0.003	\$0.0029	1,524	\$4	\$4	0.735	\$3	\$3
2026	\$57	7.9%	0.994	0.970	\$0.003	\$0.0029	1,517	\$4	\$4	0.691	\$3	\$3
2027	\$57	7.9%	0.993	0.966	\$0.003	\$0.0029	1,509	\$4	\$4	0.649	\$3	\$3
2028	\$57	7.9%	0.992	0.961	\$0.003	\$0.0029	1,502	\$4	\$4	0.611	\$3	\$3
2029	\$57	7.9%	0.991	0.956	\$0.003	\$0.0029	1,494	\$4	\$4	0.574	\$2	\$2
2030	\$57	7.9%	0.990	0.951	\$0.003	\$0.0029	1,487	\$4	\$4	0.540	\$2	\$2
2031	\$57	7.9%	0.989	0.946	\$0.003	\$0.0029	1,479	\$4	\$4	0.508	\$2	\$2
2032	\$57	7.9%	0.988	0.942	\$0.003	\$0.0029	1,472	\$4	\$4	0.477	\$2	\$2
2033	\$57	7.9%	0.987	0.937	\$0.003	\$0.0029	1,464	\$4	\$4	0.449	\$2	\$2
2034	\$57	7.9%	0.986	0.932	\$0.003	\$0.0029	1,457	\$4	\$4	0.422	\$2	\$2
2035	\$57	7.9%	0.985	0.928	\$0.003	\$0.0029	1,450	\$4	\$4	0.397	\$2	\$2
2036	\$57	7.9%	0.984	0.923	\$0.003	\$0.0029	1,443	\$4	\$4	0.373	\$2	\$2
2037	\$57	7.9%	0.983	0.918	\$0.003	\$0.0029	1,435	\$4	\$4	0.351	\$1	\$1
2038	\$57	7.9%	0.982	0.914	\$0.003	\$0.0029	1,428	\$4	\$4	0.330	\$1	\$1
2039	\$57	7.9%	0.981	0.909	\$0.003	\$0.0029	1,421	\$4	\$4	0.310	\$1	\$1
2040	\$57	7.9%	0.980	0.905	\$0.003	\$0.0029	1,414	\$4	\$4	0.291	\$1	\$1
2041	\$57	7.9%	0.979	0.900	\$0.003	\$0.0029	1,407	\$4	\$4	0.274	\$1	\$1
2042	\$57	7.9%	0.978	0.896	\$0.003	\$0.0029	1,400	\$4	\$4	0.258	\$1	\$1
2043	\$57	7.9%	0.977	0.891	\$0.003	\$0.0029	1,393	\$4	\$4	0.242	\$1	\$1
2044	\$57	7.9%	0.976	0.887	\$0.003	\$0.0029	1,386	\$4	\$4	0.228	\$1	\$1
						\$0.0029						
Validation: Present Value											\$57	\$57

Table 13. Economic value of avoided transmission capacity cost.

Year				Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	Capacity Cost	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$50	1.00	1.00	\$0.032	\$0.0325	1,563	\$50	\$51	1.000	\$50	\$51
2021	\$50	0.999	0.995	\$0.032	\$0.0325	1,555	\$50	\$51	0.940	\$47	\$47
2022	\$50	0.998	0.990	\$0.032	\$0.0325	1,547	\$50	\$50	0.884	\$44	\$44
2023	\$50	0.997	0.985	\$0.032	\$0.0325	1,540	\$50	\$50	0.831	\$41	\$42
2024	\$50	0.996	0.980	\$0.032	\$0.0325	1,532	\$50	\$50	0.781	\$39	\$39
2025	\$50	0.995	0.975	\$0.032	\$0.0325	1,524	\$49	\$50	0.735	\$36	\$36
2026	\$50	0.994	0.970	\$0.032	\$0.0325	1,517	\$49	\$49	0.691	\$34	\$34
2027	\$50	0.993	0.966	\$0.032	\$0.0325	1,509	\$49	\$49	0.649	\$32	\$32
2028	\$50	0.992	0.961	\$0.032	\$0.0325	1,502	\$49	\$49	0.611	\$30	\$30
2029	\$50	0.991	0.956	\$0.032	\$0.0325	1,494	\$49	\$49	0.574	\$28	\$28
2030	\$50	0.990	0.951	\$0.033	\$0.0325	1,487	\$48	\$48	0.540	\$26	\$26
2031	\$50	0.989	0.946	\$0.033	\$0.0325	1,479	\$48	\$48	0.508	\$24	\$24
2032	\$50	0.988	0.942	\$0.033	\$0.0325	1,472	\$48	\$48	0.477	\$23	\$23
2033	\$50	0.987	0.937	\$0.033	\$0.0325	1,464	\$48	\$48	0.449	\$21	\$21
2034	\$50	0.986	0.932	\$0.033	\$0.0325	1,457	\$48	\$47	0.422	\$20	\$20
2035	\$50	0.985	0.928	\$0.033	\$0.0325	1,450	\$47	\$47	0.397	\$19	\$19
2036	\$50	0.984	0.923	\$0.033	\$0.0325	1,443	\$47	\$47	0.373	\$18	\$17
2037	\$50	0.983	0.918	\$0.033	\$0.0325	1,435	\$47	\$47	0.351	\$16	\$16
2038	\$50	0.982	0.914	\$0.033	\$0.0325	1,428	\$47	\$46	0.330	\$15	\$15
2039	\$50	0.981	0.909	\$0.033	\$0.0325	1,421	\$47	\$46	0.310	\$14	\$14
2040	\$50	0.980	0.905	\$0.033	\$0.0325	1,414	\$46	\$46	0.291	\$14	\$13
2041	\$50	0.979	0.900	\$0.033	\$0.0325	1,407	\$46	\$46	0.274	\$13	\$13
2042	\$50	0.978	0.896	\$0.033	\$0.0325	1,400	\$46	\$45	0.258	\$12	\$12
2043	\$50	0.977	0.891	\$0.033	\$0.0325	1,393	\$46	\$45	0.242	\$11	\$11
2044	\$50	0.976	0.887	\$0.033	\$0.0325	1,386	\$46	\$45	0.228	\$10	\$10
					\$0.0325						
Validation: Present Value										\$639	\$639

Table 14. Determination of deferrable distribution costs.

Year	Distribution Project Costs	% Capacity Related	Capacity Related		
	\$	%	\$		
2018	175,490,525	4.5%	7,812,185		
2017	155,018,178	6.6%	10,270,204		
2016	165,929,956	9.6%	15,936,132		
2015	134,867,264	12.1%	16,309,114		
2014	129,899,465	16.3%	21,147,768		
2013	142,118,822	20.3%	28,825,462		
2012	109,286,058	20.8%	22,683,879		
2011	100,102,075	7.5%	7,502,291		
2010	98,267,667	11.0%	10,823,959		
2009	82,821,606	10.6%	8,749,417		
TOTAL 10-YEAR PERIOD	1,293,801,616		150,060,411		

Table 15. Economic value of avoided distribution capacity cost.

Year	Conventional Distribution Planning					Deferred Distribution Planning			
	Distribution Cost	New Dist. Capacity	Capital Cost	Disc Capital Cost	Amortized	Def. Dist. Capacity	Def. Capital Cost	Disc Capital Cost	Amortized
	\$/kW-yr	(MW)	(\$M)	(\$M)	\$/yr	(MW)	(\$M)	(\$M)	\$/yr
2020	\$153	50	\$8	\$8	\$10				\$10
2021	\$156	50	\$8	\$7	\$10	50	\$7.8	\$7.3	\$10
2022	\$159	50	\$8	\$7	\$10	50	\$8.0	\$7.1	\$10
2023	\$163	51	\$8	\$7	\$10	50	\$8.2	\$6.8	\$10
2024	\$166	51	\$8	\$7	\$10	51	\$8.4	\$6.6	\$10
2025	\$169	51	\$9	\$6	\$10	51	\$8.6	\$6.3	\$10
2026	\$172	51	\$9	\$6	\$10	51	\$8.8	\$6.1	\$10
2027	\$176	52	\$9	\$6	\$10	51	\$9.0	\$5.9	\$10
2028	\$179	52	\$9	\$6	\$10	52	\$9.2	\$5.6	\$10
2029	\$183	52	\$10	\$5	\$10	52	\$9.5	\$5.4	\$10
2030	\$187	52	\$10	\$5	\$10	52	\$9.7	\$5.2	\$10
2031	\$190	52	\$10	\$5	\$10	52	\$9.9	\$5.0	\$10
2032	\$194	53	\$10	\$5	\$10	52	\$10.2	\$4.9	\$10
2033	\$198	53	\$10	\$5	\$10	53	\$10.4	\$4.7	\$10
2034	\$202	53	\$11	\$5	\$10	53	\$10.7	\$4.5	\$10
2035	\$206	53	\$11	\$4	\$10	53	\$10.9	\$4.3	\$10
2036	\$210	54	\$11	\$4	\$10	53	\$11.2	\$4.2	\$10
2037	\$214	54	\$12	\$4	\$10	54	\$11.5	\$4.0	\$10
2038	\$219	54	\$12	\$4	\$10	54	\$11.8	\$3.9	\$10
2039	\$223	54	\$12	\$4	\$10	54	\$12.0	\$3.7	\$10
2040	\$228	54	\$12	\$4	\$10	54	\$12.3	\$3.6	\$10
2041	\$232	55	\$13	\$3	\$10	54	\$12.6	\$3.5	\$10
2042	\$237	55	\$13	\$3	\$10	55	\$12.9	\$3.3	\$10
2043	\$241	55	\$13	\$3	\$10	55	\$13.3	\$3.2	\$10
2044	\$246	55	\$14	\$3	\$10	55	\$13.6	\$3.1	\$10
2039	\$251					55	\$13.9	\$3.0	
					\$126				\$121

Continued - Table 15. Economic value of avoided distribution capacity cost. *EXAMPLE*

Prices		PV Production	Costs		Discount Factor	Disc. Costs	
Utility	VOS		Utility	VOS		Utility	VOS
\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
\$0.00537	\$0.0054	1,563	\$8	\$8	1.000	\$8	\$8
\$0.00537	\$0.0054	1,555	\$8	\$8	0.940	\$8	\$8
\$0.00538	\$0.0054	1,547	\$8	\$8	0.884	\$7	\$7
\$0.00538	\$0.0054	1,540	\$8	\$8	0.831	\$7	\$7
\$0.00538	\$0.0054	1,532	\$8	\$8	0.781	\$6	\$6
\$0.00539	\$0.0054	1,524	\$8	\$8	0.735	\$6	\$6
\$0.00539	\$0.0054	1,517	\$8	\$8	0.691	\$6	\$6
\$0.00540	\$0.0054	1,509	\$8	\$8	0.649	\$5	\$5
\$0.00540	\$0.0054	1,502	\$8	\$8	0.611	\$5	\$5
\$0.00540	\$0.0054	1,494	\$8	\$8	0.574	\$5	\$5
\$0.00541	\$0.0054	1,487	\$8	\$8	0.540	\$4	\$4
\$0.00541	\$0.0054	1,479	\$8	\$8	0.508	\$4	\$4
\$0.00542	\$0.0054	1,472	\$8	\$8	0.477	\$4	\$4
\$0.00542	\$0.0054	1,464	\$8	\$8	0.449	\$4	\$4
\$0.00542	\$0.0054	1,457	\$8	\$8	0.422	\$3	\$3
\$0.00543	\$0.0054	1,450	\$8	\$8	0.397	\$3	\$3
\$0.00543	\$0.0054	1,443	\$8	\$8	0.373	\$3	\$3
\$0.00544	\$0.0054	1,435	\$8	\$8	0.351	\$3	\$3
\$0.00544	\$0.0054	1,428	\$8	\$8	0.330	\$3	\$3
\$0.00544	\$0.0054	1,421	\$8	\$8	0.310	\$2	\$2
\$0.00545	\$0.0054	1,414	\$8	\$8	0.291	\$2	\$2
\$0.00545	\$0.0054	1,407	\$8	\$8	0.274	\$2	\$2
\$0.00546	\$0.0054	1,400	\$8	\$8	0.258	\$2	\$2
\$0.00546	\$0.0054	1,393	\$8	\$8	0.242	\$2	\$2
\$0.00546	\$0.0054	1,386	\$8	\$7	0.228	\$2	\$2
					-		
	\$0.0054		Validation: Present Value			\$106	\$106

Table 17. Economic value of avoided environmental costs

Environmental Discount Rate 5.30%

Year	Env. Cost \$/mmBtu	Solar Weighted Heat Rate mmBtu/MWh	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
			Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
2020	\$3.12	7,742	\$0.024	\$0.0359	1,563	\$38	\$56	1.000	\$38	\$56
2021	\$3.24	7,750	\$0.025	\$0.0359	1,555	\$39	\$56	0.950	\$37	\$53
2022	\$3.37	7,757	\$0.026	\$0.0359	1,547	\$40	\$56	0.902	\$36	\$50
2023	\$3.50	7,765	\$0.027	\$0.0359	1,540	\$42	\$55	0.857	\$36	\$47
2024	\$3.64	7,773	\$0.028	\$0.0359	1,532	\$43	\$55	0.813	\$35	\$45
2025	\$3.78	7,781	\$0.029	\$0.0359	1,524	\$45	\$55	0.773	\$35	\$42
2026	\$3.92	7,789	\$0.031	\$0.0359	1,517	\$46	\$54	0.734	\$34	\$40
2027	\$4.07	7,796	\$0.032	\$0.0359	1,509	\$48	\$54	0.697	\$33	\$38
2028	\$4.23	7,804	\$0.033	\$0.0359	1,502	\$50	\$54	0.662	\$33	\$36
2029	\$4.39	7,812	\$0.034	\$0.0359	1,494	\$51	\$54	0.628	\$32	\$34
2030	\$4.55	7,820	\$0.036	\$0.0359	1,487	\$53	\$53	0.597	\$32	\$32
2031	\$4.74	7,828	\$0.037	\$0.0359	1,479	\$55	\$53	0.567	\$31	\$30
2032	\$4.93	7,835	\$0.039	\$0.0359	1,472	\$57	\$53	0.538	\$31	\$28
2033	\$5.13	7,843	\$0.040	\$0.0359	1,464	\$59	\$53	0.511	\$30	\$27
2034	\$5.34	7,851	\$0.042	\$0.0359	1,457	\$61	\$52	0.485	\$30	\$25
2035	\$5.55	7,859	\$0.044	\$0.0359	1,450	\$63	\$52	0.461	\$29	\$24
2036	\$5.77	7,867	\$0.045	\$0.0359	1,443	\$65	\$52	0.438	\$29	\$23
2037	\$5.99	7,875	\$0.047	\$0.0359	1,435	\$68	\$51	0.416	\$28	\$21
2038	\$6.23	7,883	\$0.049	\$0.0359	1,428	\$70	\$51	0.395	\$28	\$20
2039	\$6.47	7,890	\$0.051	\$0.0359	1,421	\$73	\$51	0.375	\$27	\$19
2040	\$6.72	7,898	\$0.053	\$0.0359	1,414	\$75	\$51	0.356	\$27	\$18
2041	\$6.95	7,906	\$0.055	\$0.0359	1,407	\$77	\$50	0.338	\$26	\$17
2042	\$7.19	7,914	\$0.057	\$0.0359	1,400	\$80	\$50	0.321	\$26	\$16
2043	\$7.44	7,922	\$0.059	\$0.0359	1,393	\$82	\$50	0.305	\$25	\$15
2044	\$7.70	7,930	\$0.061	\$0.0359	1,386	\$85	\$50	0.290	\$25	\$14

Validation: Present Value	\$771	\$771
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Table 18. Calculation of inflation-adjusted VOS

Year	Discount Factor	PV Production	Escallation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1563	1.000	\$0.114	\$179	\$0.0934	145.932
2021	0.940	1555	1.022	\$0.114	\$167	\$0.0954	139.564
2022	0.884	1547	1.045	\$0.114	\$156	\$0.0976	133.474
2023	0.831	1540	1.068	\$0.114	\$146	\$0.0998	127.650
2024	0.781	1532	1.092	\$0.114	\$137	\$0.1020	122.080
2025	0.735	1524	1.117	\$0.114	\$128	\$0.1043	116.753
2026	0.691	1517	1.141	\$0.114	\$120	\$0.1066	111.658
2027	0.649	1509	1.167	\$0.114	\$112	\$0.1090	106.786
2028	0.611	1502	1.193	\$0.114	\$105	\$0.1114	102.126
2029	0.574	1494	1.220	\$0.114	\$98	\$0.1139	97.670
2030	0.540	1487	1.247	\$0.114	\$92	\$0.1164	93.408
2031	0.508	1479	1.275	\$0.114	\$86	\$0.1190	89.332
2032	0.477	1472	1.303	\$0.114	\$80	\$0.1217	85.434
2033	0.449	1464	1.332	\$0.114	\$75	\$0.1244	81.706
2034	0.422	1457	1.362	\$0.114	\$70	\$0.1271	78.140
2035	0.397	1450	1.392	\$0.114	\$66	\$0.1300	74.731
2036	0.397	1443	1.423	\$0.114	\$65	\$0.1329	76.015
2037	0.351	1435	1.455	\$0.114	\$58	\$0.1358	68.351
2038	0.330	1428	1.487	\$0.114	\$54	\$0.1389	65.368
2039	0.310	1421	1.521	\$0.114	\$50	\$0.1420	62.516
2040	0.291	1414	1.554	\$0.114	\$47	\$0.1451	59.788
2041	0.274	1407	1.589	\$0.114	\$44	\$0.1484	57.179
2042	0.258	1400	1.625	\$0.114	\$41	\$0.1517	54.684
2043	0.242	1393	1.661	\$0.114	\$39	\$0.1551	52.298
2044	0.228	1386	1.698	\$0.114	\$36	\$0.1585	50.016
					\$2,253		\$2,253

VOS Distribution Capacity Cost per kW

(A) System actual cost per KWH

Year	New Dist. Capacity	Capital Cost - Capacity projects
	(MW)	(\$M)
2017	43.3	\$10.270
2018	26.0	\$7.812
2019	72.8	\$5.862
2020	71.0	\$15.380
2021	75.9	\$16.000
Total	289.0	\$55.324
Cost per kW		\$191.43

Line			
1	Full Project Deferral		100%
2	Deferral Reduction Factor		20%
3	Deferral Reduction		80% (1 - 2)
4	Distibution Capacity Cost per kW	<u>\$191.43</u>	
5	Avoided Distibution Capacity Cost per kW	\$153.15	(3 x 4)

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Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value

CURRENT POSITION	Economic Value (\$/kWh)	Load Match (No Losses) (%)	Distributed Loss Savings (%)	Distributed PV Value (\$/kWh)
<i>25 Year Levelized Values</i>				
Avoided Fuel Cost	\$0.0274		9.8%	\$0.0301
Avoided Plant O&M - Fixed	\$0.0027	48.6%	10.8%	\$0.0014
Avoided Plant O&M - Variable	\$0.0012		9.8%	\$0.0014
Avoided Generation Capacity Cost	\$0.0367	48.6%	10.8%	\$0.0197
Avoided Reserve Capacity Cost	\$0.0029	48.6%	10.8%	\$0.0016
Avoided Transmission Capacity Cos	\$0.0325	48.6%	10.8%	\$0.0175
Avoided Distribution Capacity Cost	\$0.0061	54.6%	12.4%	\$0.0037
Avoided Environmental Cost	\$0.0359		9.8%	\$0.0394
Avoided Voltage Control Cost				
<u>Solar Integration Cost</u>				
TOTAL				\$0.1148

Figure ES-2. 1st-Year VOS Rate calculation

Year	Discount Factor	Escalation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1.000	\$0.115	\$0.115	\$0.0937	0.094
2021	0.940	1.022	\$0.115	\$0.108	\$0.0958	0.090
2022	0.884	1.045	\$0.115	\$0.101	\$0.0979	0.087
2023	0.831	1.068	\$0.115	\$0.095	\$0.1001	0.083
2024	0.781	1.092	\$0.115	\$0.090	\$0.1023	0.080
2025	0.735	1.117	\$0.115	\$0.084	\$0.1046	0.077
2026	0.691	1.141	\$0.115	\$0.079	\$0.1069	0.074
2027	0.649	1.167	\$0.115	\$0.075	\$0.1093	0.071
2028	0.611	1.193	\$0.115	\$0.070	\$0.1118	0.068
2029	0.574	1.220	\$0.115	\$0.066	\$0.1143	0.066
2030	0.540	1.247	\$0.115	\$0.062	\$0.1168	0.063
2031	0.508	1.275	\$0.115	\$0.058	\$0.1194	0.061
2032	0.477	1.303	\$0.115	\$0.055	\$0.1221	0.058
2033	0.449	1.332	\$0.115	\$0.052	\$0.1248	0.056
2034	0.422	1.362	\$0.115	\$0.048	\$0.1276	0.054
2035	0.397	1.392	\$0.115	\$0.046	\$0.1304	0.052
2036	0.397	1.423	\$0.115	\$0.046	\$0.1333	0.053
2037	0.351	1.455	\$0.115	\$0.040	\$0.1363	0.048
2038	0.330	1.487	\$0.115	\$0.038	\$0.1394	0.046
2039	0.310	1.521	\$0.115	\$0.036	\$0.1425	0.044
2040	0.291	1.554	\$0.115	\$0.033	\$0.1456	0.042
2041	0.274	1.589	\$0.115	\$0.031	\$0.1489	0.041
2042	0.258	1.625	\$0.115	\$0.030	\$0.1522	0.039
2043	0.242	1.661	\$0.115	\$0.028	\$0.1556	0.038
2044	0.228	1.698	\$0.115	\$0.026	\$0.1591	0.036
				\$1.512		\$1.520

Table 3. Fixed Assumptions to be used for the VOS calculations

Fuel Prices			Environmental Externalities		
Guaranteed NG Fuel Prices			Environmental Discount Rate	5.30%	per year
2020	\$2.671	\$/mmBtu	Environmental Costs	separate table	
2021	\$2.639	\$/mmBtu	Economic Assumptions		
2022	\$2.645	\$/mmBtu	General Escalation Rate	2.23%	per year
2023	\$2.720	\$/mmBtu	Treasury Yields		
2024	\$2.823	\$/mmBtu	1 Year	2.17%	
2025	\$2.935	\$/mmBtu	2 Year	2.05%	
2026	\$3.047	\$/mmBtu	3 Year	2.01%	
2027	\$3.159	\$/mmBtu	5 Year	2.04%	
2028	\$3.271	\$/mmBtu	7 Year	2.14%	
2029	\$3.380	\$/mmBtu	10 Year	2.25%	
2030	\$3.490	\$/mmBtu	20 Year	2.49%	
2031	\$3.596	\$/mmBtu	30 Year	2.68%	
Fuel Price Escalation	2.23%				
PV Assumptions					
PV Degradation Rate	0.50%				
PV Life	25				

Table 4. Environmental costs by year.

Year	Analysis Year	CO2 Cost \$/mmBtu	PM 2.5 Cost \$/mmBtu	CO Cost \$/mmBtu	NOx Cost \$/mmBtu	Pb Cost \$/mmBtu	SO2 Cost \$/mmBtu	Total Cost \$/mmBtu
2020	0	\$2.807	\$0.021	\$0.000	\$0.286	\$0.000	\$0.004	\$3.117
2021	1	\$2.924	\$0.021	\$0.000	\$0.292	\$0.000	\$0.004	\$3.241
2022	2	\$3.045	\$0.021	\$0.000	\$0.299	\$0.000	\$0.004	\$3.369
2023	3	\$3.170	\$0.022	\$0.000	\$0.305	\$0.000	\$0.004	\$3.502
2024	4	\$3.299	\$0.022	\$0.000	\$0.312	\$0.000	\$0.004	\$3.638
2025	5	\$3.433	\$0.023	\$0.000	\$0.319	\$0.000	\$0.004	\$3.779
2026	6	\$3.570	\$0.023	\$0.000	\$0.326	\$0.000	\$0.004	\$3.924
2027	7	\$3.712	\$0.024	\$0.000	\$0.334	\$0.000	\$0.004	\$4.074
2028	8	\$3.859	\$0.025	\$0.000	\$0.341	\$0.000	\$0.004	\$4.229
2029	9	\$4.010	\$0.025	\$0.000	\$0.349	\$0.000	\$0.004	\$4.388
2030	10	\$4.166	\$0.026	\$0.000	\$0.356	\$0.000	\$0.004	\$4.553
2031	11	\$4.344	\$0.026	\$0.000	\$0.364	\$0.000	\$0.004	\$4.740
2032	12	\$4.528	\$0.027	\$0.000	\$0.373	\$0.000	\$0.005	\$4.932
2033	13	\$4.718	\$0.027	\$0.000	\$0.381	\$0.000	\$0.005	\$5.131
2034	14	\$4.915	\$0.028	\$0.000	\$0.389	\$0.000	\$0.005	\$5.337
2035	15	\$5.117	\$0.029	\$0.000	\$0.398	\$0.000	\$0.005	\$5.549
2036	16	\$5.326	\$0.029	\$0.000	\$0.407	\$0.000	\$0.005	\$5.768
2037	17	\$5.542	\$0.030	\$0.000	\$0.416	\$0.000	\$0.005	\$5.993
2038	18	\$5.765	\$0.031	\$0.000	\$0.425	\$0.000	\$0.005	\$6.227
2039	19	\$5.996	\$0.031	\$0.000	\$0.435	\$0.000	\$0.005	\$6.467
2040	20	\$6.233	\$0.032	\$0.000	\$0.444	\$0.000	\$0.005	\$6.715
2041	21	\$6.457	\$0.033	\$0.000	\$0.454	\$0.000	\$0.006	\$6.950
2042	22	\$6.688	\$0.033	\$0.000	\$0.464	\$0.000	\$0.006	\$7.192
2043	23	\$6.926	\$0.034	\$0.000	\$0.475	\$0.000	\$0.006	\$7.441
2044	24	\$7.171	\$0.035	\$0.000	\$0.485	\$0.000	\$0.006	\$7.698

Table 5. VOS Data table -- required format showing assumptions used in the VOS calculation.

	Input Data	Units		Input Data	Units
Economic Factors			Power Generation - Continued		
Start Year for VOS applicability	2020	Year	Other		
Discount Rate (After-tax WACC)	6.36%	Percentage	Solar weighted Heat Rate	7,742	BTU per kWh
Load Match Analysis			Fuel Price Overhead	\$0.004	\$ per MMBtu
ELCC (no loss)	48.6%	% of rating	Generation life	40	years
PLR (no loss)	54.6%	% of rating	Heat Rate degradation	0.10%	per year
Loss Savings - Energy	9.8%	% of PV output	O&M cost (first year) - Fixed	\$3.42	per kW-yr
Loss Savings - PLR	12.4%	% of PV output	O&M cost (first year) - Variable	\$0.0010	\$ per kWh
Loss Savings - ELCC	10.8%	% of PV output	O&M cost escalation rate	2.00%	per year
			Reserve planning margin	7.9%	
			Years until new Generation is needed	0	
PV Energy			Distribution		
Simulated - First year annual energy	1,452	kWh per kW-AC	Capacity-related distribution capital costs -System	\$96	\$ per kW
year annual energy		kWh per kW-AC	Capacity-related distribution capital costs - Mpls	N/A	\$ per kW
Actual- First year annual energy	1,563		Capacity-related distribution capital costs - Mtka	N/A	\$ per kW
			Capacity-related distribution capital costs -Edina	N/A	\$ per kW
Transmission			Capacity-related distribution capital costs - SE	N/A	\$ per kW
Capacity-related transmission capital cost	\$50.33	\$ per kW	Capacity-related distribution capital costs -MG	N/A	\$ per kW
Power Generation			Capacity-related distribution capital costs - Newport	N/A	\$ per kW
Peaking CT, simple cycle			Capacity-related distribution capital costs - St. Paul	N/A	\$ per kW
Installed Cost	\$476	\$/kW	Capacity-related distribution capital costs - NW	N/A	\$ per kW
Heat Rate	9,738	BTU/kWh	Capacity-related distribution capital costs - WBL	N/A	\$ per kW
Intermediate CCGT			Distribution capital cost escalation	2.00%	per year
Installed Cost	\$1,022	\$/kW	Peak Load (Weather Normalized)	6,420	MW
Heat Rate	6,547	BTU/kWh	Peak Load Growth	0.43%	per year

Table 6. Azimuth and Tilt Angles

	Array KW	% of Total	Azimuth	Tilt	
1	3,209	4.9%	52	25	
2	2,974	4.5%	140	21	
3	2,906	4.4%	167	19	
4	18,979	28.9%	180	12	
5	3,939	6.0%	180	21	
6	7,997	12.2%	180	26	
7	6,676	10.2%	180	30	
8	3,296	5.0%	180	35	
9	947	1.4%	180	42	
10	5,453	8.3%	180	48	
11	2,769	4.2%	184	19	
12	964	1.5%	197	26	
13	2,816	4.3%	212	18	
14	1,207	1.8%	237	24	
15	1,577	2.4%	271	22	
TOTAL	65,709	100%	176.4	23.2	Weighted Average

Table 8. Economic Value of Avoided Fuel Costs.

Year				Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Utility	VOS		Utility	VOS		Utility	VOS
	\$/mmBtu	\$/mmBtu	mmBtu/kWh	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$2.67	\$2.67	7,742	\$0.021	\$0.0274	1,563	\$32	\$43	1.000	\$32	\$43
2021	\$2.64	\$2.64	7,750	\$0.020	\$0.0274	1,555	\$32	\$43	0.979	\$31	\$42
2022	\$2.64	\$2.65	7,757	\$0.021	\$0.0274	1,547	\$32	\$42	0.960	\$31	\$41
2023	\$2.72	\$2.72	7,765	\$0.021	\$0.0274	1,540	\$33	\$42	0.942	\$31	\$40
2024	\$2.82	\$2.83	7,773	\$0.022	\$0.0274	1,532	\$34	\$42	0.923	\$31	\$39
2025	\$2.93	\$2.94	7,781	\$0.023	\$0.0274	1,524	\$35	\$42	0.904	\$32	\$38
2026	\$3.05	\$3.05	7,789	\$0.024	\$0.0274	1,517	\$36	\$42	0.883	\$32	\$37
2027	\$3.16	\$3.16	7,796	\$0.025	\$0.0274	1,509	\$37	\$41	0.863	\$32	\$36
2028	\$3.27	\$3.28	7,804	\$0.026	\$0.0274	1,502	\$38	\$41	0.842	\$32	\$35
2029	\$3.38	\$3.38	7,812	\$0.026	\$0.0274	1,494	\$40	\$41	0.822	\$32	\$34
2030	\$3.49	\$3.49	7,820	\$0.027	\$0.0274	1,487	\$41	\$41	0.801	\$33	\$33
2031	\$3.60	\$3.60	7,828	\$0.028	\$0.0274	1,479	\$42	\$41	0.781	\$33	\$32
2032	\$3.68	\$3.68	7,835	\$0.029	\$0.0274	1,472	\$42	\$40	0.762	\$32	\$31
2033	\$3.76	\$3.76	7,843	\$0.030	\$0.0274	1,464	\$43	\$40	0.742	\$32	\$30
2034	\$3.84	\$3.85	7,851	\$0.030	\$0.0274	1,457	\$44	\$40	0.723	\$32	\$29
2035	\$3.93	\$3.93	7,859	\$0.031	\$0.0274	1,450	\$45	\$40	0.704	\$32	\$28
2036	\$4.01	\$4.02	7,867	\$0.032	\$0.0274	1,443	\$46	\$40	0.685	\$31	\$27
2037	\$4.10	\$4.11	7,875	\$0.032	\$0.0274	1,435	\$46	\$39	0.666	\$31	\$26
2038	\$4.20	\$4.20	7,883	\$0.033	\$0.0274	1,428	\$47	\$39	0.648	\$31	\$25
2039	\$4.29	\$4.30	7,890	\$0.034	\$0.0274	1,421	\$48	\$39	0.629	\$30	\$25
2040	\$4.39	\$4.39	7,898	\$0.035	\$0.0274	1,414	\$49	\$39	0.611	\$30	\$24
2041	\$4.48	\$4.49	7,906	\$0.035	\$0.0274	1,407	\$50	\$39	0.594	\$30	\$23
2042	\$4.58	\$4.59	7,914	\$0.036	\$0.0274	1,400	\$51	\$38	0.577	\$29	\$22
2043	\$4.69	\$4.69	7,922	\$0.037	\$0.0274	1,393	\$52	\$38	0.561	\$29	\$21
2044	\$4.79	\$4.80	7,930	\$0.038	\$0.0274	1,386	\$53	\$38	0.544	\$29	\$21

Validation: Present Value	\$779	\$779
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Table 9. Economic value of avoided plant O&M - fixed

Year	O&M Fixed	Utility Capacity	PV Capacity	Prices		p.u. PV Production	Costs		Discount Factor	Disc. Costs	
				Utility	VOS		Utility	VOS		Utility	VOS
				\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$3.42	1.00	1.00	\$0.0022	\$0.0027	1,563	\$3.42	\$4.14	1.000	\$3.42	\$4.14
2021	\$3.49	0.999	0.995	\$0.0022	\$0.0027	1,555	\$3.48	\$4.12	0.940	\$3.27	\$3.88
2022	\$3.56	0.998	0.990	\$0.0023	\$0.0027	1,547	\$3.53	\$4.10	0.884	\$3.12	\$3.63
2023	\$3.63	0.997	0.985	\$0.0024	\$0.0027	1,540	\$3.59	\$4.08	0.831	\$2.98	\$3.39
2024	\$3.71	0.996	0.980	\$0.0024	\$0.0027	1,532	\$3.65	\$4.06	0.781	\$2.85	\$3.17
2025	\$3.78	0.995	0.975	\$0.0025	\$0.0027	1,524	\$3.71	\$4.04	0.735	\$2.72	\$2.97
2026	\$3.86	0.994	0.970	\$0.0025	\$0.0027	1,517	\$3.76	\$4.02	0.691	\$2.60	\$2.78
2027	\$3.93	0.993	0.966	\$0.0026	\$0.0027	1,509	\$3.82	\$4.00	0.649	\$2.48	\$2.60
2028	\$4.01	0.992	0.961	\$0.0027	\$0.0027	1,502	\$3.89	\$3.98	0.611	\$2.37	\$2.43
2029	\$4.09	0.991	0.956	\$0.0027	\$0.0027	1,494	\$3.95	\$3.96	0.574	\$2.27	\$2.27
2030	\$4.17	0.990	0.951	\$0.0028	\$0.0027	1,487	\$4.01	\$3.94	0.540	\$2.16	\$2.13
2031	\$4.26	0.989	0.946	\$0.0028	\$0.0027	1,479	\$4.07	\$3.92	0.508	\$2.07	\$1.99
2032	\$4.34	0.988	0.942	\$0.0029	\$0.0027	1,472	\$4.14	\$3.90	0.477	\$1.97	\$1.86
2033	\$4.43	0.987	0.937	\$0.0030	\$0.0027	1,464	\$4.20	\$3.88	0.449	\$1.89	\$1.74
2034	\$4.52	0.986	0.932	\$0.0031	\$0.0027	1,457	\$4.27	\$3.86	0.422	\$1.80	\$1.63
2035	\$4.52	0.985	0.928	\$0.0031	\$0.0027	1,450	\$4.25	\$3.84	0.397	\$1.69	\$1.52
2036	\$4.70	0.984	0.923	\$0.0032	\$0.0027	1,443	\$4.41	\$3.82	0.397	\$1.75	\$1.52
2037	\$4.79	0.983	0.918	\$0.0033	\$0.0027	1,435	\$4.48	\$3.80	0.351	\$1.57	\$1.33
2038	\$4.89	0.982	0.914	\$0.0034	\$0.0027	1,428	\$4.55	\$3.78	0.330	\$1.50	\$1.25
2039	\$4.99	0.981	0.909	\$0.0034	\$0.0027	1,421	\$4.62	\$3.77	0.310	\$1.43	\$1.17
2040	\$5.09	0.980	0.905	\$0.0035	\$0.0027	1,414	\$4.70	\$3.75	0.291	\$1.37	\$1.09
2041	\$5.19	0.979	0.900	\$0.0036	\$0.0027	1,407	\$4.77	\$3.73	0.274	\$1.31	\$1.02
2042	\$5.29	0.978	0.896	\$0.0037	\$0.0027	1,400	\$4.85	\$3.71	0.258	\$1.25	\$0.96
2043	\$5.40	0.977	0.891	\$0.0038	\$0.0027	1,393	\$4.92	\$3.69	0.242	\$1.19	\$0.89
2044	\$5.51	0.976	0.887	\$0.0039	\$0.0027	1,386	\$5.00	\$3.67	0.228	\$1.14	\$0.84

\$0.0027

Validation: Present Value	\$52	\$52
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Table 10. Economic value of avoided plant O&M - variable

Year	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$0.0010	\$0.0012	1,563	\$2	\$2	1.000	\$2	\$2
2021	\$0.0011	\$0.0012	1,555	\$2	\$2	0.940	\$2	\$2
2022	\$0.0011	\$0.0012	1,547	\$2	\$2	0.884	\$1	\$2
2023	\$0.0011	\$0.0012	1,540	\$2	\$2	0.831	\$1	\$2
2024	\$0.0011	\$0.0012	1,532	\$2	\$2	0.781	\$1	\$1
2025	\$0.0011	\$0.0012	1,524	\$2	\$2	0.735	\$1	\$1
2026	\$0.0012	\$0.0012	1,517	\$2	\$2	0.691	\$1	\$1
2027	\$0.0012	\$0.0012	1,509	\$2	\$2	0.649	\$1	\$1
2028	\$0.0012	\$0.0012	1,502	\$2	\$2	0.611	\$1	\$1
2029	\$0.0012	\$0.0012	1,494	\$2	\$2	0.574	\$1	\$1
2030	\$0.0013	\$0.0012	1,487	\$2	\$2	0.540	\$1	\$1
2031	\$0.0013	\$0.0012	1,479	\$2	\$2	0.508	\$1	\$1
2032	\$0.0013	\$0.0012	1,472	\$2	\$2	0.477	\$1	\$1
2033	\$0.0013	\$0.0012	1,464	\$2	\$2	0.449	\$1	\$1
2034	\$0.0014	\$0.0012	1,457	\$2	\$2	0.422	\$1	\$1
2035	\$0.0014	\$0.0012	1,450	\$2	\$2	0.397	\$1	\$1
2036	\$0.0014	\$0.0012	1,443	\$2	\$2	0.373	\$1	\$1
2037	\$0.0014	\$0.0012	1,435	\$2	\$2	0.351	\$1	\$1
2038	\$0.0015	\$0.0012	1,428	\$2	\$2	0.330	\$1	\$1
2039	\$0.0015	\$0.0012	1,421	\$2	\$2	0.310	\$1	\$1
2040	\$0.0015	\$0.0012	1,414	\$2	\$2	0.291	\$1	\$1
2041	\$0.0016	\$0.0012	1,407	\$2	\$2	0.274	\$1	\$0
2042	\$0.0016	\$0.0012	1,400	\$2	\$2	0.258	\$1	\$0
2043	\$0.0016	\$0.0012	1,393	\$2	\$2	0.242	\$1	\$0
2044	\$0.0017	\$0.0012	1,386	\$2	\$2	0.228	\$1	\$0
Validation: Present Value							\$24	\$24

Table 11. Economic value of avoided generation capacity cost.

Year				Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	Capacity Cost	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$57	1.00	1.00	\$0.036	\$0.0367	1,563	\$57	\$57	1.000	\$57	\$57
2021	\$57	0.999	0.995	\$0.036	\$0.0367	1,555	\$57	\$57	0.940	\$53	\$54
2022	\$57	0.998	0.990	\$0.036	\$0.0367	1,547	\$56	\$57	0.884	\$50	\$50
2023	\$57	0.997	0.985	\$0.036	\$0.0367	1,540	\$56	\$56	0.831	\$47	\$47
2024	\$57	0.996	0.980	\$0.036	\$0.0367	1,532	\$56	\$56	0.781	\$44	\$44
2025	\$57	0.995	0.975	\$0.037	\$0.0367	1,524	\$56	\$56	0.735	\$41	\$41
2026	\$57	0.994	0.970	\$0.037	\$0.0367	1,517	\$55	\$56	0.691	\$38	\$38
2027	\$57	0.993	0.966	\$0.037	\$0.0367	1,509	\$55	\$55	0.649	\$36	\$36
2028	\$57	0.992	0.961	\$0.037	\$0.0367	1,502	\$55	\$55	0.611	\$34	\$34
2029	\$57	0.991	0.956	\$0.037	\$0.0367	1,494	\$55	\$55	0.574	\$31	\$31
2030	\$57	0.990	0.951	\$0.037	\$0.0367	1,487	\$55	\$55	0.540	\$29	\$29
2031	\$57	0.989	0.946	\$0.037	\$0.0367	1,479	\$54	\$54	0.508	\$28	\$28
2032	\$57	0.988	0.942	\$0.037	\$0.0367	1,472	\$54	\$54	0.477	\$26	\$26
2033	\$57	0.987	0.937	\$0.037	\$0.0367	1,464	\$54	\$54	0.449	\$24	\$24
2034	\$57	0.986	0.932	\$0.037	\$0.0367	1,457	\$54	\$53	0.422	\$23	\$23
2035	\$57	0.985	0.928	\$0.037	\$0.0367	1,450	\$53	\$53	0.397	\$21	\$21
2036	\$57	0.984	0.923	\$0.037	\$0.0367	1,443	\$53	\$53	0.373	\$20	\$20
2037	\$57	0.983	0.918	\$0.037	\$0.0367	1,435	\$53	\$53	0.351	\$19	\$18
2038	\$57	0.982	0.914	\$0.037	\$0.0367	1,428	\$53	\$52	0.330	\$17	\$17
2039	\$57	0.981	0.909	\$0.037	\$0.0367	1,421	\$53	\$52	0.310	\$16	\$16
2040	\$57	0.980	0.905	\$0.037	\$0.0367	1,414	\$52	\$52	0.291	\$15	\$15
2041	\$57	0.979	0.900	\$0.037	\$0.0367	1,407	\$52	\$52	0.274	\$14	\$14
2042	\$57	0.978	0.896	\$0.037	\$0.0367	1,400	\$52	\$51	0.258	\$13	\$13
2043	\$57	0.977	0.891	\$0.037	\$0.0367	1,393	\$52	\$51	0.242	\$13	\$12
2044	\$57	0.976	0.887	\$0.037	\$0.0367	1,386	\$52	\$51	0.228	\$12	\$12
					\$0.0367						
Validation: Present Value										\$721	\$721

Table 12. Economic value of avoided reserve capacity cost.

Year					Prices					Disc. Costs		
	Capacity Cost	Reserve Margin	Utility Capacity	PV Capacity	Utility	VOS	PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/kW-yr	%	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$57	7.9%	1.00	1.00	\$0.003	\$0.0029	1,563	\$4	\$5	1.000	\$4	\$5
2021	\$57	7.9%	0.999	0.995	\$0.003	\$0.0029	1,555	\$4	\$5	0.940	\$4	\$4
2022	\$57	7.9%	0.998	0.990	\$0.003	\$0.0029	1,547	\$4	\$4	0.884	\$4	\$4
2023	\$57	7.9%	0.997	0.985	\$0.003	\$0.0029	1,540	\$4	\$4	0.831	\$4	\$4
2024	\$57	7.9%	0.996	0.980	\$0.003	\$0.0029	1,532	\$4	\$4	0.781	\$3	\$3
2025	\$57	7.9%	0.995	0.975	\$0.003	\$0.0029	1,524	\$4	\$4	0.735	\$3	\$3
2026	\$57	7.9%	0.994	0.970	\$0.003	\$0.0029	1,517	\$4	\$4	0.691	\$3	\$3
2027	\$57	7.9%	0.993	0.966	\$0.003	\$0.0029	1,509	\$4	\$4	0.649	\$3	\$3
2028	\$57	7.9%	0.992	0.961	\$0.003	\$0.0029	1,502	\$4	\$4	0.611	\$3	\$3
2029	\$57	7.9%	0.991	0.956	\$0.003	\$0.0029	1,494	\$4	\$4	0.574	\$2	\$2
2030	\$57	7.9%	0.990	0.951	\$0.003	\$0.0029	1,487	\$4	\$4	0.540	\$2	\$2
2031	\$57	7.9%	0.989	0.946	\$0.003	\$0.0029	1,479	\$4	\$4	0.508	\$2	\$2
2032	\$57	7.9%	0.988	0.942	\$0.003	\$0.0029	1,472	\$4	\$4	0.477	\$2	\$2
2033	\$57	7.9%	0.987	0.937	\$0.003	\$0.0029	1,464	\$4	\$4	0.449	\$2	\$2
2034	\$57	7.9%	0.986	0.932	\$0.003	\$0.0029	1,457	\$4	\$4	0.422	\$2	\$2
2035	\$57	7.9%	0.985	0.928	\$0.003	\$0.0029	1,450	\$4	\$4	0.397	\$2	\$2
2036	\$57	7.9%	0.984	0.923	\$0.003	\$0.0029	1,443	\$4	\$4	0.373	\$2	\$2
2037	\$57	7.9%	0.983	0.918	\$0.003	\$0.0029	1,435	\$4	\$4	0.351	\$1	\$1
2038	\$57	7.9%	0.982	0.914	\$0.003	\$0.0029	1,428	\$4	\$4	0.330	\$1	\$1
2039	\$57	7.9%	0.981	0.909	\$0.003	\$0.0029	1,421	\$4	\$4	0.310	\$1	\$1
2040	\$57	7.9%	0.980	0.905	\$0.003	\$0.0029	1,414	\$4	\$4	0.291	\$1	\$1
2041	\$57	7.9%	0.979	0.900	\$0.003	\$0.0029	1,407	\$4	\$4	0.274	\$1	\$1
2042	\$57	7.9%	0.978	0.896	\$0.003	\$0.0029	1,400	\$4	\$4	0.258	\$1	\$1
2043	\$57	7.9%	0.977	0.891	\$0.003	\$0.0029	1,393	\$4	\$4	0.242	\$1	\$1
2044	\$57	7.9%	0.976	0.887	\$0.003	\$0.0029	1,386	\$4	\$4	0.228	\$1	\$1

\$0.0029

Validation: Present Value	\$57	\$57
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Table 13. Economic value of avoided transmission capacity cost.

Year				Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	Capacity Cost	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$50	1.00	1.00	\$0.032	\$0.0325	1,563	\$50	\$51	1.000	\$50	\$51
2021	\$50	0.999	0.995	\$0.032	\$0.0325	1,555	\$50	\$51	0.940	\$47	\$47
2022	\$50	0.998	0.990	\$0.032	\$0.0325	1,547	\$50	\$50	0.884	\$44	\$44
2023	\$50	0.997	0.985	\$0.032	\$0.0325	1,540	\$50	\$50	0.831	\$41	\$42
2024	\$50	0.996	0.980	\$0.032	\$0.0325	1,532	\$50	\$50	0.781	\$39	\$39
2025	\$50	0.995	0.975	\$0.032	\$0.0325	1,524	\$49	\$50	0.735	\$36	\$36
2026	\$50	0.994	0.970	\$0.032	\$0.0325	1,517	\$49	\$49	0.691	\$34	\$34
2027	\$50	0.993	0.966	\$0.032	\$0.0325	1,509	\$49	\$49	0.649	\$32	\$32
2028	\$50	0.992	0.961	\$0.032	\$0.0325	1,502	\$49	\$49	0.611	\$30	\$30
2029	\$50	0.991	0.956	\$0.032	\$0.0325	1,494	\$49	\$49	0.574	\$28	\$28
2030	\$50	0.990	0.951	\$0.033	\$0.0325	1,487	\$48	\$48	0.540	\$26	\$26
2031	\$50	0.989	0.946	\$0.033	\$0.0325	1,479	\$48	\$48	0.508	\$24	\$24
2032	\$50	0.988	0.942	\$0.033	\$0.0325	1,472	\$48	\$48	0.477	\$23	\$23
2033	\$50	0.987	0.937	\$0.033	\$0.0325	1,464	\$48	\$48	0.449	\$21	\$21
2034	\$50	0.986	0.932	\$0.033	\$0.0325	1,457	\$48	\$47	0.422	\$20	\$20
2035	\$50	0.985	0.928	\$0.033	\$0.0325	1,450	\$47	\$47	0.397	\$19	\$19
2036	\$50	0.984	0.923	\$0.033	\$0.0325	1,443	\$47	\$47	0.373	\$18	\$17
2037	\$50	0.983	0.918	\$0.033	\$0.0325	1,435	\$47	\$47	0.351	\$16	\$16
2038	\$50	0.982	0.914	\$0.033	\$0.0325	1,428	\$47	\$46	0.330	\$15	\$15
2039	\$50	0.981	0.909	\$0.033	\$0.0325	1,421	\$47	\$46	0.310	\$14	\$14
2040	\$50	0.980	0.905	\$0.033	\$0.0325	1,414	\$46	\$46	0.291	\$14	\$13
2041	\$50	0.979	0.900	\$0.033	\$0.0325	1,407	\$46	\$46	0.274	\$13	\$13
2042	\$50	0.978	0.896	\$0.033	\$0.0325	1,400	\$46	\$45	0.258	\$12	\$12
2043	\$50	0.977	0.891	\$0.033	\$0.0325	1,393	\$46	\$45	0.242	\$11	\$11
2044	\$50	0.976	0.887	\$0.033	\$0.0325	1,386	\$46	\$45	0.228	\$10	\$10
					\$0.0325						
Validation: Present Value										\$639	\$639

Table 14. Determination of deferrable distribution costs.

Year	Distribution Project Costs	% Capacity Related	Capacity Related		
	\$	%	\$		
2018	175,490,525	4.5%	7,812,185		
2017	155,018,178	6.6%	10,270,204		
2016	165,929,956	9.6%	15,936,132		
2015	134,867,264	12.1%	16,309,114		
2014	129,899,465	16.3%	21,147,768		
2013	142,118,822	20.3%	28,825,462		
2012	109,286,058	20.8%	22,683,879		
2011	100,102,075	7.5%	7,502,291		
2010	98,267,667	11.0%	10,823,959		
2009	82,821,606	10.6%	8,749,417		
TOTAL 10-YEAR PERIOD	1,293,801,616		150,060,411		

Table 15. Economic value of avoided distribution capacity cost.

Year	Conventional Distribution Planning					Deferred Distribution Planning			
	Distribution Cost	New Dist. Capacity	Capital Cost	Disc Capital Cost	Amortized	Def. Dist. Capacity	Def. Capital Cost	Disc Capital Cost	Amortized
	\$/kW-yr	(MW)	(\$M)	(\$M)	\$/yr	(MW)	(\$M)	(\$M)	\$/yr
2020	\$172	50	\$9	\$9	\$12				\$11
2021	\$176	50	\$9	\$8	\$12	50	\$8.8	\$8.3	\$11
2022	\$179	50	\$9	\$8	\$12	50	\$9.0	\$8.0	\$11
2023	\$183	51	\$9	\$8	\$12	50	\$9.2	\$7.7	\$11
2024	\$186	51	\$9	\$7	\$12	51	\$9.4	\$7.4	\$11
2025	\$190	51	\$10	\$7	\$12	51	\$9.7	\$7.1	\$11
2026	\$194	51	\$10	\$7	\$12	51	\$9.9	\$6.8	\$11
2027	\$198	52	\$10	\$7	\$12	51	\$10.2	\$6.6	\$11
2028	\$202	52	\$10	\$6	\$12	52	\$10.4	\$6.4	\$11
2029	\$206	52	\$11	\$6	\$12	52	\$10.7	\$6.1	\$11
2030	\$210	52	\$11	\$6	\$12	52	\$10.9	\$5.9	\$11
2031	\$214	52	\$11	\$6	\$12	52	\$11.2	\$5.7	\$11
2032	\$219	53	\$11	\$5	\$12	52	\$11.5	\$5.5	\$11
2033	\$223	53	\$12	\$5	\$12	53	\$11.7	\$5.3	\$11
2034	\$227	53	\$12	\$5	\$12	53	\$12.0	\$5.1	\$11
2035	\$232	53	\$12	\$5	\$12	53	\$12.3	\$4.9	\$11
2036	\$237	54	\$13	\$5	\$12	53	\$12.6	\$4.7	\$11
2037	\$241	54	\$13	\$5	\$12	54	\$12.9	\$4.5	\$11
2038	\$246	54	\$13	\$4	\$12	54	\$13.2	\$4.4	\$11
2039	\$251	54	\$14	\$4	\$12	54	\$13.6	\$4.2	\$11
2040	\$256	54	\$14	\$4	\$12	54	\$13.9	\$4.0	\$11
2041	\$261	55	\$14	\$4	\$12	54	\$14.2	\$3.9	\$11
2042	\$266	55	\$15	\$4	\$12	55	\$14.6	\$3.8	\$11
2043	\$272	55	\$15	\$4	\$12	55	\$14.9	\$3.6	\$11
2044	\$277	55	\$15	\$3	\$12	55	\$15.3	\$3.5	\$11
2039	\$283					55	\$15.7	\$3.4	
					\$142				\$136

Continued - Table 15. Economic value of avoided distribution capacity cost. *EXAMPLE*

Prices		PV Production	Costs		Discount Factor	Disc. Costs	
Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
\$0.00604	\$0.0061	1,563	\$9	\$10	1.000	\$9	\$10
\$0.00604	\$0.0061	1,555	\$9	\$9	0.940	\$9	\$9
\$0.00605	\$0.0061	1,547	\$9	\$9	0.884	\$8	\$8
\$0.00605	\$0.0061	1,540	\$9	\$9	0.831	\$8	\$8
\$0.00606	\$0.0061	1,532	\$9	\$9	0.781	\$7	\$7
\$0.00606	\$0.0061	1,524	\$9	\$9	0.735	\$7	\$7
\$0.00607	\$0.0061	1,517	\$9	\$9	0.691	\$6	\$6
\$0.00607	\$0.0061	1,509	\$9	\$9	0.649	\$6	\$6
\$0.00607	\$0.0061	1,502	\$9	\$9	0.611	\$6	\$6
\$0.00608	\$0.0061	1,494	\$9	\$9	0.574	\$5	\$5
\$0.00608	\$0.0061	1,487	\$9	\$9	0.540	\$5	\$5
\$0.00609	\$0.0061	1,479	\$9	\$9	0.508	\$5	\$5
\$0.00609	\$0.0061	1,472	\$9	\$9	0.477	\$4	\$4
\$0.00610	\$0.0061	1,464	\$9	\$9	0.449	\$4	\$4
\$0.00610	\$0.0061	1,457	\$9	\$9	0.422	\$4	\$4
\$0.00611	\$0.0061	1,450	\$9	\$9	0.397	\$4	\$3
\$0.00611	\$0.0061	1,443	\$9	\$9	0.373	\$3	\$3
\$0.00612	\$0.0061	1,435	\$9	\$9	0.351	\$3	\$3
\$0.00612	\$0.0061	1,428	\$9	\$9	0.330	\$3	\$3
\$0.00612	\$0.0061	1,421	\$9	\$9	0.310	\$3	\$3
\$0.00613	\$0.0061	1,414	\$9	\$9	0.291	\$3	\$3
\$0.00613	\$0.0061	1,407	\$9	\$9	0.274	\$2	\$2
\$0.00614	\$0.0061	1,400	\$9	\$9	0.258	\$2	\$2
\$0.00614	\$0.0061	1,393	\$9	\$8	0.242	\$2	\$2
\$0.00615	\$0.0061	1,386	\$9	\$8	0.228	\$2	\$2
					-		
	\$0.0061		Validation: Present Value			\$119	\$119

Table 17. Economic value of avoided environmental costs

Environmental Discount Rate 5.30%

Year	Env. Cost \$/mmBtu	Solar Weighted Heat Rate mmBtu/MWh	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
			Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
2020	\$3.12	7,742	\$0.024	\$0.0359	1,563	\$38	\$56	1.000	\$38	\$56
2021	\$3.24	7,750	\$0.025	\$0.0359	1,555	\$39	\$56	0.950	\$37	\$53
2022	\$3.37	7,757	\$0.026	\$0.0359	1,547	\$40	\$56	0.902	\$36	\$50
2023	\$3.50	7,765	\$0.027	\$0.0359	1,540	\$42	\$55	0.857	\$36	\$47
2024	\$3.64	7,773	\$0.028	\$0.0359	1,532	\$43	\$55	0.813	\$35	\$45
2025	\$3.78	7,781	\$0.029	\$0.0359	1,524	\$45	\$55	0.773	\$35	\$42
2026	\$3.92	7,789	\$0.031	\$0.0359	1,517	\$46	\$54	0.734	\$34	\$40
2027	\$4.07	7,796	\$0.032	\$0.0359	1,509	\$48	\$54	0.697	\$33	\$38
2028	\$4.23	7,804	\$0.033	\$0.0359	1,502	\$50	\$54	0.662	\$33	\$36
2029	\$4.39	7,812	\$0.034	\$0.0359	1,494	\$51	\$54	0.628	\$32	\$34
2030	\$4.55	7,820	\$0.036	\$0.0359	1,487	\$53	\$53	0.597	\$32	\$32
2031	\$4.74	7,828	\$0.037	\$0.0359	1,479	\$55	\$53	0.567	\$31	\$30
2032	\$4.93	7,835	\$0.039	\$0.0359	1,472	\$57	\$53	0.538	\$31	\$28
2033	\$5.13	7,843	\$0.040	\$0.0359	1,464	\$59	\$53	0.511	\$30	\$27
2034	\$5.34	7,851	\$0.042	\$0.0359	1,457	\$61	\$52	0.485	\$30	\$25
2035	\$5.55	7,859	\$0.044	\$0.0359	1,450	\$63	\$52	0.461	\$29	\$24
2036	\$5.77	7,867	\$0.045	\$0.0359	1,443	\$65	\$52	0.438	\$29	\$23
2037	\$5.99	7,875	\$0.047	\$0.0359	1,435	\$68	\$51	0.416	\$28	\$21
2038	\$6.23	7,883	\$0.049	\$0.0359	1,428	\$70	\$51	0.395	\$28	\$20
2039	\$6.47	7,890	\$0.051	\$0.0359	1,421	\$73	\$51	0.375	\$27	\$19
2040	\$6.72	7,898	\$0.053	\$0.0359	1,414	\$75	\$51	0.356	\$27	\$18
2041	\$6.95	7,906	\$0.055	\$0.0359	1,407	\$77	\$50	0.338	\$26	\$17
2042	\$7.19	7,914	\$0.057	\$0.0359	1,400	\$80	\$50	0.321	\$26	\$16
2043	\$7.44	7,922	\$0.059	\$0.0359	1,393	\$82	\$50	0.305	\$25	\$15
2044	\$7.70	7,930	\$0.061	\$0.0359	1,386	\$85	\$50	0.290	\$25	\$14

Validation: Present Value	\$771	\$771
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Table 18. Calculation of inflation-adjusted VOS

Year	Discount Factor	PV Production	Escallation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1563	1.000	\$0.115	\$179	\$0.0937	146.443
2021	0.940	1555	1.022	\$0.115	\$168	\$0.0958	140.052
2022	0.884	1547	1.045	\$0.115	\$157	\$0.0979	133.941
2023	0.831	1540	1.068	\$0.115	\$147	\$0.1001	128.096
2024	0.781	1532	1.092	\$0.115	\$137	\$0.1023	122.507
2025	0.735	1524	1.117	\$0.115	\$129	\$0.1046	117.161
2026	0.691	1517	1.141	\$0.115	\$120	\$0.1069	112.048
2027	0.649	1509	1.167	\$0.115	\$113	\$0.1093	107.159
2028	0.611	1502	1.193	\$0.115	\$105	\$0.1118	102.483
2029	0.574	1494	1.220	\$0.115	\$98	\$0.1143	98.011
2030	0.540	1487	1.247	\$0.115	\$92	\$0.1168	93.734
2031	0.508	1479	1.275	\$0.115	\$86	\$0.1194	89.644
2032	0.477	1472	1.303	\$0.115	\$81	\$0.1221	85.732
2033	0.449	1464	1.332	\$0.115	\$75	\$0.1248	81.991
2034	0.422	1457	1.362	\$0.115	\$71	\$0.1276	78.414
2035	0.397	1450	1.392	\$0.115	\$66	\$0.1304	74.992
2036	0.397	1443	1.423	\$0.115	\$66	\$0.1333	76.281
2037	0.351	1435	1.455	\$0.115	\$58	\$0.1363	68.590
2038	0.330	1428	1.487	\$0.115	\$54	\$0.1394	65.597
2039	0.310	1421	1.521	\$0.115	\$51	\$0.1425	62.735
2040	0.291	1414	1.554	\$0.115	\$47	\$0.1456	59.997
2041	0.274	1407	1.589	\$0.115	\$44	\$0.1489	57.379
2042	0.258	1400	1.625	\$0.115	\$41	\$0.1522	54.875
2043	0.242	1393	1.661	\$0.115	\$39	\$0.1556	52.481
2044	0.228	1386	1.698	\$0.115	\$36	\$0.1591	50.191
					\$2,261		\$2,261

VOS Distribution Capacity Cost per kW

(A) System actual cost per KWH

Year	New Dist. Capacity	Capital Cost - Capacity projects
	(MW)	(\$M)
2017	43.3	\$10.270
2018	26.0	\$7.812
2019	72.8	\$5.862
2020	71.0	\$15.380
2021	75.9	\$16.000
Total	289.0	\$55.324
Cost per kW		\$191.43

Line			
1	Full Project Deferral		100%
2	Deferral Reduction Factor		10%
3	Deferral Reduction		90% (1 - 2)
4	Distibution Capacity Cost per kW	<u>\$191.43</u>	
5	Avoided Distibution Capacity Cost per kW	\$172.29	(3 x 4)

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Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value - System Wide & Each Planning Area

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Table 13. Economic value of avoided transmission capacity cost.

Table 13. Economic value of avoided transmission capacity cost.

Table 14. Determination of deferrable costs.

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Table 17. Economic value of avoided environmental costs

Table 18. Calculation of the inflation-adjusted VOS

Note: Table 1, 2 and 16 were not included as they are not required for the VOS calculation. Table 7 (Losses to be considered) are included in Fig. ES-1

Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value

CURRENT POSITION	Economic Value (\$/kWh)	Load Match (No Losses) (%)	Distributed Loss Savings (%)	Distributed PV Value (\$/kWh)
<i>25 Year Levelized Values</i>				
Avoided Fuel Cost	\$0.0274		9.8%	\$0.0301
Avoided Plant O&M - Fixed	\$0.0027	48.6%	10.8%	\$0.0014
Avoided Plant O&M - Variable	\$0.0012		9.8%	\$0.0014
Avoided Generation Capacity Cost	\$0.0367	48.6%	10.8%	\$0.0197
Avoided Reserve Capacity Cost	\$0.0029	48.6%	10.8%	\$0.0016
Avoided Transmission Capacity Cos	\$0.0325	48.6%	10.8%	\$0.0175
Avoided Distribution Capacity Cost	\$0.0068	54.6%	12.4%	\$0.0041
Avoided Environmental Cost	\$0.0359		9.8%	\$0.0394
Avoided Voltage Control Cost				
<u>Solar Integration Cost</u>				
TOTAL				\$0.1152

Figure ES-2. 1st-Year VOS Rate calculation

Year	Discount Factor	Escalation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1.000	\$0.115	\$0.115	\$0.0940	0.094
2021	0.940	1.022	\$0.115	\$0.108	\$0.0961	0.090
2022	0.884	1.045	\$0.115	\$0.102	\$0.0983	0.087
2023	0.831	1.068	\$0.115	\$0.096	\$0.1005	0.083
2024	0.781	1.092	\$0.115	\$0.090	\$0.1027	0.080
2025	0.735	1.117	\$0.115	\$0.085	\$0.1050	0.077
2026	0.691	1.141	\$0.115	\$0.080	\$0.1073	0.074
2027	0.649	1.167	\$0.115	\$0.075	\$0.1097	0.071
2028	0.611	1.193	\$0.115	\$0.070	\$0.1122	0.068
2029	0.574	1.220	\$0.115	\$0.066	\$0.1147	0.066
2030	0.540	1.247	\$0.115	\$0.062	\$0.1172	0.063
2031	0.508	1.275	\$0.115	\$0.058	\$0.1198	0.061
2032	0.477	1.303	\$0.115	\$0.055	\$0.1225	0.058
2033	0.449	1.332	\$0.115	\$0.052	\$0.1252	0.056
2034	0.422	1.362	\$0.115	\$0.049	\$0.1280	0.054
2035	0.397	1.392	\$0.115	\$0.046	\$0.1309	0.052
2036	0.397	1.423	\$0.115	\$0.046	\$0.1338	0.053
2037	0.351	1.455	\$0.115	\$0.040	\$0.1368	0.048
2038	0.330	1.487	\$0.115	\$0.038	\$0.1398	0.046
2039	0.310	1.521	\$0.115	\$0.036	\$0.1430	0.044
2040	0.291	1.554	\$0.115	\$0.034	\$0.1461	0.043
2041	0.274	1.589	\$0.115	\$0.032	\$0.1494	0.041
2042	0.258	1.625	\$0.115	\$0.030	\$0.1527	0.039
2043	0.242	1.661	\$0.115	\$0.028	\$0.1561	0.038
2044	0.228	1.698	\$0.115	\$0.026	\$0.1596	0.036
				\$1.517		\$1.525

Table 3. Fixed Assumptions to be used for the VOS calculations

Fuel Prices			Environmental Externalities		
Guaranteed NG Fuel Prices			Environmental Discount Rate		
2020	\$2.671	\$/mmBtu	5.30%	per year	
2021	\$2.639	\$/mmBtu	Environmental Costs		
2022	\$2.645	\$/mmBtu	separate table		
2023	\$2.720	\$/mmBtu	Economic Assumptions		
2024	\$2.823	\$/mmBtu	General Escalation Rate		
2025	\$2.935	\$/mmBtu	2.23%	per year	
2026	\$3.047	\$/mmBtu	Treasury Yields		
2027	\$3.159	\$/mmBtu	1 Year	2.17%	
2028	\$3.271	\$/mmBtu	2 Year	2.05%	
2029	\$3.380	\$/mmBtu	3 Year	2.01%	
2030	\$3.490	\$/mmBtu	5 Year	2.04%	
2031	\$3.596	\$/mmBtu	7 Year	2.14%	
			10 Year	2.25%	
			20 Year	2.49%	
			30 Year	2.68%	
Fuel Price Escalation	2.23%				
PV Assumptions					
PV Degradation Rate	0.50%				
PV Life	25				

Table 4. Environmental costs by year.

Year	Analysis Year	CO2 Cost \$/mmBtu	PM 2.5 Cost \$/mmBtu	CO Cost \$/mmBtu	NOx Cost \$/mmBtu	Pb Cost \$/mmBtu	SO2 Cost \$/mmBtu	Total Cost \$/mmBtu
2020	0	\$2.807	\$0.021	\$0.000	\$0.286	\$0.000	\$0.004	\$3.117
2021	1	\$2.924	\$0.021	\$0.000	\$0.292	\$0.000	\$0.004	\$3.241
2022	2	\$3.045	\$0.021	\$0.000	\$0.299	\$0.000	\$0.004	\$3.369
2023	3	\$3.170	\$0.022	\$0.000	\$0.305	\$0.000	\$0.004	\$3.502
2024	4	\$3.299	\$0.022	\$0.000	\$0.312	\$0.000	\$0.004	\$3.638
2025	5	\$3.433	\$0.023	\$0.000	\$0.319	\$0.000	\$0.004	\$3.779
2026	6	\$3.570	\$0.023	\$0.000	\$0.326	\$0.000	\$0.004	\$3.924
2027	7	\$3.712	\$0.024	\$0.000	\$0.334	\$0.000	\$0.004	\$4.074
2028	8	\$3.859	\$0.025	\$0.000	\$0.341	\$0.000	\$0.004	\$4.229
2029	9	\$4.010	\$0.025	\$0.000	\$0.349	\$0.000	\$0.004	\$4.388
2030	10	\$4.166	\$0.026	\$0.000	\$0.356	\$0.000	\$0.004	\$4.553
2031	11	\$4.344	\$0.026	\$0.000	\$0.364	\$0.000	\$0.004	\$4.740
2032	12	\$4.528	\$0.027	\$0.000	\$0.373	\$0.000	\$0.005	\$4.932
2033	13	\$4.718	\$0.027	\$0.000	\$0.381	\$0.000	\$0.005	\$5.131
2034	14	\$4.915	\$0.028	\$0.000	\$0.389	\$0.000	\$0.005	\$5.337
2035	15	\$5.117	\$0.029	\$0.000	\$0.398	\$0.000	\$0.005	\$5.549
2036	16	\$5.326	\$0.029	\$0.000	\$0.407	\$0.000	\$0.005	\$5.768
2037	17	\$5.542	\$0.030	\$0.000	\$0.416	\$0.000	\$0.005	\$5.993
2038	18	\$5.765	\$0.031	\$0.000	\$0.425	\$0.000	\$0.005	\$6.227
2039	19	\$5.996	\$0.031	\$0.000	\$0.435	\$0.000	\$0.005	\$6.467
2040	20	\$6.233	\$0.032	\$0.000	\$0.444	\$0.000	\$0.005	\$6.715
2041	21	\$6.457	\$0.033	\$0.000	\$0.454	\$0.000	\$0.006	\$6.950
2042	22	\$6.688	\$0.033	\$0.000	\$0.464	\$0.000	\$0.006	\$7.192
2043	23	\$6.926	\$0.034	\$0.000	\$0.475	\$0.000	\$0.006	\$7.441
2044	24	\$7.171	\$0.035	\$0.000	\$0.485	\$0.000	\$0.006	\$7.698

Table 5. VOS Data table -- required format showing assumptions used in the VOS calculation.

	Input Data	Units		Input Data	Units
Economic Factors			Power Generation - Continued		
Start Year for VOS applicability	2020	Year	Other		
Discount Rate (After-tax WACC)	6.36%	Percentage	Solar weighted Heat Rate	7,742	BTU per kWh
Load Match Analysis			Fuel Price Overhead	\$0.004	\$ per MMBtu
ELCC (no loss)	48.6%	% of rating	Generation life	40	years
PLR (no loss)	54.6%	% of rating	Heat Rate degradation	0.10%	per year
Loss Savings - Energy	9.8%	% of PV output	O&M cost (first year) - Fixed	\$3.42	per kW-yr
Loss Savings - PLR	12.4%	% of PV output	O&M cost (first year) - Variable	\$0.0010	\$ per kWh
Loss Savings - ELCC	10.8%	% of PV output	O&M cost escalation rate	2.00%	per year
			Reserve planning margin	7.9%	
			Years until new Generation is needed	0	
PV Energy			Distribution		
Simulated - First year annual energy	1,452	kWh per kW-AC	Capacity-related distribution capital costs -System	\$96	\$ per kW
year annual energy		kWh per kW-AC	Capacity-related distribution capital costs - Mpls	N/A	\$ per kW
Actual- First year annual energy	1,563		Capacity-related distribution capital costs - Mtka	N/A	\$ per kW
Transmission			Capacity-related distribution capital costs -Edina	N/A	\$ per kW
Capacity-related transmission capital cost	\$50.33	\$ per kW	Capacity-related distribution capital costs - SE	N/A	\$ per kW
Power Generation			Capacity-related distribution capital costs -MG	N/A	\$ per kW
Peaking CT, simple cycle			Capacity-related distribution capital costs - Newport	N/A	\$ per kW
Installed Cost	\$476	\$/kW	Capacity-related distribution capital costs - St. Paul	N/A	\$ per kW
Heat Rate	9,738	BTU/kWh	Capacity-related distribution capital costs - NW	N/A	\$ per kW
Intermediate CCGT			Capacity-related distribution capital costs - WBL	N/A	\$ per kW
Installed Cost	\$1,022	\$/kW	Distribution capital cost escalation	2.00%	per year
Heat Rate	6,547	BTU/kWh	Peak Load (Weather Normalized)	6,420	MW
			Peak Load Growth	0.43%	per year

Table 6. Azimuth and Tilt Angles

	Array KW	% of Total	Azimuth	Tilt	
1	3,209	4.9%	52	25	
2	2,974	4.5%	140	21	
3	2,906	4.4%	167	19	
4	18,979	28.9%	180	12	
5	3,939	6.0%	180	21	
6	7,997	12.2%	180	26	
7	6,676	10.2%	180	30	
8	3,296	5.0%	180	35	
9	947	1.4%	180	42	
10	5,453	8.3%	180	48	
11	2,769	4.2%	184	19	
12	964	1.5%	197	26	
13	2,816	4.3%	212	18	
14	1,207	1.8%	237	24	
15	1,577	2.4%	271	22	
TOTAL	65,709	100%	176.4	23.2	Weighted Average

Table 8. Economic Value of Avoided Fuel Costs.

Year				Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Utility	VOS		Utility	VOS		Utility	VOS
	\$/mmBtu	\$/mmBtu	mmBtu/kWh	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$2.67	\$2.67	7,742	\$0.021	\$0.0274	1,563	\$32	\$43	1.000	\$32	\$43
2021	\$2.64	\$2.64	7,750	\$0.020	\$0.0274	1,555	\$32	\$43	0.979	\$31	\$42
2022	\$2.64	\$2.65	7,757	\$0.021	\$0.0274	1,547	\$32	\$42	0.960	\$31	\$41
2023	\$2.72	\$2.72	7,765	\$0.021	\$0.0274	1,540	\$33	\$42	0.942	\$31	\$40
2024	\$2.82	\$2.83	7,773	\$0.022	\$0.0274	1,532	\$34	\$42	0.923	\$31	\$39
2025	\$2.93	\$2.94	7,781	\$0.023	\$0.0274	1,524	\$35	\$42	0.904	\$32	\$38
2026	\$3.05	\$3.05	7,789	\$0.024	\$0.0274	1,517	\$36	\$42	0.883	\$32	\$37
2027	\$3.16	\$3.16	7,796	\$0.025	\$0.0274	1,509	\$37	\$41	0.863	\$32	\$36
2028	\$3.27	\$3.28	7,804	\$0.026	\$0.0274	1,502	\$38	\$41	0.842	\$32	\$35
2029	\$3.38	\$3.38	7,812	\$0.026	\$0.0274	1,494	\$40	\$41	0.822	\$32	\$34
2030	\$3.49	\$3.49	7,820	\$0.027	\$0.0274	1,487	\$41	\$41	0.801	\$33	\$33
2031	\$3.60	\$3.60	7,828	\$0.028	\$0.0274	1,479	\$42	\$41	0.781	\$33	\$32
2032	\$3.68	\$3.68	7,835	\$0.029	\$0.0274	1,472	\$42	\$40	0.762	\$32	\$31
2033	\$3.76	\$3.76	7,843	\$0.030	\$0.0274	1,464	\$43	\$40	0.742	\$32	\$30
2034	\$3.84	\$3.85	7,851	\$0.030	\$0.0274	1,457	\$44	\$40	0.723	\$32	\$29
2035	\$3.93	\$3.93	7,859	\$0.031	\$0.0274	1,450	\$45	\$40	0.704	\$32	\$28
2036	\$4.01	\$4.02	7,867	\$0.032	\$0.0274	1,443	\$46	\$40	0.685	\$31	\$27
2037	\$4.10	\$4.11	7,875	\$0.032	\$0.0274	1,435	\$46	\$39	0.666	\$31	\$26
2038	\$4.20	\$4.20	7,883	\$0.033	\$0.0274	1,428	\$47	\$39	0.648	\$31	\$25
2039	\$4.29	\$4.30	7,890	\$0.034	\$0.0274	1,421	\$48	\$39	0.629	\$30	\$25
2040	\$4.39	\$4.39	7,898	\$0.035	\$0.0274	1,414	\$49	\$39	0.611	\$30	\$24
2041	\$4.48	\$4.49	7,906	\$0.035	\$0.0274	1,407	\$50	\$39	0.594	\$30	\$23
2042	\$4.58	\$4.59	7,914	\$0.036	\$0.0274	1,400	\$51	\$38	0.577	\$29	\$22
2043	\$4.69	\$4.69	7,922	\$0.037	\$0.0274	1,393	\$52	\$38	0.561	\$29	\$21
2044	\$4.79	\$4.80	7,930	\$0.038	\$0.0274	1,386	\$53	\$38	0.544	\$29	\$21

Validation: Present Value	\$779	\$779
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Table 9. Economic value of avoided plant O&M - fixed

Year	O&M Fixed	Utility Capacity	PV Capacity	Prices		p.u. PV Production	Costs		Discount Factor	Disc. Costs	
				Utility	VOS		Utility	VOS		Utility	VOS
				\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$3.42	1.00	1.00	\$0.0022	\$0.0027	1,563	\$3.42	\$4.14	1.000	\$3.42	\$4.14
2021	\$3.49	0.999	0.995	\$0.0022	\$0.0027	1,555	\$3.48	\$4.12	0.940	\$3.27	\$3.88
2022	\$3.56	0.998	0.990	\$0.0023	\$0.0027	1,547	\$3.53	\$4.10	0.884	\$3.12	\$3.63
2023	\$3.63	0.997	0.985	\$0.0024	\$0.0027	1,540	\$3.59	\$4.08	0.831	\$2.98	\$3.39
2024	\$3.71	0.996	0.980	\$0.0024	\$0.0027	1,532	\$3.65	\$4.06	0.781	\$2.85	\$3.17
2025	\$3.78	0.995	0.975	\$0.0025	\$0.0027	1,524	\$3.71	\$4.04	0.735	\$2.72	\$2.97
2026	\$3.86	0.994	0.970	\$0.0025	\$0.0027	1,517	\$3.76	\$4.02	0.691	\$2.60	\$2.78
2027	\$3.93	0.993	0.966	\$0.0026	\$0.0027	1,509	\$3.82	\$4.00	0.649	\$2.48	\$2.60
2028	\$4.01	0.992	0.961	\$0.0027	\$0.0027	1,502	\$3.89	\$3.98	0.611	\$2.37	\$2.43
2029	\$4.09	0.991	0.956	\$0.0027	\$0.0027	1,494	\$3.95	\$3.96	0.574	\$2.27	\$2.27
2030	\$4.17	0.990	0.951	\$0.0028	\$0.0027	1,487	\$4.01	\$3.94	0.540	\$2.16	\$2.13
2031	\$4.26	0.989	0.946	\$0.0028	\$0.0027	1,479	\$4.07	\$3.92	0.508	\$2.07	\$1.99
2032	\$4.34	0.988	0.942	\$0.0029	\$0.0027	1,472	\$4.14	\$3.90	0.477	\$1.97	\$1.86
2033	\$4.43	0.987	0.937	\$0.0030	\$0.0027	1,464	\$4.20	\$3.88	0.449	\$1.89	\$1.74
2034	\$4.52	0.986	0.932	\$0.0031	\$0.0027	1,457	\$4.27	\$3.86	0.422	\$1.80	\$1.63
2035	\$4.52	0.985	0.928	\$0.0031	\$0.0027	1,450	\$4.25	\$3.84	0.397	\$1.69	\$1.52
2036	\$4.70	0.984	0.923	\$0.0032	\$0.0027	1,443	\$4.41	\$3.82	0.397	\$1.75	\$1.52
2037	\$4.79	0.983	0.918	\$0.0033	\$0.0027	1,435	\$4.48	\$3.80	0.351	\$1.57	\$1.33
2038	\$4.89	0.982	0.914	\$0.0034	\$0.0027	1,428	\$4.55	\$3.78	0.330	\$1.50	\$1.25
2039	\$4.99	0.981	0.909	\$0.0034	\$0.0027	1,421	\$4.62	\$3.77	0.310	\$1.43	\$1.17
2040	\$5.09	0.980	0.905	\$0.0035	\$0.0027	1,414	\$4.70	\$3.75	0.291	\$1.37	\$1.09
2041	\$5.19	0.979	0.900	\$0.0036	\$0.0027	1,407	\$4.77	\$3.73	0.274	\$1.31	\$1.02
2042	\$5.29	0.978	0.896	\$0.0037	\$0.0027	1,400	\$4.85	\$3.71	0.258	\$1.25	\$0.96
2043	\$5.40	0.977	0.891	\$0.0038	\$0.0027	1,393	\$4.92	\$3.69	0.242	\$1.19	\$0.89
2044	\$5.51	0.976	0.887	\$0.0039	\$0.0027	1,386	\$5.00	\$3.67	0.228	\$1.14	\$0.84

\$0.0027

Validation: Present Value	\$52	\$52
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Table 10. Economic value of avoided plant O&M - variable

Year	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$0.0010	\$0.0012	1,563	\$2	\$2	1.000	\$2	\$2
2021	\$0.0011	\$0.0012	1,555	\$2	\$2	0.940	\$2	\$2
2022	\$0.0011	\$0.0012	1,547	\$2	\$2	0.884	\$1	\$2
2023	\$0.0011	\$0.0012	1,540	\$2	\$2	0.831	\$1	\$2
2024	\$0.0011	\$0.0012	1,532	\$2	\$2	0.781	\$1	\$1
2025	\$0.0011	\$0.0012	1,524	\$2	\$2	0.735	\$1	\$1
2026	\$0.0012	\$0.0012	1,517	\$2	\$2	0.691	\$1	\$1
2027	\$0.0012	\$0.0012	1,509	\$2	\$2	0.649	\$1	\$1
2028	\$0.0012	\$0.0012	1,502	\$2	\$2	0.611	\$1	\$1
2029	\$0.0012	\$0.0012	1,494	\$2	\$2	0.574	\$1	\$1
2030	\$0.0013	\$0.0012	1,487	\$2	\$2	0.540	\$1	\$1
2031	\$0.0013	\$0.0012	1,479	\$2	\$2	0.508	\$1	\$1
2032	\$0.0013	\$0.0012	1,472	\$2	\$2	0.477	\$1	\$1
2033	\$0.0013	\$0.0012	1,464	\$2	\$2	0.449	\$1	\$1
2034	\$0.0014	\$0.0012	1,457	\$2	\$2	0.422	\$1	\$1
2035	\$0.0014	\$0.0012	1,450	\$2	\$2	0.397	\$1	\$1
2036	\$0.0014	\$0.0012	1,443	\$2	\$2	0.373	\$1	\$1
2037	\$0.0014	\$0.0012	1,435	\$2	\$2	0.351	\$1	\$1
2038	\$0.0015	\$0.0012	1,428	\$2	\$2	0.330	\$1	\$1
2039	\$0.0015	\$0.0012	1,421	\$2	\$2	0.310	\$1	\$1
2040	\$0.0015	\$0.0012	1,414	\$2	\$2	0.291	\$1	\$1
2041	\$0.0016	\$0.0012	1,407	\$2	\$2	0.274	\$1	\$0
2042	\$0.0016	\$0.0012	1,400	\$2	\$2	0.258	\$1	\$0
2043	\$0.0016	\$0.0012	1,393	\$2	\$2	0.242	\$1	\$0
2044	\$0.0017	\$0.0012	1,386	\$2	\$2	0.228	\$1	\$0

Validation: Present Value	\$24	\$24
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Table 11. Economic value of avoided generation capacity cost.

Year				Prices		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	Capacity Cost	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2020	\$57	1.00	1.00	\$0.036	\$0.0367	1,563	\$57	\$57	1.000	\$57	\$57
2021	\$57	0.999	0.995	\$0.036	\$0.0367	1,555	\$57	\$57	0.940	\$53	\$54
2022	\$57	0.998	0.990	\$0.036	\$0.0367	1,547	\$56	\$57	0.884	\$50	\$50
2023	\$57	0.997	0.985	\$0.036	\$0.0367	1,540	\$56	\$56	0.831	\$47	\$47
2024	\$57	0.996	0.980	\$0.036	\$0.0367	1,532	\$56	\$56	0.781	\$44	\$44
2025	\$57	0.995	0.975	\$0.037	\$0.0367	1,524	\$56	\$56	0.735	\$41	\$41
2026	\$57	0.994	0.970	\$0.037	\$0.0367	1,517	\$55	\$56	0.691	\$38	\$38
2027	\$57	0.993	0.966	\$0.037	\$0.0367	1,509	\$55	\$55	0.649	\$36	\$36
2028	\$57	0.992	0.961	\$0.037	\$0.0367	1,502	\$55	\$55	0.611	\$34	\$34
2029	\$57	0.991	0.956	\$0.037	\$0.0367	1,494	\$55	\$55	0.574	\$31	\$31
2030	\$57	0.990	0.951	\$0.037	\$0.0367	1,487	\$55	\$55	0.540	\$29	\$29
2031	\$57	0.989	0.946	\$0.037	\$0.0367	1,479	\$54	\$54	0.508	\$28	\$28
2032	\$57	0.988	0.942	\$0.037	\$0.0367	1,472	\$54	\$54	0.477	\$26	\$26
2033	\$57	0.987	0.937	\$0.037	\$0.0367	1,464	\$54	\$54	0.449	\$24	\$24
2034	\$57	0.986	0.932	\$0.037	\$0.0367	1,457	\$54	\$53	0.422	\$23	\$23
2035	\$57	0.985	0.928	\$0.037	\$0.0367	1,450	\$53	\$53	0.397	\$21	\$21
2036	\$57	0.984	0.923	\$0.037	\$0.0367	1,443	\$53	\$53	0.373	\$20	\$20
2037	\$57	0.983	0.918	\$0.037	\$0.0367	1,435	\$53	\$53	0.351	\$19	\$18
2038	\$57	0.982	0.914	\$0.037	\$0.0367	1,428	\$53	\$52	0.330	\$17	\$17
2039	\$57	0.981	0.909	\$0.037	\$0.0367	1,421	\$53	\$52	0.310	\$16	\$16
2040	\$57	0.980	0.905	\$0.037	\$0.0367	1,414	\$52	\$52	0.291	\$15	\$15
2041	\$57	0.979	0.900	\$0.037	\$0.0367	1,407	\$52	\$52	0.274	\$14	\$14
2042	\$57	0.978	0.896	\$0.037	\$0.0367	1,400	\$52	\$51	0.258	\$13	\$13
2043	\$57	0.977	0.891	\$0.037	\$0.0367	1,393	\$52	\$51	0.242	\$13	\$12
2044	\$57	0.976	0.887	\$0.037	\$0.0367	1,386	\$52	\$51	0.228	\$12	\$12
					\$0.0367						
Validation: Present Value										\$721	\$721

Table 12. Economic value of avoided reserve capacity cost.

Year					Prices					Disc. Costs		
	Capacity Cost	Reserve Margin	Utility Capacity	PV Capacity	Utility	VOS	PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/kW-yr	%	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$57	7.9%	1.00	1.00	\$0.003	\$0.0029	1,563	\$4	\$5	1.000	\$4	\$5
2021	\$57	7.9%	0.999	0.995	\$0.003	\$0.0029	1,555	\$4	\$5	0.940	\$4	\$4
2022	\$57	7.9%	0.998	0.990	\$0.003	\$0.0029	1,547	\$4	\$4	0.884	\$4	\$4
2023	\$57	7.9%	0.997	0.985	\$0.003	\$0.0029	1,540	\$4	\$4	0.831	\$4	\$4
2024	\$57	7.9%	0.996	0.980	\$0.003	\$0.0029	1,532	\$4	\$4	0.781	\$3	\$3
2025	\$57	7.9%	0.995	0.975	\$0.003	\$0.0029	1,524	\$4	\$4	0.735	\$3	\$3
2026	\$57	7.9%	0.994	0.970	\$0.003	\$0.0029	1,517	\$4	\$4	0.691	\$3	\$3
2027	\$57	7.9%	0.993	0.966	\$0.003	\$0.0029	1,509	\$4	\$4	0.649	\$3	\$3
2028	\$57	7.9%	0.992	0.961	\$0.003	\$0.0029	1,502	\$4	\$4	0.611	\$3	\$3
2029	\$57	7.9%	0.991	0.956	\$0.003	\$0.0029	1,494	\$4	\$4	0.574	\$2	\$2
2030	\$57	7.9%	0.990	0.951	\$0.003	\$0.0029	1,487	\$4	\$4	0.540	\$2	\$2
2031	\$57	7.9%	0.989	0.946	\$0.003	\$0.0029	1,479	\$4	\$4	0.508	\$2	\$2
2032	\$57	7.9%	0.988	0.942	\$0.003	\$0.0029	1,472	\$4	\$4	0.477	\$2	\$2
2033	\$57	7.9%	0.987	0.937	\$0.003	\$0.0029	1,464	\$4	\$4	0.449	\$2	\$2
2034	\$57	7.9%	0.986	0.932	\$0.003	\$0.0029	1,457	\$4	\$4	0.422	\$2	\$2
2035	\$57	7.9%	0.985	0.928	\$0.003	\$0.0029	1,450	\$4	\$4	0.397	\$2	\$2
2036	\$57	7.9%	0.984	0.923	\$0.003	\$0.0029	1,443	\$4	\$4	0.373	\$2	\$2
2037	\$57	7.9%	0.983	0.918	\$0.003	\$0.0029	1,435	\$4	\$4	0.351	\$1	\$1
2038	\$57	7.9%	0.982	0.914	\$0.003	\$0.0029	1,428	\$4	\$4	0.330	\$1	\$1
2039	\$57	7.9%	0.981	0.909	\$0.003	\$0.0029	1,421	\$4	\$4	0.310	\$1	\$1
2040	\$57	7.9%	0.980	0.905	\$0.003	\$0.0029	1,414	\$4	\$4	0.291	\$1	\$1
2041	\$57	7.9%	0.979	0.900	\$0.003	\$0.0029	1,407	\$4	\$4	0.274	\$1	\$1
2042	\$57	7.9%	0.978	0.896	\$0.003	\$0.0029	1,400	\$4	\$4	0.258	\$1	\$1
2043	\$57	7.9%	0.977	0.891	\$0.003	\$0.0029	1,393	\$4	\$4	0.242	\$1	\$1
2044	\$57	7.9%	0.976	0.887	\$0.003	\$0.0029	1,386	\$4	\$4	0.228	\$1	\$1
						\$0.0029						
Validation: Present Value											\$57	\$57

Table 13. Economic value of avoided transmission capacity cost.

Year				Prices					Disc. Costs		
	Capacity Cost	Utility Capacity	PV Capacity	Utility	VOS	PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/kW-yr	pu.	kW	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
2020	\$50	1.00	1.00	\$0.032	\$0.0325	1,563	\$50	\$51	1.000	\$50	\$51
2021	\$50	0.999	0.995	\$0.032	\$0.0325	1,555	\$50	\$51	0.940	\$47	\$47
2022	\$50	0.998	0.990	\$0.032	\$0.0325	1,547	\$50	\$50	0.884	\$44	\$44
2023	\$50	0.997	0.985	\$0.032	\$0.0325	1,540	\$50	\$50	0.831	\$41	\$42
2024	\$50	0.996	0.980	\$0.032	\$0.0325	1,532	\$50	\$50	0.781	\$39	\$39
2025	\$50	0.995	0.975	\$0.032	\$0.0325	1,524	\$49	\$50	0.735	\$36	\$36
2026	\$50	0.994	0.970	\$0.032	\$0.0325	1,517	\$49	\$49	0.691	\$34	\$34
2027	\$50	0.993	0.966	\$0.032	\$0.0325	1,509	\$49	\$49	0.649	\$32	\$32
2028	\$50	0.992	0.961	\$0.032	\$0.0325	1,502	\$49	\$49	0.611	\$30	\$30
2029	\$50	0.991	0.956	\$0.032	\$0.0325	1,494	\$49	\$49	0.574	\$28	\$28
2030	\$50	0.990	0.951	\$0.033	\$0.0325	1,487	\$48	\$48	0.540	\$26	\$26
2031	\$50	0.989	0.946	\$0.033	\$0.0325	1,479	\$48	\$48	0.508	\$24	\$24
2032	\$50	0.988	0.942	\$0.033	\$0.0325	1,472	\$48	\$48	0.477	\$23	\$23
2033	\$50	0.987	0.937	\$0.033	\$0.0325	1,464	\$48	\$48	0.449	\$21	\$21
2034	\$50	0.986	0.932	\$0.033	\$0.0325	1,457	\$48	\$47	0.422	\$20	\$20
2035	\$50	0.985	0.928	\$0.033	\$0.0325	1,450	\$47	\$47	0.397	\$19	\$19
2036	\$50	0.984	0.923	\$0.033	\$0.0325	1,443	\$47	\$47	0.373	\$18	\$17
2037	\$50	0.983	0.918	\$0.033	\$0.0325	1,435	\$47	\$47	0.351	\$16	\$16
2038	\$50	0.982	0.914	\$0.033	\$0.0325	1,428	\$47	\$46	0.330	\$15	\$15
2039	\$50	0.981	0.909	\$0.033	\$0.0325	1,421	\$47	\$46	0.310	\$14	\$14
2040	\$50	0.980	0.905	\$0.033	\$0.0325	1,414	\$46	\$46	0.291	\$14	\$13
2041	\$50	0.979	0.900	\$0.033	\$0.0325	1,407	\$46	\$46	0.274	\$13	\$13
2042	\$50	0.978	0.896	\$0.033	\$0.0325	1,400	\$46	\$45	0.258	\$12	\$12
2043	\$50	0.977	0.891	\$0.033	\$0.0325	1,393	\$46	\$45	0.242	\$11	\$11
2044	\$50	0.976	0.887	\$0.033	\$0.0325	1,386	\$46	\$45	0.228	\$10	\$10
					\$0.0325						
Validation: Present Value										\$639	\$639

Table 14. Determination of deferrable distribution costs.

Year	Distribution Project Costs	% Capacity Related	Capacity Related		
	\$	%	\$		
2018	175,490,525	4.5%	7,812,185		
2017	155,018,178	6.6%	10,270,204		
2016	165,929,956	9.6%	15,936,132		
2015	134,867,264	12.1%	16,309,114		
2014	129,899,465	16.3%	21,147,768		
2013	142,118,822	20.3%	28,825,462		
2012	109,286,058	20.8%	22,683,879		
2011	100,102,075	7.5%	7,502,291		
2010	98,267,667	11.0%	10,823,959		
2009	82,821,606	10.6%	8,749,417		
TOTAL 10-YEAR PERIOD	1,293,801,616		150,060,411		

Table 15. Economic value of avoided distribution capacity cost.

Year	Conventional Distribution Planning					Deferred Distribution Planning			
	Distribution Cost	New Dist. Capacity	Capital Cost	Disc Capital Cost	Amortized	Def. Dist. Capacity	Def. Capital Cost	Disc Capital Cost	Amortized
	\$/kW-yr	(MW)	(\$M)	(\$M)	\$/yr	(MW)	(\$M)	(\$M)	\$/yr
2020	\$191	50	\$10	\$10	\$13				\$12
2021	\$195	50	\$10	\$9	\$13	50	\$9.8	\$9.2	\$12
2022	\$199	50	\$10	\$9	\$13	50	\$10.0	\$8.8	\$12
2023	\$203	51	\$10	\$9	\$13	50	\$10.2	\$8.5	\$12
2024	\$207	51	\$11	\$8	\$13	51	\$10.5	\$8.2	\$12
2025	\$211	51	\$11	\$8	\$13	51	\$10.7	\$7.9	\$12
2026	\$216	51	\$11	\$8	\$13	51	\$11.0	\$7.6	\$12
2027	\$220	52	\$11	\$7	\$13	51	\$11.3	\$7.3	\$12
2028	\$224	52	\$12	\$7	\$13	52	\$11.6	\$7.1	\$12
2029	\$229	52	\$12	\$7	\$13	52	\$11.8	\$6.8	\$12
2030	\$233	52	\$12	\$7	\$13	52	\$12.1	\$6.5	\$12
2031	\$238	52	\$12	\$6	\$13	52	\$12.4	\$6.3	\$12
2032	\$243	53	\$13	\$6	\$13	52	\$12.7	\$6.1	\$12
2033	\$248	53	\$13	\$6	\$13	53	\$13.0	\$5.8	\$12
2034	\$253	53	\$13	\$6	\$13	53	\$13.4	\$5.6	\$12
2035	\$258	53	\$14	\$5	\$13	53	\$13.7	\$5.4	\$12
2036	\$263	54	\$14	\$5	\$13	53	\$14.0	\$5.2	\$12
2037	\$268	54	\$14	\$5	\$13	54	\$14.3	\$5.0	\$12
2038	\$273	54	\$15	\$5	\$13	54	\$14.7	\$4.8	\$12
2039	\$279	54	\$15	\$5	\$13	54	\$15.1	\$4.7	\$12
2040	\$284	54	\$15	\$5	\$13	54	\$15.4	\$4.5	\$12
2041	\$290	55	\$16	\$4	\$13	54	\$15.8	\$4.3	\$12
2042	\$296	55	\$16	\$4	\$13	55	\$16.2	\$4.2	\$12
2043	\$302	55	\$17	\$4	\$13	55	\$16.6	\$4.0	\$12
2044	\$308	55	\$17	\$4	\$13	55	\$17.0	\$3.9	\$12
2039	\$314					55	\$17.4	\$3.7	
					\$158				\$152

Continued - Table 15. Economic value of avoided distribution capacity cost. *EXAMPLE*

Prices		PV Production	Costs		Discount Factor	Disc. Costs	
Utility	VOS		Utility	VOS		Utility	VOS
\$/kWh	\$/kWh	(kWh)	(\$)	(\$)		(\$)	(\$)
\$0.00671	\$0.0068	1,563	\$10	\$11	1.000	\$10	\$11
\$0.00671	\$0.0068	1,555	\$10	\$11	0.940	\$10	\$10
\$0.00672	\$0.0068	1,547	\$10	\$10	0.884	\$9	\$9
\$0.00672	\$0.0068	1,540	\$10	\$10	0.831	\$9	\$9
\$0.00673	\$0.0068	1,532	\$10	\$10	0.781	\$8	\$8
\$0.00673	\$0.0068	1,524	\$10	\$10	0.735	\$8	\$8
\$0.00674	\$0.0068	1,517	\$10	\$10	0.691	\$7	\$7
\$0.00674	\$0.0068	1,509	\$10	\$10	0.649	\$7	\$7
\$0.00675	\$0.0068	1,502	\$10	\$10	0.611	\$6	\$6
\$0.00676	\$0.0068	1,494	\$10	\$10	0.574	\$6	\$6
\$0.00676	\$0.0068	1,487	\$10	\$10	0.540	\$5	\$5
\$0.00677	\$0.0068	1,479	\$10	\$10	0.508	\$5	\$5
\$0.00677	\$0.0068	1,472	\$10	\$10	0.477	\$5	\$5
\$0.00678	\$0.0068	1,464	\$10	\$10	0.449	\$4	\$4
\$0.00678	\$0.0068	1,457	\$10	\$10	0.422	\$4	\$4
\$0.00679	\$0.0068	1,450	\$10	\$10	0.397	\$4	\$4
\$0.00679	\$0.0068	1,443	\$10	\$10	0.373	\$4	\$4
\$0.00680	\$0.0068	1,435	\$10	\$10	0.351	\$3	\$3
\$0.00680	\$0.0068	1,428	\$10	\$10	0.330	\$3	\$3
\$0.00681	\$0.0068	1,421	\$10	\$10	0.310	\$3	\$3
\$0.00681	\$0.0068	1,414	\$10	\$10	0.291	\$3	\$3
\$0.00682	\$0.0068	1,407	\$10	\$10	0.274	\$3	\$3
\$0.00682	\$0.0068	1,400	\$10	\$9	0.258	\$2	\$2
\$0.00683	\$0.0068	1,393	\$10	\$9	0.242	\$2	\$2
\$0.00683	\$0.0068	1,386	\$9	\$9	0.228	\$2	\$2
					-		
	\$0.0068		Validation: Present Value			\$133	\$133

Table 17. Economic value of avoided environmental costs

Environmental Discount Rate

5.30%

Year	Env. Cost \$/mmBtu	Solar Weighted Heat Rate mmBtu/MWh	Prices		p.u. PV Production (kWh)	Costs		Discount Factor (risk free)	Disc. Costs	
			Utility \$/kWh	VOS \$/kWh		Utility (\$)	VOS (\$)		Utility (\$)	VOS (\$)
2020	\$3.12	7,742	\$0.024	\$0.0359	1,563	\$38	\$56	1.000	\$38	\$56
2021	\$3.24	7,750	\$0.025	\$0.0359	1,555	\$39	\$56	0.950	\$37	\$53
2022	\$3.37	7,757	\$0.026	\$0.0359	1,547	\$40	\$56	0.902	\$36	\$50
2023	\$3.50	7,765	\$0.027	\$0.0359	1,540	\$42	\$55	0.857	\$36	\$47
2024	\$3.64	7,773	\$0.028	\$0.0359	1,532	\$43	\$55	0.813	\$35	\$45
2025	\$3.78	7,781	\$0.029	\$0.0359	1,524	\$45	\$55	0.773	\$35	\$42
2026	\$3.92	7,789	\$0.031	\$0.0359	1,517	\$46	\$54	0.734	\$34	\$40
2027	\$4.07	7,796	\$0.032	\$0.0359	1,509	\$48	\$54	0.697	\$33	\$38
2028	\$4.23	7,804	\$0.033	\$0.0359	1,502	\$50	\$54	0.662	\$33	\$36
2029	\$4.39	7,812	\$0.034	\$0.0359	1,494	\$51	\$54	0.628	\$32	\$34
2030	\$4.55	7,820	\$0.036	\$0.0359	1,487	\$53	\$53	0.597	\$32	\$32
2031	\$4.74	7,828	\$0.037	\$0.0359	1,479	\$55	\$53	0.567	\$31	\$30
2032	\$4.93	7,835	\$0.039	\$0.0359	1,472	\$57	\$53	0.538	\$31	\$28
2033	\$5.13	7,843	\$0.040	\$0.0359	1,464	\$59	\$53	0.511	\$30	\$27
2034	\$5.34	7,851	\$0.042	\$0.0359	1,457	\$61	\$52	0.485	\$30	\$25
2035	\$5.55	7,859	\$0.044	\$0.0359	1,450	\$63	\$52	0.461	\$29	\$24
2036	\$5.77	7,867	\$0.045	\$0.0359	1,443	\$65	\$52	0.438	\$29	\$23
2037	\$5.99	7,875	\$0.047	\$0.0359	1,435	\$68	\$51	0.416	\$28	\$21
2038	\$6.23	7,883	\$0.049	\$0.0359	1,428	\$70	\$51	0.395	\$28	\$20
2039	\$6.47	7,890	\$0.051	\$0.0359	1,421	\$73	\$51	0.375	\$27	\$19
2040	\$6.72	7,898	\$0.053	\$0.0359	1,414	\$75	\$51	0.356	\$27	\$18
2041	\$6.95	7,906	\$0.055	\$0.0359	1,407	\$77	\$50	0.338	\$26	\$17
2042	\$7.19	7,914	\$0.057	\$0.0359	1,400	\$80	\$50	0.321	\$26	\$16
2043	\$7.44	7,922	\$0.059	\$0.0359	1,393	\$82	\$50	0.305	\$25	\$15
2044	\$7.70	7,930	\$0.061	\$0.0359	1,386	\$85	\$50	0.290	\$25	\$14

Validation: Present Value	\$771	\$771
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Table 18. Calculation of inflation-adjusted VOS

Year	Discount Factor	PV Production	Escallation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2020	1.000	1563	1.000	\$0.115	\$180	\$0.0940	146.953
2021	0.940	1555	1.022	\$0.115	\$168	\$0.0961	140.540
2022	0.884	1547	1.045	\$0.115	\$158	\$0.0983	134.408
2023	0.831	1540	1.068	\$0.115	\$147	\$0.1005	128.543
2024	0.781	1532	1.092	\$0.115	\$138	\$0.1027	122.934
2025	0.735	1524	1.117	\$0.115	\$129	\$0.1050	117.569
2026	0.691	1517	1.141	\$0.115	\$121	\$0.1073	112.439
2027	0.649	1509	1.167	\$0.115	\$113	\$0.1097	107.532
2028	0.611	1502	1.193	\$0.115	\$106	\$0.1122	102.840
2029	0.574	1494	1.220	\$0.115	\$99	\$0.1147	98.353
2030	0.540	1487	1.247	\$0.115	\$92	\$0.1172	94.061
2031	0.508	1479	1.275	\$0.115	\$86	\$0.1198	89.956
2032	0.477	1472	1.303	\$0.115	\$81	\$0.1225	86.031
2033	0.449	1464	1.332	\$0.115	\$76	\$0.1252	82.277
2034	0.422	1457	1.362	\$0.115	\$71	\$0.1280	78.687
2035	0.397	1450	1.392	\$0.115	\$66	\$0.1309	75.253
2036	0.397	1443	1.423	\$0.115	\$66	\$0.1338	76.547
2037	0.351	1435	1.455	\$0.115	\$58	\$0.1368	68.829
2038	0.330	1428	1.487	\$0.115	\$54	\$0.1398	65.825
2039	0.310	1421	1.521	\$0.115	\$51	\$0.1430	62.953
2040	0.291	1414	1.554	\$0.115	\$47	\$0.1461	60.206
2041	0.274	1407	1.589	\$0.115	\$44	\$0.1494	57.579
2042	0.258	1400	1.625	\$0.115	\$42	\$0.1527	55.066
2043	0.242	1393	1.661	\$0.115	\$39	\$0.1561	52.663
2044	0.228	1386	1.698	\$0.115	\$36	\$0.1596	50.365
					\$2,268		\$2,268

VOS Distribution Capacity Cost per kW

(A) System actual cost per KWH

Year	New Dist. Capacity (MW)	Capital Cost - Capacity projects (\$M)
2017	43.3	\$10.270
2018	26.0	\$7.812
2019	72.8	\$5.862
2020	71.0	\$15.380
2021	75.9	\$16.000
Total	289.0	\$55.324
Cost per kW		\$191.43

Line			
1	Full Project Deferral		100%
2	Deferral Reduction Factor		0%
3	Deferral Reduction		100% (1 - 2)
4	Distibution Capacity Cost per kW	<u>\$191.43</u>	
5	Avoided Distibution Capacity Cost per kW	\$191.43	(3 x 4)