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Xcel Energy Information Request No. 18  
Docket No.: E002/M-13-867  
Response To: Minnesota Solar Energy Industries Association  
Requestor: David Shaffer  
Date Received: July 3, 2019

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Question:

If not provided in the workpapers, please provide the calculations used to convert the \$80 per kW Effective Avoided Distribution Cost into a Value of Solar Distribution Component of 0.33 cents per kWh.

Response:

Please see Attachment B to Information Response 16 that shows the conversion of the \$160 system distribution cost per kW into the 0.33 cents per kWh. Applying the 50% Deferral Reduction Factor to \$160 system distribution cost per kW yields an \$80 Effective Avoided Distribution cost per kW as is calculated on page 6 of the Company's May 1<sup>st</sup> compliance filing. Applying the \$80 Effective Avoided Distribution cost per kW to the 2018 VOS yields an avoided distribution cost of 0.16 cents per kWh. Please see Attachment A, for the calculation of Avoided Distribution Cost Component based on the \$80 Effective Avoid Distribution Cost per kW.

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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**

<b>CURRENT POSITION</b>	<b>Economic Value</b>	<b>Load Match</b>	<b>Distributed Loss Savings</b>	<b>Distributed PV Value</b>
<i>25 Year Levelized Values</i>	<b>(\$/kWh)</b>	<b>(%)</b>	<b>(%)</b>	<b>(\$/kWh)</b>
Avoided Fuel Cost	\$0.0262		9.8%	\$0.0288
Avoided Plant O&M - Fixed	\$0.0023	48.6%	11.0%	\$0.0013
Avoided Plant O&M - Variable	\$0.0030		9.8%	\$0.0033
Avoided Generation Capacity Cost	\$0.0440	48.6%	11.0%	\$0.0237
Avoided Reserve Capacity Cost	\$0.0036	48.6%	11.0%	\$0.0019
Avoided Transmission Capacity Cost	\$0.0338	48.6%	11.0%	\$0.0182
Avoided Distribution Capacity Cost	\$0.0026	55.2%	12.6%	\$0.0016
Avoided Environmental Cost	\$0.0316		9.8%	\$0.0348
Avoided Voltage Control Cost				
<u>Solar Integration Cost</u>				
<b>TOTAL</b>				<b>\$0.1136</b>

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

Year	Discount Factor	Escalation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2018	1.000	1.000	\$0.114	\$0.114	\$0.0922	0.092
2019	0.942	1.023	\$0.114	\$0.107	\$0.0943	0.089
2020	0.887	1.046	\$0.114	\$0.101	\$0.0965	0.086
2021	0.835	1.070	\$0.114	\$0.095	\$0.0986	0.082
2022	0.787	1.094	\$0.114	\$0.089	\$0.1009	0.079
2023	0.741	1.119	\$0.114	\$0.084	\$0.1032	0.076
2024	0.698	1.144	\$0.114	\$0.079	\$0.1055	0.074
2025	0.698	1.170	\$0.114	\$0.079	\$0.1079	0.075
2026	0.698	1.197	\$0.114	\$0.079	\$0.1104	0.077
2027	0.583	1.224	\$0.114	\$0.066	\$0.1129	0.066
2028	0.549	1.252	\$0.114	\$0.062	\$0.1154	0.063
2029	0.517	1.280	\$0.114	\$0.059	\$0.1181	0.061
2030	0.487	1.309	\$0.114	\$0.055	\$0.1207	0.059
2031	0.459	1.339	\$0.114	\$0.052	\$0.1235	0.057
2032	0.432	1.369	\$0.114	\$0.049	\$0.1263	0.055
2033	0.407	1.400	\$0.114	\$0.046	\$0.1291	0.053
2034	0.407	1.432	\$0.114	\$0.046	\$0.1321	0.054
2035	0.361	1.465	\$0.114	\$0.041	\$0.1351	0.049
2036	0.340	1.498	\$0.114	\$0.039	\$0.1381	0.047
2037	0.320	1.532	\$0.114	\$0.036	\$0.1413	0.045
2038	0.301	1.567	\$0.114	\$0.034	\$0.1445	0.044
2039	0.284	1.602	\$0.114	\$0.032	\$0.1478	0.042
2040	0.267	1.639	\$0.114	\$0.030	\$0.1511	0.040
2041	0.252	1.676	\$0.114	\$0.029	\$0.1545	0.039
2042	0.237	1.714	\$0.114	\$0.027	\$0.1581	0.037
				\$1.532		\$1.540

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

<b>Fuel Prices</b>			<b>Environmental Externalities</b>	
Guaranteed NG Fuel Prices			Environmental Discount Rate	5.34% per year
2018	\$3.035	\$/mmBtu	Environmental Costs	separate table
2019	\$2.855	\$/mmBtu		
2020	\$2.835	\$/mmBtu		
2021	\$2.859	\$/mmBtu	<b>Economic Assumptions</b>	
2022	\$2.892	\$/mmBtu	General Escalation Rate	2.27% per year
2023	\$2.945	\$/mmBtu		
2024	\$3.010	\$/mmBtu	<b>Treasury Yields</b>	
2025	\$3.085	\$/mmBtu	1 Year	1.14%
2026	\$3.164	\$/mmBtu	2 Year	1.31%
2027	\$3.246	\$/mmBtu	3 Year	1.50%
2028	\$3.331	\$/mmBtu	5 Year	1.84%
2029	\$3.420	\$/mmBtu	7 Year	2.10%
			10 Year	2.29%
			20 Year	2.65%
			30 Year	2.90%
Fuel Price Escalation	2.27%			
<b>PV Assumptions</b>				
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
2018	0	\$2.488	\$0.020	\$0.000	\$0.268	\$0.000	\$0.003	\$2.779
2019	1	\$2.622	\$0.020	\$0.000	\$0.274	\$0.000	\$0.003	\$2.919
2020	2	\$2.760	\$0.020	\$0.000	\$0.280	\$0.000	\$0.003	\$3.064
2021	3	\$2.876	\$0.021	\$0.000	\$0.287	\$0.000	\$0.004	\$3.188
2022	4	\$2.997	\$0.021	\$0.000	\$0.293	\$0.000	\$0.004	\$3.315
2023	5	\$3.121	\$0.022	\$0.000	\$0.300	\$0.000	\$0.004	\$3.446
2024	6	\$3.249	\$0.022	\$0.000	\$0.307	\$0.000	\$0.004	\$3.582
2025	7	\$3.382	\$0.023	\$0.000	\$0.314	\$0.000	\$0.004	\$3.722
2026	8	\$3.519	\$0.023	\$0.000	\$0.321	\$0.000	\$0.004	\$3.867
2027	9	\$3.660	\$0.024	\$0.000	\$0.328	\$0.000	\$0.004	\$4.016
2028	10	\$3.806	\$0.024	\$0.000	\$0.335	\$0.000	\$0.004	\$4.170
2029	11	\$3.957	\$0.025	\$0.000	\$0.343	\$0.000	\$0.004	\$4.329
2030	12	\$4.113	\$0.026	\$0.000	\$0.351	\$0.000	\$0.004	\$4.493
2031	13	\$4.290	\$0.026	\$0.000	\$0.359	\$0.000	\$0.004	\$4.680
2032	14	\$4.473	\$0.027	\$0.000	\$0.367	\$0.000	\$0.005	\$4.872
2033	15	\$4.663	\$0.027	\$0.000	\$0.375	\$0.000	\$0.005	\$5.070
2034	16	\$4.859	\$0.028	\$0.000	\$0.384	\$0.000	\$0.005	\$5.275
2035	17	\$5.061	\$0.029	\$0.000	\$0.393	\$0.000	\$0.005	\$5.487
2036	18	\$5.270	\$0.029	\$0.000	\$0.401	\$0.000	\$0.005	\$5.706
2037	19	\$5.486	\$0.030	\$0.000	\$0.411	\$0.000	\$0.005	\$5.932
2038	20	\$5.709	\$0.031	\$0.000	\$0.420	\$0.000	\$0.005	\$6.165
2039	21	\$5.939	\$0.031	\$0.000	\$0.429	\$0.000	\$0.005	\$6.405
2040	22	\$6.177	\$0.032	\$0.000	\$0.439	\$0.000	\$0.005	\$6.654
2041	23	\$6.401	\$0.033	\$0.000	\$0.449	\$0.000	\$0.006	\$6.889
2042	24	\$6.633	\$0.033	\$0.000	\$0.459	\$0.000	\$0.006	\$7.132

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

	Input Data	Units		Input Data	Units
<b>Economic Factors</b>			<b>Power Generation - Continued</b>		
Start Year for VOS applicability	2018		Other		
Discount Rate (WACC)	6.18%	per year	Solar weighted Heat Rate	7,482	BTU per kWh
<b>Load Match Analysis</b>			Fuel Price Overhead	\$0.029	\$ per MMBtu
ELCC (no loss)	48.6%	% of rating	Generation life	35	years
PLR (no loss)	55.2%	% of rating	Heat Rate degradation	0.10%	per year
Loss Savings - Energy	9.8%	% of PV output	O&M cost (first year) - Fixed	\$2.65	per kW-yr
Loss Savings - PLR	12.6%	% of PV output	O&M cost (first year) - Variable	\$0.002	\$ per kWh
Loss Savings - ELCC	11.0%	% of PV output	O&M cost escalation rate	2.64%	per year
<b>PV Energy</b>			Reserve planning margin	8.1%	
First year annual energy	1,452	kWh per kW-AC	Years until new Generation is needed	0	
<b>Transmission</b>			<b>Distribution</b>		
Capacity-related transmission capital cost	\$48.67	\$ per kW	Capacity-related distribution capital costs -System	\$80	\$ per kW
<b>Power Generation</b>			Capacity-related distribution capital costs - Mpls	N/A	\$ per kW
Peaking CT, simple cycle			Capacity-related distribution capital costs - Mtka	N/A	\$ per kW
Installed Cost	\$631	\$/kW	Capacity-related distribution capital costs -Edina	N/A	\$ per kW
Heat Rate	9,942	BTU/kWh	Capacity-related distribution capital costs - SE	N/A	\$ per kW
Intermediate CCGT			Capacity-related distribution capital costs -MG	N/A	\$ per kW
Installed Cost	\$971	\$/kW	Capacity-related distribution capital costs - Newport	N/A	\$ per kW
Heat Rate	6,822	BTU/kWh	Capacity-related distribution capital costs - St. Paul	N/A	\$ per kW
			Capacity-related distribution capital costs - NW	N/A	\$ per kW
			Capacity-related distribution capital costs - WBL	N/A	\$ per kW
			Distribution capital cost escalation	2.64%	per year
			Peak Load (Weather Normalized)	6,809	MW
			Peak Load Growth	0.27%	per year

**Table 6. Azimuth and Tilt Angles**

	Array KW	% of Total	Azimuth	Tilt	
1	715	1.2%	80	25	
2	1,058	3.0%	138	26	
3	1,065	3.7%	169	26	
4	4,944	7.5%	180	16	
5	1,147	8.4%	180	24	
6	4,832	20.8%	180	27	
7	4,053	15.6%	180	30	
8	1,729	7.4%	180	35	
9	552	2.6%	180	41	
10	1,843	19.4%	180	46	
11	656	3.2%	187	27	
12	387	1.8%	198	28	
13	862	3.2%	212	24	
14	521	1.3%	240	26	
15	481	1.0%	272	25	
<b>TOTAL</b>	<b>24,844</b>	<b>100%</b>	<b>180.2</b>	<b>30.3</b>	<b>Weighted Average</b>



**Table 8. Economic Value of Avoided Fuel Costs.**

Year	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Prices		p.u. PV Production	Costs		Discount Factor (risk free)	Disc. Costs	
				Utility	VOS		Utility	VOS		Utility	VOS
				\$/mmBtu	\$/mmBtu		mmBtu/MWh	\$/kWh		\$/kWh	(kWh)
2018	\$3.03	\$3.06	7,482	\$0.023	\$0.0262	1,452	\$33	\$38	1.000	\$33	\$38
2019	\$2.85	\$2.88	7,489	\$0.022	\$0.0262	1,444	\$31	\$38	0.989	\$31	\$37
2020	\$2.84	\$2.87	7,497	\$0.021	\$0.0262	1,437	\$31	\$38	0.974	\$30	\$37
2021	\$2.86	\$2.89	7,504	\$0.022	\$0.0262	1,430	\$31	\$38	0.956	\$30	\$36
2022	\$2.89	\$2.92	7,512	\$0.022	\$0.0262	1,423	\$31	\$37	0.936	\$29	\$35
2023	\$2.94	\$2.98	7,519	\$0.022	\$0.0262	1,416	\$32	\$37	0.913	\$29	\$34
2024	\$3.01	\$3.04	7,527	\$0.023	\$0.0262	1,409	\$32	\$37	0.889	\$29	\$33
2025	\$3.09	\$3.12	7,535	\$0.024	\$0.0262	1,402	\$33	\$37	0.864	\$28	\$32
2026	\$3.16	\$3.20	7,542	\$0.024	\$0.0262	1,395	\$34	\$37	0.842	\$28	\$31
2027	\$3.25	\$3.28	7,550	\$0.025	\$0.0262	1,388	\$34	\$36	0.820	\$28	\$30
2028	\$3.33	\$3.37	7,557	\$0.025	\$0.0262	1,381	\$35	\$36	0.797	\$28	\$29
2029	\$3.42	\$3.46	7,565	\$0.026	\$0.0262	1,374	\$36	\$36	0.776	\$28	\$28
2030	\$3.50	\$3.54	7,572	\$0.027	\$0.0262	1,367	\$37	\$36	0.756	\$28	\$27
2031	\$3.58	\$3.62	7,580	\$0.027	\$0.0262	1,360	\$37	\$36	0.735	\$27	\$26
2032	\$3.66	\$3.70	7,587	\$0.028	\$0.0262	1,353	\$38	\$36	0.714	\$27	\$25
2033	\$3.74	\$3.78	7,595	\$0.029	\$0.0262	1,347	\$39	\$35	0.693	\$27	\$24
2034	\$3.83	\$3.87	7,603	\$0.029	\$0.0262	1,340	\$39	\$35	0.673	\$27	\$24
2035	\$3.91	\$3.96	7,610	\$0.030	\$0.0262	1,333	\$40	\$35	0.653	\$26	\$23
2036	\$4.00	\$4.04	7,618	\$0.031	\$0.0262	1,326	\$41	\$35	0.632	\$26	\$22
2037	\$4.09	\$4.14	7,625	\$0.032	\$0.0262	1,320	\$42	\$35	0.612	\$25	\$21
2038	\$4.19	\$4.23	7,633	\$0.032	\$0.0262	1,313	\$42	\$34	0.593	\$25	\$20
2039	\$4.28	\$4.33	7,641	\$0.033	\$0.0262	1,307	\$43	\$34	0.574	\$25	\$20
2040	\$4.38	\$4.42	7,648	\$0.034	\$0.0262	1,300	\$44	\$34	0.556	\$24	\$19
2041	\$4.48	\$4.53	7,656	\$0.035	\$0.0262	1,294	\$45	\$34	0.539	\$24	\$18
2042	\$4.58	\$4.63	7,664	\$0.035	\$0.0262	1,287	\$46	\$34	0.521	\$24	\$18

<b>Validation: Present Value</b>	<b>\$687</b>	<b>\$687</b>
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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		(\$)	(\$)		(\$)	(\$)
2018	\$2.65	1.00	1.00	\$0.0018	\$0.0023	1,452	\$2.65	\$3.40	1.000	\$2.65	\$3.40
2019	\$2.72	0.999	0.995	\$0.0019	\$0.0023	1,444	\$2.71	\$3.38	0.942	\$2.55	\$3.19
2020	\$2.79	0.998	0.990	\$0.0019	\$0.0023	1,437	\$2.77	\$3.37	0.887	\$2.46	\$2.99
2021	\$2.87	0.997	0.985	\$0.0020	\$0.0023	1,430	\$2.83	\$3.35	0.835	\$2.37	\$2.80
2022	\$2.94	0.996	0.980	\$0.0021	\$0.0023	1,423	\$2.89	\$3.33	0.787	\$2.28	\$2.62
2023	\$3.02	0.995	0.975	\$0.0021	\$0.0023	1,416	\$2.96	\$3.32	0.741	\$2.19	\$2.46
2024	\$3.02	0.994	0.970	\$0.0021	\$0.0023	1,409	\$2.95	\$3.30	0.698	\$2.06	\$2.30
2025	\$3.02	0.993	0.966	\$0.0021	\$0.0023	1,402	\$2.94	\$3.28	0.698	\$2.05	\$2.29
2026	\$3.26	0.992	0.961	\$0.0023	\$0.0023	1,395	\$3.16	\$3.27	0.698	\$2.21	\$2.28
2027	\$3.35	0.991	0.956	\$0.0024	\$0.0023	1,388	\$3.23	\$3.25	0.583	\$1.88	\$1.90
2028	\$3.44	0.990	0.951	\$0.0025	\$0.0023	1,381	\$3.30	\$3.24	0.549	\$1.81	\$1.78
2029	\$3.53	0.989	0.946	\$0.0025	\$0.0023	1,374	\$3.38	\$3.22	0.517	\$1.75	\$1.66
2030	\$3.62	0.988	0.942	\$0.0026	\$0.0023	1,367	\$3.45	\$3.20	0.487	\$1.68	\$1.56
2031	\$3.72	0.987	0.937	\$0.0027	\$0.0023	1,360	\$3.53	\$3.19	0.459	\$1.62	\$1.46
2032	\$3.82	0.986	0.932	\$0.0028	\$0.0023	1,353	\$3.61	\$3.17	0.432	\$1.56	\$1.37
2033	\$3.82	0.985	0.928	\$0.0028	\$0.0023	1,347	\$3.59	\$3.16	0.407	\$1.46	\$1.28
2034	\$4.02	0.984	0.923	\$0.0030	\$0.0023	1,340	\$3.77	\$3.14	0.407	\$1.53	\$1.28
2035	\$4.13	0.983	0.918	\$0.0030	\$0.0023	1,333	\$3.85	\$3.12	0.361	\$1.39	\$1.13
2036	\$4.24	0.982	0.914	\$0.0031	\$0.0023	1,326	\$3.94	\$3.11	0.340	\$1.34	\$1.06
2037	\$4.35	0.981	0.909	\$0.0032	\$0.0023	1,320	\$4.03	\$3.09	0.320	\$1.29	\$0.99
2038	\$4.46	0.980	0.905	\$0.0033	\$0.0023	1,313	\$4.12	\$3.08	0.301	\$1.24	\$0.93
2039	\$4.58	0.979	0.900	\$0.0034	\$0.0023	1,307	\$4.21	\$3.06	0.284	\$1.20	\$0.87
2040	\$4.70	0.978	0.896	\$0.0035	\$0.0023	1,300	\$4.30	\$3.05	0.267	\$1.15	\$0.81
2041	\$4.83	0.977	0.891	\$0.0036	\$0.0023	1,294	\$4.40	\$3.03	0.252	\$1.11	\$0.76
2042	\$4.95	0.976	0.887	\$0.0038	\$0.0023	1,287	\$4.50	\$3.02	0.237	\$1.07	\$0.72

Validation: Present Value	\$44	\$44
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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		(\$)	(\$)		(\$)	(\$)
2018	\$0.002	\$0.0030	1,452	\$3	\$4	1.000	\$3	\$4
2019	\$0.002	\$0.0030	1,444	\$3	\$4	0.942	\$3	\$4
2020	\$0.002	\$0.0030	1,437	\$4	\$4	0.887	\$3	\$4
2021	\$0.003	\$0.0030	1,430	\$4	\$4	0.835	\$3	\$4
2022	\$0.003	\$0.0030	1,423	\$4	\$4	0.787	\$3	\$3
2023	\$0.003	\$0.0030	1,416	\$4	\$4	0.741	\$3	\$3
2024	\$0.003	\$0.0030	1,409	\$4	\$4	0.698	\$3	\$3
2025	\$0.003	\$0.0030	1,402	\$4	\$4	0.657	\$3	\$3
2026	\$0.003	\$0.0030	1,395	\$4	\$4	0.619	\$2	\$3
2027	\$0.003	\$0.0030	1,388	\$4	\$4	0.583	\$2	\$2
2028	\$0.003	\$0.0030	1,381	\$4	\$4	0.549	\$2	\$2
2029	\$0.003	\$0.0030	1,374	\$4	\$4	0.517	\$2	\$2
2030	\$0.003	\$0.0030	1,367	\$4	\$4	0.487	\$2	\$2
2031	\$0.003	\$0.0030	1,360	\$4	\$4	0.459	\$2	\$2
2032	\$0.003	\$0.0030	1,353	\$5	\$4	0.432	\$2	\$2
2033	\$0.003	\$0.0030	1,347	\$5	\$4	0.407	\$2	\$2
2034	\$0.004	\$0.0030	1,340	\$5	\$4	0.383	\$2	\$2
2035	\$0.004	\$0.0030	1,333	\$5	\$4	0.361	\$2	\$1
2036	\$0.004	\$0.0030	1,326	\$5	\$4	0.340	\$2	\$1
2037	\$0.004	\$0.0030	1,320	\$5	\$4	0.320	\$2	\$1
2038	\$0.004	\$0.0030	1,313	\$5	\$4	0.301	\$2	\$1
2039	\$0.004	\$0.0030	1,307	\$5	\$4	0.284	\$1	\$1
2040	\$0.004	\$0.0030	1,300	\$5	\$4	0.267	\$1	\$1
2041	\$0.004	\$0.0030	1,294	\$5	\$4	0.252	\$1	\$1
2042	\$0.004	\$0.0030	1,287	\$6	\$4	0.237	\$1	\$1

<b>Validation: Present Value</b>	<b>\$55</b>	<b>\$55</b>
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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
				\$/kWh	\$/kWh		(\$)	(\$)		(\$)	(\$)
2018	\$63	1.00	1.00	\$0.044	\$0.0440	1,452	\$63	\$64	1.000	\$63	\$64
2019	\$63	0.999	0.995	\$0.044	\$0.0440	1,444	\$63	\$64	0.942	\$59	\$60
2020	\$63	0.998	0.990	\$0.044	\$0.0440	1,437	\$63	\$63	0.887	\$56	\$56
2021	\$63	0.997	0.985	\$0.044	\$0.0440	1,430	\$63	\$63	0.835	\$52	\$53
2022	\$63	0.996	0.980	\$0.044	\$0.0440	1,423	\$62	\$63	0.787	\$49	\$49
2023	\$63	0.995	0.975	\$0.044	\$0.0440	1,416	\$62	\$62	0.741	\$46	\$46
2024	\$63	0.994	0.970	\$0.044	\$0.0440	1,409	\$62	\$62	0.698	\$43	\$43
2025	\$63	0.993	0.966	\$0.044	\$0.0440	1,402	\$62	\$62	0.657	\$40	\$41
2026	\$63	0.992	0.961	\$0.044	\$0.0440	1,395	\$61	\$61	0.619	\$38	\$38
2027	\$63	0.991	0.956	\$0.044	\$0.0440	1,388	\$61	\$61	0.583	\$36	\$36
2028	\$63	0.990	0.951	\$0.044	\$0.0440	1,381	\$61	\$61	0.549	\$33	\$33
2029	\$63	0.989	0.946	\$0.044	\$0.0440	1,374	\$61	\$60	0.517	\$31	\$31
2030	\$63	0.988	0.942	\$0.044	\$0.0440	1,367	\$60	\$60	0.487	\$29	\$29
2031	\$63	0.987	0.937	\$0.044	\$0.0440	1,360	\$60	\$60	0.459	\$28	\$27
2032	\$63	0.986	0.932	\$0.044	\$0.0440	1,353	\$60	\$60	0.432	\$26	\$26
2033	\$63	0.985	0.928	\$0.044	\$0.0440	1,347	\$60	\$59	0.407	\$24	\$24
2034	\$63	0.984	0.923	\$0.044	\$0.0440	1,340	\$59	\$59	0.383	\$23	\$23
2035	\$63	0.983	0.918	\$0.044	\$0.0440	1,333	\$59	\$59	0.361	\$21	\$21
2036	\$63	0.982	0.914	\$0.044	\$0.0440	1,326	\$59	\$58	0.340	\$20	\$20
2037	\$63	0.981	0.909	\$0.044	\$0.0440	1,320	\$59	\$58	0.320	\$19	\$19
2038	\$63	0.980	0.905	\$0.045	\$0.0440	1,313	\$58	\$58	0.301	\$18	\$17
2039	\$63	0.979	0.900	\$0.045	\$0.0440	1,307	\$58	\$58	0.284	\$17	\$16
2040	\$63	0.978	0.896	\$0.045	\$0.0440	1,300	\$58	\$57	0.267	\$15	\$15
2041	\$63	0.977	0.891	\$0.045	\$0.0440	1,294	\$58	\$57	0.252	\$15	\$14
2042	\$63	0.976	0.887	\$0.045	\$0.0440	1,287	\$58	\$57	0.237	\$14	\$13
					\$0.0440						
<b>Validation: Present Value</b>										\$815	\$815

**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)	(\$)	(\$)		(\$)	(\$)
2018	\$63	8.1%	1.00	1.00	\$0.004	\$0.0036	1,452	\$5	\$5	1.000	\$5	\$5
2019	\$63	8.1%	0.999	0.995	\$0.004	\$0.0036	1,444	\$5	\$5	0.942	\$5	\$5
2020	\$63	8.1%	0.998	0.990	\$0.004	\$0.0036	1,437	\$5	\$5	0.887	\$5	\$5
2021	\$63	8.1%	0.997	0.985	\$0.004	\$0.0036	1,430	\$5	\$5	0.835	\$4	\$4
2022	\$63	8.1%	0.996	0.980	\$0.004	\$0.0036	1,423	\$5	\$5	0.787	\$4	\$4
2023	\$63	8.1%	0.995	0.975	\$0.004	\$0.0036	1,416	\$5	\$5	0.741	\$4	\$4
2024	\$63	8.1%	0.994	0.970	\$0.004	\$0.0036	1,409	\$5	\$5	0.698	\$3	\$4
2025	\$63	8.1%	0.993	0.966	\$0.004	\$0.0036	1,402	\$5	\$5	0.657	\$3	\$3
2026	\$63	8.1%	0.992	0.961	\$0.004	\$0.0036	1,395	\$5	\$5	0.619	\$3	\$3
2027	\$63	8.1%	0.991	0.956	\$0.004	\$0.0036	1,388	\$5	\$5	0.583	\$3	\$3
2028	\$63	8.1%	0.990	0.951	\$0.004	\$0.0036	1,381	\$5	\$5	0.549	\$3	\$3
2029	\$63	8.1%	0.989	0.946	\$0.004	\$0.0036	1,374	\$5	\$5	0.517	\$3	\$3
2030	\$63	8.1%	0.988	0.942	\$0.004	\$0.0036	1,367	\$5	\$5	0.487	\$2	\$2
2031	\$63	8.1%	0.987	0.937	\$0.004	\$0.0036	1,360	\$5	\$5	0.459	\$2	\$2
2032	\$63	8.1%	0.986	0.932	\$0.004	\$0.0036	1,353	\$5	\$5	0.432	\$2	\$2
2033	\$63	8.1%	0.985	0.928	\$0.004	\$0.0036	1,347	\$5	\$5	0.407	\$2	\$2
2034	\$63	8.1%	0.984	0.923	\$0.004	\$0.0036	1,340	\$5	\$5	0.383	\$2	\$2
2035	\$63	8.1%	0.983	0.918	\$0.004	\$0.0036	1,333	\$5	\$5	0.361	\$2	\$2
2036	\$63	8.1%	0.982	0.914	\$0.004	\$0.0036	1,326	\$5	\$5	0.340	\$2	\$2
2037	\$63	8.1%	0.981	0.909	\$0.004	\$0.0036	1,320	\$5	\$5	0.320	\$2	\$2
2038	\$63	8.1%	0.980	0.905	\$0.004	\$0.0036	1,313	\$5	\$5	0.301	\$1	\$1
2039	\$63	8.1%	0.979	0.900	\$0.004	\$0.0036	1,307	\$5	\$5	0.284	\$1	\$1
2040	\$63	8.1%	0.978	0.896	\$0.004	\$0.0036	1,300	\$5	\$5	0.267	\$1	\$1
2041	\$63	8.1%	0.977	0.891	\$0.004	\$0.0036	1,294	\$5	\$5	0.252	\$1	\$1
2042	\$63	8.1%	0.976	0.887	\$0.004	\$0.0036	1,287	\$5	\$5	0.237	\$1	\$1
						\$0.0036						
<b>Validation: Present Value</b>											\$66	\$66

**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 (\$)
2018	\$49	1.00	1.00	\$0.034	\$0.0338	1,452	\$49	\$49	1.000	\$49	\$49
2019	\$49	0.999	0.995	\$0.034	\$0.0338	1,444	\$48	\$49	0.942	\$46	\$46
2020	\$49	0.998	0.990	\$0.034	\$0.0338	1,437	\$48	\$49	0.887	\$43	\$43
2021	\$49	0.997	0.985	\$0.034	\$0.0338	1,430	\$48	\$48	0.835	\$40	\$40
2022	\$49	0.996	0.980	\$0.034	\$0.0338	1,423	\$48	\$48	0.787	\$38	\$38
2023	\$49	0.995	0.975	\$0.034	\$0.0338	1,416	\$48	\$48	0.741	\$35	\$35
2024	\$49	0.994	0.970	\$0.034	\$0.0338	1,409	\$48	\$48	0.698	\$33	\$33
2025	\$49	0.993	0.966	\$0.034	\$0.0338	1,402	\$47	\$47	0.657	\$31	\$31
2026	\$49	0.992	0.961	\$0.034	\$0.0338	1,395	\$47	\$47	0.619	\$29	\$29
2027	\$49	0.991	0.956	\$0.034	\$0.0338	1,388	\$47	\$47	0.583	\$27	\$27
2028	\$49	0.990	0.951	\$0.034	\$0.0338	1,381	\$47	\$47	0.549	\$26	\$26
2029	\$49	0.989	0.946	\$0.034	\$0.0338	1,374	\$47	\$46	0.517	\$24	\$24
2030	\$49	0.988	0.942	\$0.034	\$0.0338	1,367	\$46	\$46	0.487	\$23	\$23
2031	\$49	0.987	0.937	\$0.034	\$0.0338	1,360	\$46	\$46	0.459	\$21	\$21
2032	\$49	0.986	0.932	\$0.034	\$0.0338	1,353	\$46	\$46	0.432	\$20	\$20
2033	\$49	0.985	0.928	\$0.034	\$0.0338	1,347	\$46	\$46	0.407	\$19	\$19
2034	\$49	0.984	0.923	\$0.034	\$0.0338	1,340	\$46	\$45	0.383	\$17	\$17
2035	\$49	0.983	0.918	\$0.034	\$0.0338	1,333	\$45	\$45	0.361	\$16	\$16
2036	\$49	0.982	0.914	\$0.034	\$0.0338	1,326	\$45	\$45	0.340	\$15	\$15
2037	\$49	0.981	0.909	\$0.034	\$0.0338	1,320	\$45	\$45	0.320	\$14	\$14
2038	\$49	0.980	0.905	\$0.034	\$0.0338	1,313	\$45	\$44	0.301	\$14	\$13
2039	\$49	0.979	0.900	\$0.034	\$0.0338	1,307	\$45	\$44	0.284	\$13	\$13
2040	\$49	0.978	0.896	\$0.034	\$0.0338	1,300	\$45	\$44	0.267	\$12	\$12
2041	\$49	0.977	0.891	\$0.034	\$0.0338	1,294	\$44	\$44	0.252	\$11	\$11
2042	\$49	0.976	0.887	\$0.034	\$0.0338	1,287	\$44	\$44	0.237	\$10	\$10
					\$0.0338						
<b>Validation: Present Value</b>										\$627	\$627

**Table 14. Determination of deferrable distribution costs.**

Year	Distribution Project Costs	% Capacity Related	Capacity Related		
	\$	%	\$		
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		
2008	100,420,422	29.5%	29,595,797		
2007	83,835,204	8.5%	7,134,725		
<b>TOTAL 10-YEAR PERIOD</b>	<b>1,147,548,539</b>		<b>168,708,544</b>		

**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
2018	\$80	50	\$4	\$4	\$6				\$5
2019	\$82	50	\$4	\$4	\$6	50	\$4.1	\$3.9	\$5
2020	\$84	50	\$4	\$4	\$6	50	\$4.2	\$3.7	\$5
2021	\$87	50	\$4	\$4	\$6	50	\$4.3	\$3.6	\$5
2022	\$89	51	\$4	\$4	\$6	50	\$4.5	\$3.5	\$5
2023	\$91	51	\$5	\$3	\$6	51	\$4.6	\$3.4	\$5
2024	\$94	51	\$5	\$3	\$6	51	\$4.7	\$3.3	\$5
2025	\$96	51	\$5	\$3	\$6	51	\$4.9	\$3.2	\$5
2026	\$99	51	\$5	\$3	\$6	51	\$5.0	\$3.1	\$5
2027	\$101	51	\$5	\$3	\$6	51	\$5.2	\$3.0	\$5
2028	\$104	51	\$5	\$3	\$6	51	\$5.3	\$2.9	\$5
2029	\$107	52	\$5	\$3	\$6	51	\$5.5	\$2.8	\$5
2030	\$109	52	\$6	\$3	\$6	52	\$5.6	\$2.7	\$5
2031	\$112	52	\$6	\$3	\$6	52	\$5.8	\$2.7	\$5
2032	\$115	52	\$6	\$3	\$6	52	\$6.0	\$2.6	\$5
2033	\$118	52	\$6	\$3	\$6	52	\$6.1	\$2.5	\$5
2034	\$121	52	\$6	\$2	\$6	52	\$6.3	\$2.4	\$5
2035	\$125	52	\$7	\$2	\$6	52	\$6.5	\$2.3	\$5
2036	\$128	52	\$7	\$2	\$6	52	\$6.7	\$2.3	\$5
2037	\$131	53	\$7	\$2	\$6	52	\$6.9	\$2.2	\$5
2038	\$135	53	\$7	\$2	\$6	53	\$7.1	\$2.1	\$5
2039	\$138	53	\$7	\$2	\$6	53	\$7.3	\$2.1	\$5
2040	\$142	53	\$8	\$2	\$6	53	\$7.5	\$2.0	\$5
2041	\$146	53	\$8	\$2	\$6	53	\$7.7	\$1.9	\$5
2042	\$150	53	\$8	\$2	\$6	53	\$8.0	\$1.9	\$5
2039	\$153					53	\$8.2	\$1.8	
					\$71				\$68



**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)	(\$)	(\$)		(\$)	(\$)
\$0.00258	\$0.0026	1,452	\$4	\$4	1.000	\$4	\$4
\$0.00258	\$0.0026	1,444	\$4	\$4	0.942	\$4	\$4
\$0.00259	\$0.0026	1,437	\$4	\$4	0.887	\$3	\$3
\$0.00260	\$0.0026	1,430	\$4	\$4	0.835	\$3	\$3
\$0.00260	\$0.0026	1,423	\$4	\$4	0.787	\$3	\$3
\$0.00261	\$0.0026	1,416	\$4	\$4	0.741	\$3	\$3
\$0.00261	\$0.0026	1,409	\$4	\$4	0.698	\$3	\$3
\$0.00262	\$0.0026	1,402	\$4	\$4	0.657	\$2	\$2
\$0.00263	\$0.0026	1,395	\$4	\$4	0.619	\$2	\$2
\$0.00263	\$0.0026	1,388	\$4	\$4	0.583	\$2	\$2
\$0.00264	\$0.0026	1,381	\$4	\$4	0.549	\$2	\$2
\$0.00264	\$0.0026	1,374	\$4	\$4	0.517	\$2	\$2
\$0.00265	\$0.0026	1,367	\$4	\$4	0.487	\$2	\$2
\$0.00266	\$0.0026	1,360	\$4	\$4	0.459	\$2	\$2
\$0.00266	\$0.0026	1,353	\$4	\$4	0.432	\$2	\$2
\$0.00267	\$0.0026	1,347	\$4	\$4	0.407	\$1	\$1
\$0.00267	\$0.0026	1,340	\$4	\$4	0.383	\$1	\$1
\$0.00268	\$0.0026	1,333	\$4	\$4	0.361	\$1	\$1
\$0.00269	\$0.0026	1,326	\$4	\$3	0.340	\$1	\$1
\$0.00269	\$0.0026	1,320	\$4	\$3	0.320	\$1	\$1
\$0.00270	\$0.0026	1,313	\$4	\$3	0.301	\$1	\$1
\$0.00271	\$0.0026	1,307	\$4	\$3	0.284	\$1	\$1
\$0.00271	\$0.0026	1,300	\$4	\$3	0.267	\$1	\$1
\$0.00272	\$0.0026	1,294	\$4	\$3	0.252	\$1	\$1
\$0.00272	\$0.0026	1,287	\$4	\$3	0.237	\$1	\$1
					-		
	\$0.0026		Validation: Present Value			\$49	\$49

**Table 17. Economic value of avoided environmental costs**

Environmental Discount Rate

5.34%

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 (\$)
2018	\$2.78	7,482	\$0.021	\$0.0316	1,452	\$30	\$46	1.000	\$30	\$46
2019	\$2.92	7,489	\$0.022	\$0.0316	1,444	\$32	\$46	0.949	\$30	\$43
2020	\$3.06	7,497	\$0.023	\$0.0316	1,437	\$33	\$45	0.901	\$30	\$41
2021	\$3.19	7,504	\$0.024	\$0.0316	1,430	\$34	\$45	0.856	\$29	\$39
2022	\$3.31	7,512	\$0.025	\$0.0316	1,423	\$35	\$45	0.812	\$29	\$37
2023	\$3.45	7,519	\$0.026	\$0.0316	1,416	\$37	\$45	0.771	\$28	\$35
2024	\$3.58	7,527	\$0.027	\$0.0316	1,409	\$38	\$45	0.732	\$28	\$33
2025	\$3.72	7,535	\$0.028	\$0.0316	1,402	\$39	\$44	0.695	\$27	\$31
2026	\$3.87	7,542	\$0.029	\$0.0316	1,395	\$41	\$44	0.660	\$27	\$29
2027	\$4.02	7,550	\$0.030	\$0.0316	1,388	\$42	\$44	0.626	\$26	\$27
2028	\$4.17	7,557	\$0.032	\$0.0316	1,381	\$44	\$44	0.594	\$26	\$26
2029	\$4.33	7,565	\$0.033	\$0.0316	1,374	\$45	\$43	0.564	\$25	\$25
2030	\$4.49	7,572	\$0.034	\$0.0316	1,367	\$47	\$43	0.536	\$25	\$23
2031	\$4.68	7,580	\$0.035	\$0.0316	1,360	\$48	\$43	0.509	\$25	\$22
2032	\$4.87	7,587	\$0.037	\$0.0316	1,353	\$50	\$43	0.483	\$24	\$21
2033	\$5.07	7,595	\$0.039	\$0.0316	1,347	\$52	\$43	0.458	\$24	\$20
2034	\$5.28	7,603	\$0.040	\$0.0316	1,340	\$54	\$42	0.435	\$23	\$18
2035	\$5.49	7,610	\$0.042	\$0.0316	1,333	\$56	\$42	0.413	\$23	\$17
2036	\$5.71	7,618	\$0.043	\$0.0316	1,326	\$58	\$42	0.392	\$23	\$16
2037	\$5.93	7,625	\$0.045	\$0.0316	1,320	\$60	\$42	0.372	\$22	\$16
2038	\$6.16	7,633	\$0.047	\$0.0316	1,313	\$62	\$42	0.353	\$22	\$15
2039	\$6.41	7,641	\$0.049	\$0.0316	1,307	\$64	\$41	0.336	\$21	\$14
2040	\$6.65	7,648	\$0.051	\$0.0316	1,300	\$66	\$41	0.319	\$21	\$13
2041	\$6.89	7,656	\$0.053	\$0.0316	1,294	\$68	\$41	0.302	\$21	\$12
2042	\$7.13	7,664	\$0.055	\$0.0316	1,287	\$70	\$41	0.287	\$20	\$12

Validation: Present Value

\$630

\$630

**Table 18. Calculation of inflation-adjusted VOS**

Year	Discount Factor	PV Production	Escallation Factor	VOS Levelized	Disc.	VOS Inflation Adj. (\$/kWh)	Disc
2018	1.000	1452	1.000	\$0.114	\$165	\$0.0922	133.883
2019	0.942	1444	1.023	\$0.114	\$155	\$0.0943	128.308
2020	0.887	1437	1.046	\$0.114	\$145	\$0.0965	122.965
2021	0.835	1430	1.070	\$0.114	\$136	\$0.0986	117.845
2022	0.787	1423	1.094	\$0.114	\$127	\$0.1009	112.938
2023	0.741	1416	1.119	\$0.114	\$119	\$0.1032	108.235
2024	0.698	1409	1.144	\$0.114	\$112	\$0.1055	103.728
2025	0.698	1402	1.170	\$0.114	\$111	\$0.1079	105.552
2026	0.698	1395	1.197	\$0.114	\$111	\$0.1104	107.408
2027	0.583	1388	1.224	\$0.114	\$92	\$0.1129	91.302
2028	0.549	1381	1.252	\$0.114	\$86	\$0.1154	87.500
2029	0.517	1374	1.280	\$0.114	\$81	\$0.1181	83.857
2030	0.487	1367	1.309	\$0.114	\$76	\$0.1207	80.365
2031	0.459	1360	1.339	\$0.114	\$71	\$0.1235	77.019
2032	0.432	1353	1.369	\$0.114	\$66	\$0.1263	73.812
2033	0.407	1347	1.400	\$0.114	\$62	\$0.1291	70.738
2034	0.407	1340	1.432	\$0.114	\$62	\$0.1321	71.982
2035	0.361	1333	1.465	\$0.114	\$55	\$0.1351	64.970
2036	0.340	1326	1.498	\$0.114	\$51	\$0.1381	62.264
2037	0.320	1320	1.532	\$0.114	\$48	\$0.1413	59.672
2038	0.301	1313	1.567	\$0.114	\$45	\$0.1445	57.187
2039	0.284	1307	1.602	\$0.114	\$42	\$0.1478	54.806
2040	0.267	1300	1.639	\$0.114	\$39	\$0.1511	52.523
2041	0.252	1294	1.676	\$0.114	\$37	\$0.1545	50.336
2042	0.237	1287	1.714	\$0.114	\$35	\$0.1581	48.240
					\$2,127		\$2,127