

CONTENTS

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)	(No Losses)	(%)	(\$/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%	pear 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			Costs			Disc. Costs				
	Guaranteed NG Price	Burner Tip NG Price	Heat Rate	Utility	VOS	p.u. PV Production	Utility	VOS	Discount Factor	Utility	VOS
	\$/mmBtu	\$/mmBtu	mmBtu/kWh	\$/kWh	\$/kWh	(kWh)	(\$)	(\$)	(risk free)	(\$)	(\$)
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
----------------------------------	--------------	--------------

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

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	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		PV Production (kWh)	Costs		Discount Factor	Disc. Costs	
	Capacity Cost	Reserve Margin	Utility Capacity	PV Capacity	Utility	VOS		Utility	VOS		Utility	VOS
	\$/kW-yr	%	pu.	kW	\$/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	\$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			Costs			Disc. Costs	
Utility	VOS	PV Production	Utility	VOS	Discount Factor	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
----------------------------------	--------------	--------------

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