



APPENDIX H

Potential Resources

2023-2037 INTEGRATED RESOURCE PLAN

Submitted to the Minnesota Public Utilities Commission

Docket No. **ET-2/RP-22-75**

March 31st, 2023

Appendix H – Potential Resources and Characteristics

Modeled Resource	Years Available as Resource Addition	Max Capacity (MW)	Winter Firm Capacity (% of MaxCap)	Spring Firm Capacity (% of MaxCap)	Summer Firm Capacity (% of MaxCap)	Fall Firm Capacity (% of MaxCap)	Cost Data Source
New Combustion Turbine	2027-2037	200	100	84	80	84	NREL ATB
New Demand Response	2028	33*	64	68	100	68	GRE
New Energy Efficiency	2028	20*	-	-	-	-	GRE
New Lithium-ion Battery	2027-2037	200	95	95	95	95	NREL ATB
New Solar PPA	2027-2037	200	6	15	45	25	GRE
New Wind PPA	2027-2037	200	40	23	18	23	GRE
New Self-Build Wind**	2027-2037	200	40	23	18	23	NREL ATB
*See annual Demand Response and Energy Efficiency escalation							
**Self-Build Wind only included as new resource option in "Self-Build Wind with PTC" sensitivity							

Modeled Resource	Capital Expenditures (\$000)									
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
New Combustion Turbine	\$157,000.00	\$160,925.00	\$164,948.13	\$169,071.83	\$173,289.62	\$177,631.09	\$182,071.87	\$186,623.66	\$191,289.25	\$196,071.49
New Demand Response	-	-	-	-	-	\$104.00	-	-	-	-
New Energy Efficiency	-	-	-	-	-	\$1,138.90	-	-	-	-
New Lithium-ion Battery	\$251,142.00	\$233,352.00	\$220,795.00	\$211,378.00	\$203,006.00	\$193,588.00	\$186,263.00	\$178,938.00	\$176,791.00	\$174,554.00
New Solar PPA	-	-	-	-	-	-	-	-	-	-
New Wind PPA	-	-	-	-	-	-	-	-	-	-
New Self-Build Wind	\$212,140.00	\$212,140.00	\$212,140.00	\$212,140.00	\$212,140.00	\$202,298.00	\$192,456.00	\$182,614.00	\$180,788.00	\$178,962.00

	Capital Expenditures (\$000)				
Modeled Resource	2033	2034	2035	2036	2037
New Combustion Turbine	\$200,973.27	\$205,997.61	\$211,147.55	\$216,426.23	\$221,836.89
New Demand Response	-	-	-	-	-
New Energy Efficiency	-	-	-	-	-
New Lithium-ion Battery	\$172,317.00	\$170,080.00	\$167,844.00	\$165,607.00	\$163,370.00
New Solar PPA	-	-	-	-	-
New Wind PPA	-	-	-	-	-
New Self-Build Wind	\$177,135.00	\$175,309.00	\$173,483.00	\$171,657.00	\$169,831.00

	Fixed Operating & Maintenance Costs (FO&M) (\$/kW-year)									
Modeled Resource	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
New Combustion Turbine	\$21.53	\$22.06	\$22.61	\$23.18	\$23.76	\$24.35	\$24.96	\$25.59	\$26.23	\$26.88
New Demand Response						\$137.58	\$141.02	\$144.54	\$148.16	\$151.86
New Energy Efficiency						\$3,168.00	\$3,247.00	\$3,174.00	\$3,411.00	\$3,497.00
New Lithium-ion Battery	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00
New Solar PPA	-	-	-	-	-	-	-	-	-	-
New Wind PPA	-	-	-	-	-	-	-	-	-	-
New Self-Build Wind	\$42.00	\$42.00	\$42.00	\$42.00	\$42.00	\$42.00	\$41.00	\$41.00	\$41.00	\$40.00

	Fixed Operating & Maintenance Costs (FO&M) (\$/kW-year)				
Modeled Resource	2033	2034	2035	2036	2037
New Combustion Turbine	\$27.55	\$28.24	\$28.95	\$29.67	\$30.41
New Demand Response	\$155.66	\$159.55	\$163.54	\$167.63	\$171.82
New Energy Efficiency	\$4,779.00	\$2,939.00	\$3,765.00	\$2,860.00	\$3,956.00
New Lithium-ion Battery	\$34.00	\$34.00	\$34.00	\$34.00	\$34.00
New Solar PPA	-	-	-	-	-
New Wind PPA	-	-	-	-	-
New Self-Build Wind	\$40.00	\$40.00	\$39.00	\$39.00	\$39.00

	Variable Operating & Maintenance Costs (VO&M) (\$/MWh)									
Modeled Resource	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
New Combustion Turbine	\$5.13	\$5.25	\$5.38	\$5.52	\$5.66	\$5.80	\$5.94	\$6.09	\$6.24	\$6.40
New Demand Response	-	-	-	-	-	-	-	-	-	-
New Energy Efficiency	-	-	-	-	-	-	-	-	-	-
New Lithium-ion Battery	-	-	-	-	-	-	-	-	-	-
New Solar PPA	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00
New Wind PPA	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00
New Self-Build Wind	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00

	Variable Operating & Maintenance Costs (VO&M) (\$/MWh)				
Modeled Resource	2033	2034	2035	2036	2037
New Combustion Turbine	\$6.56	\$6.72	\$6.89	\$7.06	\$7.24
New Demand Response	-	-	-	-	-
New Energy Efficiency	-	-	-	-	-
New Lithium-ion Battery	-	-	-	-	-
New Solar PPA	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00
New Wind PPA	\$45.00	\$45.00	\$45.00	\$45.00	\$45.00
New Self-Build Wind	-\$26.00	-\$26.00	-\$26.00	-\$26.00	-\$26.00

Annual Demand Response and Energy Efficiency Escalation (MW)										
Cumulative Program Size (MW)	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Demand Response	3	6	9	12	15	18	21	25	29	33
Energy Efficiency	2	4	6	8	10	12	14	16	18	20

Energy Efficiency Fixed Cost Data					
	Additional savings (kW), incremental*	Incentives	Administration	Total	\$/kW
2028	2,705	\$4,161,710.99	\$4,405,316.20	\$8,567,027.19	\$3,168
2029	2,704	\$4,265,753.76	\$4,515,449.11	\$8,781,202.87	\$3,247
2030	2,836	\$4,372,397.60	\$4,628,335.33	\$9,000,732.94	\$3,174
2031	2,704	\$4,481,707.54	\$4,744,043.72	\$9,225,751.26	\$3,411
2032	2,705	\$4,593,750.23	\$4,862,644.81	\$9,456,395.04	\$3,497
2033	2,028	\$4,708,593.99	\$4,984,210.93	\$9,692,804.92	\$4,779
2034	3,381	\$4,826,308.84	\$5,108,816.20	\$9,935,125.04	\$2,939
2035	2,704	\$4,946,966.56	\$5,236,536.61	\$10,183,503.17	\$3,765
2036	2,705	\$5,070,640.72	\$5,367,450.02	\$10,438,090.75	\$3,860
2037	2,704	\$5,197,406.74	\$5,501,636.28	\$10,699,043.02	\$3,956
*Capacity adjusted for EE program offered in EnCompass					