Appendix F

Supply-Side Resource Modeling Assumptions

SHEET INDEX

Solar>>

1a. Utility-Scale Solar Detail
1b. Utility-Scale Solar Costs

Wind>>

Land-Based Wind Details
Land-Based Wind Costs

Battery Storage>>

4-Hour Storage Detail
4-Hour Storage Costs
6-Hour Storage Detail
6-Hour Storage Costs
8-Hour Storage Detail
8-Hour Storage Costs
10-Hour Storage Detail
10-Hour Storage Costs

Natural Gas>>

Combustion Turbine (F-Frame)
2x1 Combined Cycle (F-Frame)
2x1 Combined Cycle (H-Frame)

INTENTIONALLY LEFT BLANK

Natural Gas: Combustion Turbine (F-Frame)

Nominal 233 MWnet F-Frame simple cycle combustion turbine. Advanced Technology - NA

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/5883/2023_v2_Workbook_07_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/fossil_energy_technologies

NREL Moderate		Direct from NREL Calculation																															
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.971	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	0.000	$1,000	$1,003	$995	$987	$979	$971	$963	$955	$947	$939	$931	$923	$915	$908	$900	$892	$884	$876	$868	$860	$852	$844	$836	$828	$820	$812	$805	$797	$789	$781
Fixed O&M	$/kW-year	Real 2021$		$34.00	$34.00	$33.80	$33.70	$33.60	$33.40	$33.30	$33.20	$33.00	$32.90	$32.80	$32.60	$32.50	$32.40	$32.30	$32.10	$32.00	$31.90	$31.70	$31.60	$31.50	$31.30	$31.20	$31.10	$30.90	$30.80	$30.70	$30.50	$30.40	$30.30
Variable O&M	$/MWh	Real 2021$		$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44	$6.44
Heat Rate	MMBtu/MWh	-		9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717
Capital Cost	$/kW	Nominal		$1,000	$1,028	$1,045	$1,063	$1,080	$1,098	$1,117	$1,135	$1,154	$1,173	$1,192	$1,211	$1,231	$1,251	$1,271	$1,291	$1,312	$1,333	$1,354	$1,375	$1,396	$1,418	$1,440	$1,462	$1,484	$1,506	$1,529	$1,552	$1,576	$1,598
Fixed O&M	$/kW-year	Nominal		$34.00	$34.60	$35.00	$35.52	$36.05	$36.47	$37.02	$37.58	$38.02	$38.60	$39.19	$39.65	$40.26	$40.88	$41.51	$42.01	$42.66	$43.32	$43.84	$44.53	$45.23	$45.78	$46.50	$47.23	$47.80	$48.56	$49.34	$49.93	$40.73	$41.54
Variable O&M	$/MWh	Nominal		$6.44	$6.60	$6.77	$6.94	$7.11	$7.26	$7.47	$7.66	$7.85	$8.08	$8.24	$8.45	$8.66	$8.88	$9.10	$9.33	$9.56	$9.80	$10.04	$10.30	$10.55	$10.82	$11.09	$11.36	$11.65	$11.94	$12.24	$12.54	$12.86	$13.18
Heat Rate	MMBtu/MWh	-		9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717	9.717

2028 COD

Project Size (MW)	233
Debt Rate (%)	5.00%
Book Life (Years)	20
Debt Life (Years)	20
Installed Cost ($/kW)	$1,133
Fixed O&M ($/kW-year)	$22.58
Fixed O&M Escalation (%)	2.00%

Property Taxes	0.00%
Insurance	0.00%
Decommissioning	0.00%

Interest During Construction	6.00%
Accumulated Interest - Year 1	1.000
Accumulated Interest - Year 2	1.000
Accumulated Interest - Year 3	1.000
Accumulated Interest - Year 4	1.000
Construction Finance Factor	1.0000
AFUDC ($000)	$0

Year Index	Capital Fraction
0	20%
1	40%
2	30%
3	5%
	100%

	Year	Capital Expense	Book Value	Book Depreciation	Tax Depreciation	Property Taxes	Insurance	Decommissioning	Debt	Debt Service	Interest	FOM ($/kW-mo)	Total Fixed Costs ($000)
	0	264,500	264,500						-264,500				
2028	1		251,275	13,225	0	0	0	0	258,501	21,224	13,225	$27.58	$32,876
2029	2		238,050	13,225	0	0	0	0	246,102	21,224	12,825	$28.15	$32,604
2030	3		224,825	13,225	0	0	0	0	236,283	21,224	12,405	$28.69	$32,315
2031	4		211,600	13,225	0	0	0	0	230,023	21,224	11,964	$29.27	$32,008
2032	5		198,375	13,225	0	0	0	0	220,300	21,224	11,501	$29.85	$31,681
2033	6		185,150	13,225	0	0	0	0	210,091	21,224	11,015	$30.45	$31,334
2034	7		171,925	13,225	0	0	0	0	199,371	21,224	10,505	$31.06	$30,966
2035	8		158,700	13,225	0	0	0	0	188,115	21,224	9,969	$31.68	$30,575
2036	9		145,475	13,225	0	0	0	0	176,297	21,224	9,406	$32.31	$30,159
2037	10		132,250	13,225	0	0	0	0	163,888	21,224	8,815	$32.98	$29,719
2038	11		119,025	13,225	0	0	0	0	150,858	21,224	8,194	$33.62	$29,252
2039	12		105,800	13,225	0	0	0	0	137,177	21,224	7,543	$34.29	$28,757
2040	13		92,575	13,225	0	0	0	0	122,811	21,224	6,859	$34.97	$28,233
2041	14		79,350	13,225	0	0	0	0	107,727	21,224	6,141	$35.67	$27,678
2042	15		66,125	13,225	0	0	0	0	91,890	21,224	5,386	$36.38	$27,090
2043	16		52,900	13,225	0	0	0	0	75,260	21,224	4,594	$37.12	$26,467
2044	17		39,675	13,225	0	0	0	0	57,799	21,224	3,763	$37.86	$25,809
2045	18		26,450	13,225	0	0	0	0	39,464	21,224	2,890	$38.62	$25,112
2046	19		13,225	13,225	0	0	0	0	20,214	21,224	1,973	$39.39	$24,376
2047	20		0	13,225	0	0	0	0	0	21,224	1,011	$40.18	$23,597
		NPV	164,813		0	0	0		264,500	112,135		404	$371,182
		Levelized $/kW-mo	$4.73		$0.00	$0.00	$0.00		$7.59	$3.22		$2.70	$10.85

Levelized Fixed Costs ($/kW-mo)	
Depreciation	$4.73
Interest	$3.22
Other*	$0.00
Fixed O&M	$2.70
Total	**$10.85**

* Property Taxes, Insurance, Decommissioning

Technology-Specific Variables

	New Install (Y/N)	Heat Rate (MMBtu/MWh)	Minimum Plant Loading	Outage Rates (%) Forced	Planned	Emissions (lbs/MWh) SO2	NOx	CO	CO2	Ramp Rate (%/min)	CCS (Y/N)
NG F-Frame CT	Y	9.717	50%	5%	7%	0.001	0.004	0.08E-03	116	8%	N
NG F-Frame CC	Y	6.903	50%	5%	10%	0.001	0.004	0.08E-03	116.6	5%	N
NG R-Frame CC	Y	6.198	50%	5%	10%	0.001	0.004	0.08E-03	116.6	5%	N
NG F-Frame CC 90% CCS	Y	7.228	50%	5%	10%	0.000	0.003	0.08E-03	5.9	5%	Y
NG R-Frame CC 90% CCS	Y	7.007	50%	5%	10%	0.000	0.003	0.08E-03	5.9	5%	Y
NG F-Frame CC 95% CCS	Y	7.298	50%	5%	10%	0.000	0.003	0.08E-03	3.0	5%	Y
NG R-Frame CC 95% CCS	Y	7.046	50%	5%	10%	0.000	0.003	0.08E-03	3.0	5%	Y

Natural Gas: 2x1 Combined Cycle (F-Frame)

Nominal 727 MWnet 2X1 F-Frame natural gas combined cycle (NGCC) power plant. Advanced Technology - Advanced NGCC ("X" F-Frame high firing temperature combustion turbine technology)

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/6860/2023 v2 Workbook 07 20 23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/fossil_energy_technologies

NREL Moderate		Direct from NREL Calculation																															
Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,116	$1,116	$1,107	$1,097	$1,088	$1,078	$1,068	$1,059	$1,049	$1,039	$1,030	$1,020	$1,010	$1,010	$1,001	$991	$983	$975	$967	$959	$950	$942	$934	$926	$918	$910	$901	$893	$885	$877	$869
Fixed O&M	$/kW-year	Real 2021$	$31.10	$31.10	$30.80	$30.50	$30.20	$29.90	$29.60	$29.30	$29.00	$28.70	$28.40	$28.10	$27.70	$27.40	$27.10	$26.90	$26.70	$26.50	$26.30	$26.10	$25.90	$25.70	$25.50	$25.30	$25.10	$24.90	$24.70	$24.50	$24.30	$24.10	
Variable O&M	$/MWh	Real 2021$	$1.96	$1.96	$1.96	$1.94	$1.93	$1.91	$1.90	$1.89	$1.87	$1.86	$1.84	$1.83	$1.81	$1.80	$1.79	$1.77	$1.76	$1.75	$1.74	$1.73	$1.72	$1.71	$1.70	$1.69	$1.68	$1.67	$1.66	$1.65	$1.64	$1.63	$1.62
Heat Rate	MMBtu/MWh	-	6.363	6.363	6.348	6.332	6.316	6.300	6.285	6.269	6.253	6.238	6.222	6.206	6.190	6.175	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159
Capital Cost	$/kW	Nominal	$1,116	$1,144	$1,163	$1,181	$1,200	$1,219	$1,239	$1,259	$1,218	$1,278	$1,298	$1,318	$1,338	$1,359	$1,379	$1,400	$1,424	$1,447	$1,471	$1,495	$1,519	$1,544	$1,569	$1,594	$1,619	$1,646	$1,671	$1,697	$1,724	$1,751	$1,778
Fixed O&M	$/kW-year	Nominal	$31.10	$31.88	$32.36	$32.85	$33.34	$33.83	$34.33	$34.83	$35.33	$35.84	$36.35	$36.87	$37.25	$37.77	$38.29	$38.96	$39.64	$40.32	$41.02	$41.72	$42.44	$43.17	$43.90	$44.64	$45.40	$46.16	$46.94	$47.72	$48.51	$49.32	
Variable O&M	$/MWh	Nominal	$1.96	$2.01	$2.06	$2.08	$2.11	$2.15	$2.19	$2.23	$2.27	$2.30	$2.34	$2.37	$2.42	$2.47	$2.50	$2.55	$2.60	$2.65	$2.70	$2.75	$2.80	$2.86	$2.91	$2.96	$3.02	$3.08	$3.14	$3.19	$2.25	$3.32	
Heat Rate	MMBtu/MWh	-	6.363	6.363	6.348	6.332	6.316	6.300	6.285	6.269	6.253	6.238	6.222	6.206	6.190	6.175	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159	6.159

2028 COD

Project Size (MW)	233
Debt Rate (%)	5.00%
Book Life (Years)	20
Debt Life (Years)	20
Installed Cost ($/kW)	$1,258
Fixed O&M ($/kW-year)	$34.83
Fixed O&M Escalation (%)	2.00%

Property Taxes	0.00%
Insurance	0.00%
Decommissioning	0.00%

Interest During Construction	5.00%
Accumulated Interest - Year 1	1.025
Accumulated Interest - Year 2	1.076
Accumulated Interest - Year 3	1.130
Accumulated Interest - Year 4	1.186
Construction Finance Factor	1.0658
AFUDC ($000)	$19,332

Year Index	Capital Fraction
0	32%
1	46%
2	22%
3	0%
	100%

	Year	Capital Expense	Book Value	Book Depreciation	Tax Depreciation	Property Taxes	Insurance	Decommissioning	Sold	Debt Service	Interest	FOM ($/kW-year)	Total Fixed Costs ($000)
	0	312,527	312,527						-312,527				
2028	1		296,900	15,626	0	0	0	0	303,075	25,078	15,636	$34.83	$39,368
2029	2		281,274	15,626	0	0	0	0	293,151	25,078	15,154	$35.55	$39,057
2030	3		265,648	15,626	0	0	0	0	283,731	25,078	14,636	$36.26	$38,727
2031	4		250,021	15,626	0	0	0	0	271,789	25,078	14,137	$36.98	$38,375
2032	5		234,395	15,626	0	0	0	0	260,301	25,078	13,580	$37.70	$38,000
2033	6		218,769	15,626	0	0	0	0	248,238	25,078	13,015	$38.45	$37,601
2034	7		203,142	15,626	0	0	0	0	235,572	25,078	12,412	$39.22	$37,177
2035	8		187,516	15,626	0	0	0	0	222,272	25,078	11,779	$40.01	$36,727
2036	9		171,890	15,626	0	0	0	0	208,308	25,078	11,114	$40.81	$36,248
2037	10		156,263	15,626	0	0	0	0	193,645	25,078	10,415	$41.62	$35,740
2038	11		140,637	15,626	0	0	0	0	178,250	25,078	9,682	$42.46	$35,201
2039	12		125,011	15,626	0	0	0	0	162,084	25,078	8,912	$43.30	$34,629
2040	13		109,384	15,626	0	0	0	0	145,110	25,078	8,104	$44.17	$34,022
2041	14		93,758	15,626	0	0	0	0	127,288	25,078	7,256	$45.05	$33,380
2042	15		78,132	15,626	0	0	0	0	108,574	25,078	6,364	$45.96	$32,698
2043	16		62,505	15,626	0	0	0	0	88,925	25,078	5,429	$46.87	$31,977
2044	17		46,879	15,626	0	0	0	0	68,263	25,078	4,446	$47.81	$31,213
2045	18		31,253	15,626	0	0	0	0	46,630	25,078	3,415	$48.77	$30,404
2046	19		15,626	15,626	0	0	0	0	23,884	25,078	2,332	$49.74	$29,548
2047	20		0	15,626	0	0	0	0	0	25,078	1,194	$50.74	$28,643
			NPV	194,739		0	0	0		312,527	132,496	$11	$446,245
			Levelized $/kW-mo	$5.59		$0.00	$0.00	$0.00		$8.97	$3.80	$3.42	$12.81

Levelized Fixed Costs ($/kW-mo)	
Depreciation	$5.59
Interest	$3.80
Other*	$0.00
Fixed O&M	$3.42
Total	**$12.81**

* Property Taxes, Insurance, Decommissioning

Technology-Specific Variables

	New-Build (Y/N)	Heat Rate (MMBtu/MWh)	Minimum Plant Load (%)	Outage Rates (%) Forced	Outage Rates (%) Planned	Emissions (lbs/MMBtu) SO2	Emissions (lbs/MMBtu) NOx	Emissions (lbs/MMBtu) Hg	Emissions (lbs/MMBtu) CO2	Ramp Rate (%/min)	CCS (Y/N)
NG F-Frame CT	Y	9.717	10%	5%	7%	0.001	0.036	0.000-00	119	8%	N
NG F-Frame CC	Y	6.363	50%	5%	10%	0.001	0.004	0.000-00	118.8	5%	N
NG H-Frame CC	Y	6.166	50%	5%	10%	0.001	0.004	0.000-00	110.8	5%	N
NG F-Frame CC 90% CCS	Y	7.229	50%	5%	10%	0.000	0.003	0.000-00	5.9	5%	Y
NG H-Frame CC 90% CCS	Y	7.007	50%	5%	10%	0.000	0.003	0.000-00	5.9	5%	Y
NG F-Frame CC 97% CCS	Y	7.298	50%	5%	10%	0.000	0.003	0.000-00	3.6	5%	Y
NG H-Frame CC 97% CCS	Y	7.045	50%	5%	10%	0.000	0.003	0.000-00	3.6	5%	Y

Natural Gas: 2x1 Combined Cycle (H-Frame)

Nominal 982 MWnet 2X1 H-Frame natural gas combined cycle (NGCC) power plant. Advanced Technology - Advanced NGCC ("X"-Frame high firing temperature combustion turbine technology)

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/5883/2023_v1_Workbook_07_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/fossil_energy_technologies

NREL Moderate		Direct from NREL Calculation																															
Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%		2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,148	$1,148	$1,137	$1,126	$1,115	$1,104	$1,093	$1,082	$1,071	$1,060	$1,050	$1,039	$1,028	$1,017	$1,006	$987	$989	$981	$973	$964	$956	$948	$940	$931	$923	$915	$906	$898	$890	$882
Fixed O&M	$/kW-year	Real 2021$	$30.80	$30.80	$30.50	$30.20	$29.90	$29.60	$29.30	$29.00	$38.70	$38.40	$38.10	$37.80	$27.50	$27.20	$26.90	$26.70	$26.50	$26.30	$26.10	$25.90	$25.70	$25.50	$25.30	$25.10	$24.90	$24.70	$24.50	$24.30	$24.10	$23.90
Variable O&M	$/MWh	Real 2021$	$1.96	$1.96	$1.94	$1.93	$1.91	$1.90	$1.89	$1.87	$1.86	$1.84	$1.83	$1.81	$1.80	$1.79	$1.77	$1.76	$1.75	$1.74	$1.73	$1.72	$1.71	$1.70	$1.69	$1.68	$1.67	$1.66	$1.65	$1.64	$1.63	$1.62
Heat Rate	MMBtu/MWh	-	6.196	6.196	6.187	6.177	6.168	6.159	6.150	6.140	6.131	6.122	6.112	6.103	6.094	6.085	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075
Capital Cost	$/kW	Nominal	$1,148	$1,177	$1,195	$1,213	$1,231	$1,249	$1,268	$1,287	$1,305	$1,324	$1,343	$1,363	$1,382	$1,401	$1,421	$1,444	$1,468	$1,492	$1,517	$1,542	$1,567	$1,592	$1,617	$1,643	$1,669	$1,696	$1,722	$1,749	$1,777	$1,804
Fixed O&M	$/kW-year	Nominal	$30.80	$31.57	$32.04	$32.52	$33.00	$33.49	$33.98	$34.47	$34.97	$35.47	$35.97	$36.48	$36.98	$37.50	$38.01	$38.67	$39.34	$40.02	$40.71	$41.41	$42.11	$42.83	$43.56	$44.29	$45.04	$45.79	$46.56	$47.33	$48.12	$48.91
Variable O&M	$/MWh	Nominal	$1.96	$1.96	$1.94	$1.93	$1.91	$1.91	$1.90	$1.88	$1.87	$1.86	$1.84	$1.83	$1.81	$1.80	$1.78	$1.77	$1.76	$1.75	$1.74	$1.73	$1.72	$1.71	$1.70	$1.69	$1.67	$1.66	$1.65	$1.64	$1.63	$1.62	$1.61
Heat Rate	MMBtu/MWh	-	6.196	6.196	6.187	6.177	6.168	6.159	6.150	6.140	6.131	6.122	6.112	6.103	6.094	6.085	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075	6.075

2028 COD

Project Size (MW)	231
Debt Rate (%)	5.00%
Book Life (Years)	20
Debt Life (Years)	20
Installed Cost ($/kW)	$1,287
Fixed O&M ($/kW-year)	$34.47
Fixed O&M Escalation (%)	2.00%

Property Taxes	0.00%
Insurance	0.00%
Decommissioning	0.00%

Interest During Construction	5.00%
Accumulated Interest - Year 1	1.025
Accumulated Interest - Year 2	1.076
Accumulated Interest - Year 3	1.130
Accumulated Interest - Year 4	1.186
Construction Finance Factor	1.0608
AFUDC ($000)	$19,768

Year Index	Capital Fraction
0	20%
1	40%
2	30%
3	5%
	100%

	Year	Capital Expense	Book Value	Book Depreciation	Tax Depreciation	Property Taxes	Insurance	Decommissioning	Sales	Debt Service	Interest	FOM ($/kW-year)	Total Fixed Costs ($000)
	0		319,553	319,553					-319,553				
2028	1		303,576	15,978	0	0	0		303,889	25,642	15,978	$34.47	$39,987
2029	2		287,598	15,978	0	0	0		296,742	25,642	15,494	$35.16	$39,665
2030	3		271,620	15,978	0	0	0		289,087	25,642	14,987	$35.86	$39,321
2031	4		255,643	15,978	0	0	0		277,900	25,642	14,454	$36.58	$38,956
2032	5		239,665	15,978	0	0	0		266,153	25,642	13,895	$37.31	$38,567
2033	6		223,687	15,978	0	0	0		253,819	25,642	13,308	$38.06	$38,153
2034	7		207,710	15,978	0	0	0		240,868	25,642	12,691	$38.82	$37,714
2035	8		191,732	15,978	0	0	0		227,269	25,642	12,043	$39.60	$37,247
2036	9		175,754	15,978	0	0	0		212,991	25,642	11,363	$40.39	$36,752
2037	10		159,777	15,978	0	0	0		197,999	25,642	10,650	$41.20	$36,226
2038	11		143,799	15,978	0	0	0		182,257	25,642	9,900	$42.02	$35,669
2039	12		127,821	15,978	0	0	0		165,728	25,642	9,113	$42.86	$35,077
2040	13		111,844	15,978	0	0	0		148,373	25,642	8,286	$43.72	$34,451
2041	14		95,866	15,978	0	0	0		130,150	25,642	7,419	$44.59	$33,786
2042	15		79,888	15,978	0	0	0		111,015	25,642	6,507	$45.48	$33,083
2043	16		63,911	15,978	0	0	0		90,924	25,642	5,551	$46.39	$32,338
2044	17		47,933	15,978	0	0	0		69,829	25,642	4,546	$47.32	$31,550
2045	18		31,955	15,978	0	0	0		47,679	25,642	3,491	$48.27	$30,716
2046	19		15,978	15,978	0	0	0		24,421	25,642	2,384	$49.23	$29,833
2047	20		0	15,978	0	0	0		0	25,642	1,221	$50.22	$28,900
		NPV		199,117		0	0	0		319,553	135,475	$66	$452,384
		Levelized $/kW-mo		$5.71		$0.00	$0.00	$0.00		$9.17	$3.89	$3.38	$12.98

Levelized Fixed Costs ($/kW-mo)	
Depreciation	$5.71
Interest	$3.89
Other*	$0.00
Fixed O&M	$3.38
Total	**$12.98**

* Property Taxes, Insurance, Decommissioning

Technology-Specific Variables

	New-Build (Y/N)	Heat Rate (MMBtu/MWh)	Minimum Plant Load (%)	Outage Rates (%) Forced	Outage Rates (%) Planned	Emissions (lbs/MMBtu) SO2	Emissions (lbs/MMBtu) NOx	Emissions (lbs/MMBtu) Hg	Emissions (lbs/MMBtu) CO2	Ramp Rate (%/min)	CCS (Y/N)
NG F-Frame CT	Y	9.777	10%	5%	7%	0.001	0.036	0.000-00	119	8%	N
NG F-Frame CC	Y	6.365	50%	5%	10%	0.001	0.034	0.000-00	118.8	5%	N
NG H-Frame CC	Y	6.196	50%	5%	10%	0.001	0.034	0.000-00	118.8	5%	N
NG F-Frame CC 90% CCS	Y	7.229	50%	5%	10%	0.000	0.003	0.000-00	5.9	5%	Y
NG H-Frame CC 90% CCS	Y	7.037	50%	5%	10%	0.000	0.003	0.000-00	5.9	5%	Y
NG F-Frame CC 97% CCS	Y	7.298	50%	5%	10%	0.000	0.003	0.000-00	3.6	5%	Y
NG H-Frame CC 97% CCS	Y	7.045	50%	5%	10%	0.000	0.003	0.000-00	3.6	5%	Y

INTENTIONALLY LEFT BLANK

Utility-Scale Solar

Representative plant is single-axis tracking with capacity of 100 MW DC

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://atb.nrel.gov/files/FMS/2023_v2_Workbook_02_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/utility-scale_pv

NREL Moderate

Variable	Units	Direct from NREL Calculation / Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW-AC	Real 2021$		$1,246	$1,325	$1,285	$1,245	$1,204	$1,164	$1,123	$1,083	$1,043	$1,002	$962	$921	$881	$841	$800	$788	$775	$762	$750	$737	$724	$712	$699	$686	$674	$661	$648	$636	$623	$610
Fixed O&M	$/kW-AC-year	Real 2021$		$22.53	$22.00	$21.50	$20.99	$20.48	$19.98	$19.48	$18.98	$18.48	$17.98	$17.49	$16.99	$16.50	$16.01	$15.52	$15.38	$15.25	$15.11	$14.98	$14.84	$14.71	$14.57	$14.44	$14.31	$14.17	$14.04	$13.90	$13.77	$13.63	$13.50
Capital Cost	$/kW-AC	Nominal		$1,246	$1,358	$1,350	$1,340	$1,329	$1,317	$1,303	$1,287	$1,270	$1,251.66	$1,231	$1,209	$1,185	$1,159	$1,131	$1,141	$1,150	$1,160	$1,169	$1,178	$1,187	$1,195	$1,203	$1,211	$1,219	$1,226	$1,232	$1,238	$1,244	$1,249
Fixed O&M	$/kW-AC-year	Nominal		$22.53	$22.55	$22.58	$22.60	$22.61	$22.61	$22.59	$22.56	$22.52	$22.46	$22.38	$22.30	$22.19	$22.07	$21.93	$22.28	$22.64	$23.00	$23.36	$23.73	$24.10	$24.48	$24.86	$25.24	$25.63	$26.02	$26.42	$26.81	$27.21	$27.62

NREL Advanced

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW-AC	Real 2021$		$1,246	$1,325	$1,270	$1,215	$1,160	$1,105	$1,050	$995	$940	$885	$830	$775	$720	$665	$610	$603	$596	$589	$582	$575	$567	$560	$553	$546	$539	$532	$524	$517	$510	$503
Fixed O&M	$/kW-AC-year	Real 2021$		$22.53	$22.00	$21.30	$20.60	$19.90	$19.21	$18.52	$17.84	$17.15	$16.48	$15.80	$15.13	$14.46	$13.79	$13.12	$13.03	$12.93	$12.83	$12.73	$12.63	$12.54	$12.44	$12.34	$12.25	$12.15	$12.05	$11.96	$11.86	$11.77	$11.67
Capital Cost	$/kW-AC	Nominal	$0	$1,246	$1,358	$1,335	$1,309	$1,281	$1,251	$1,218	$1,183	$1,146	$1,106	$1,063	$1,017	$969	$917	$863	$874	$885	$896	$907	$919	$930	$941	$952	$963	$974	$985	$996	$1,007	$1,018	$1,029
Fixed O&M	$/kW-AC-year	Nominal	$0.00	$22.53	$22.55	$22.38	$22.18	$21.97	$21.73	$21.48	$21.20	$20.90	$20.58	$20.23	$19.85	$19.44	$19.01	$18.54	$18.87	$19.19	$19.52	$19.86	$20.20	$20.54	$20.89	$21.25	$21.61	$21.98	$22.35	$22.72	$23.10	$23.49	$23.88

NREL Conservative

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW-AC	Real 2021$		$1,246	$1,325	$1,305	$1,285	$1,265	$1,245	$1,224	$1,204	$1,184	$1,164	$1,144	$1,124	$1,103	$1,083	$1,063	$1,046	$1,028	$1,010	$993	$975	$958	$940	$923	$905	$888	$870	$853	$835	$818	$800
Fixed O&M	$/kW-AC-year	Real 2021$		$22.53	$22.00	$21.74	$21.48	$21.22	$20.96	$20.70	$20.45	$20.19	$19.93	$19.68	$19.42	$19.17	$18.91	$18.66	$18.47	$18.28	$18.08	$17.89	$17.70	$17.51	$17.32	$17.13	$16.94	$16.75	$16.56	$16.37	$16.18	$15.99	$15.79
Capital Cost	$/kW-AC	Nominal	$0	$1,246	$1,358	$1,371	$1,384	$1,396	$1,408	$1,420	$1,432	$1,443	$1,454	$1,464	$1,474	$1,484	$1,493	$1,502	$1,514	$1,526	$1,538	$1,549	$1,559	$1,570	$1,580	$1,589	$1,598	$1,606	$1,614	$1,621	$1,627	$1,633	$1,638
Fixed O&M	$/kW-AC-year	Nominal	$0.00	$22.53	$22.55	$22.84	$23.13	$23.43	$23.72	$24.01	$24.30	$24.60	$24.89	$25.19	$25.48	$25.78	$26.07	$26.36	$26.74	$27.13	$27.52	$27.91	$28.30	$28.70	$29.09	$29.49	$29.89	$30.29	$30.70	$31.10	$31.51	$31.91	$32.32

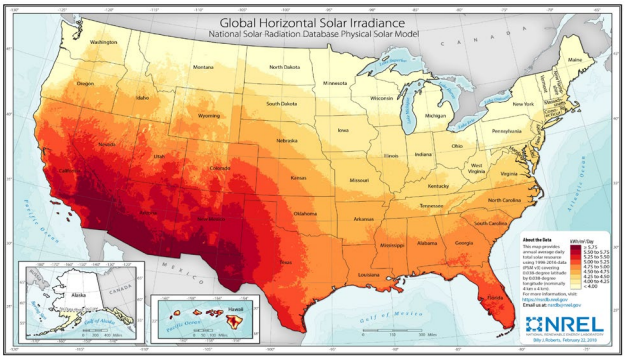
	Inputs
	Calculated

	SOLAR (Utility-scale, Single-Axis Tracking)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
		0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
NREL	Inflation Rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
NREL	Tax Rate (Federal & State)	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
CALCULATION	Present Value - Depreciation (PV-Deprec)		0.875																													
NREL	Interest During Construction	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.7%	3.9%	4.1%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
	WACC	5%																														
	Recovery Life (years)	30																														
	Capital Recovery Factor (CRF)	6.5%																														
	ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Market Adjustment																															
NOMINAL	Overnight Capital Cost ($/kW-AC)	$1,245.82	$1,358.47	$1,371.23	$1,383.79	$1,396.11	$1,408.18	$1,419.99	$1,431.51	$1,442.71	$1,453.58	$1,464.09	$1,474.22	$1,483.94	$1,493.23	$1,502.05	$1,514.23	$1,526.08	$1,537.58	$1,548.71	$1,559.42	$1,569.71	$1,579.53	$1,588.88	$1,597.88	$1,605.94	$1,613.61	$1,620.67	$1,627.07	$1,632.78	$1,637.75
NOMINAL	Fixed O&M ($/kW-yr-AC)	$22.53	$22.55	$22.84	$23.13	$23.43	$23.72	$24.01	$24.30	$24.60	$24.89	$25.19	$25.48	$25.78	$26.07	$26.36	$26.74	$27.13	$27.52	$27.91	$28.30	$28.70	$29.09	$29.49	$29.89	$30.29	$30.70	$31.10	$31.51	$31.91	$32.32	
	Variable O&M ($/MWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capacity Factor (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
NOMINAL	LCOE ($/MWh)	$ 36.19	$ 38.55	$ 38.94	$ 39.34	$ 39.73	$ 40.11	$ 40.49	$ 40.86	$ 41.23	$ 41.59	$ 41.94	$ 42.29	$ 42.62	$ 46.06	$ 49.96	$ 57.19	$ 57.72	$ 58.24	$ 58.75	$ 59.24	$ 59.73	$ 60.20	$ 60.66	$ 61.11	$ 61.54	$ 61.95	$ 62.34	$ 62.72	$ 63.07	$ 63.41
	Project Finance Factor (No ITC)	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043
	Project Finance Factor (w/ITC)	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.769	0.864	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043
	Construction Finance Factor	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
	LCOE Calcs																															
NOMINAL	No ITC	$49.40	$52.95	$53.48	$54.01	$54.53	$55.07	$55.61	$56.14	$56.66	$57.16	$57.63	$58.08	$58.52	$58.95	$59.36	$59.92	$60.47	$61.01	$61.54	$62.06	$62.56	$63.05	$63.53	$63.99	$64.43	$64.86	$65.26	$65.65	$66.02	$66.36	
NOMINAL	ITC (Model)	$35.96	$38.29	$38.69	$39.08	$39.47	$39.87	$40.27	$40.66	$41.05	$41.43	$41.78	$42.12	$42.46	$46.56	$51.23	$59.92	$60.47	$61.01	$61.54	$62.06	$62.56	$63.05	$63.53	$63.99	$64.43	$64.86	$65.26	$65.65	$66.02	$66.36	
Real 2023 $	No ITC (2020 Real $)	$51.96	$54.30	$53.48	$52.69	$51.90	$51.14	$50.38	$49.62	$48.85	$48.09	$47.30	$46.51	$45.72	$44.93	$44.14	$43.47	$42.80	$42.13	$41.45	$40.78	$40.11	$39.44	$38.77	$38.10	$37.43	$36.75	$36.08	$35.41	$34.74	$34.07	
Real 2023 $	ITC (2020 Real $)	$37.83	$39.28	$38.69	$38.13	$37.57	$37.02	$36.48	$35.94	$35.40	$34.85	$34.29	$33.73	$33.17	$35.48	$38.09	$43.47	$42.80	$42.13	$41.45	$40.78	$40.11	$39.44	$38.77	$38.10	$37.43	$36.75	$36.08	$35.41	$34.74	$34.07	
	Effective Capital Costs																															
NOMINAL	No ITC (Nominal $)	$1,246	$1,358	$1,371	$1,384	$1,396	$1,408	$1,420	$1,432	$1,443	$1,454	$1,464	$1,474	$1,484	$1,493	$1,502	$1,514	$1,526	$1,538	$1,549	$1,559	$1,570	$1,580	$1,589	$1,598	$1,606	$1,614	$1,621	$1,627	$1,633	$1,638	
NOMINAL	ITC (Nominal $)	$818	$892	$900	$908	$916	$924	$932	$940	$947	$954	$961	$968	$974	$1,100	$1,244	$1,514	$1,526	$1,538	$1,549	$1,559	$1,570	$1,580	$1,589	$1,598	$1,606	$1,614	$1,621	$1,627	$1,633	$1,638	
Real 2023 $	Solar No ITC (Real 2020 $)	$1,311	$1,393	$1,371	$1,350	$1,329	$1,308	$1,286	$1,265	$1,244	$1,223	$1,202	$1,180	$1,159	$1,138	$1,117	$1,098	$1,080	$1,062	$1,043	$1,025	$1,006	$988	$970	$951	$933	$914	$896	$878	$859	$841	
Real 2023 $	Solar ITC (Real 2020 $)	$860	$915	$900	$886	$872	$858	$844	$831	$817	$803	$789	$775	$761	$838	$925	$1,098	$1,080	$1,062	$1,043	$1,025	$1,006	$988	$970	$951	$933	$914	$896	$878	$859	$841	

MACRS Yr.	1	2	3	4	5	6
Depreciation Fraction	0.2000	0.3200	0.1920	0.1152	0.1152	0.0576
Depreciation Factor	0.9524	0.9070	0.8638	0.8227	0.7835	0.7462

Construction Duration yrs		3																															
Year	Capital Fraction	Accumulated Interest																															
0	1	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
1	0	1.039	1.039	1.039	1.039	1.039	1.039	1.042	1.044	1.046	1.048	1.051	1.053	1.055	1.055	1.055	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.053
2	0	1.067	1.067	1.067	1.067	1.067	1.067	1.071	1.075	1.078	1.082	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086

https://www.nrel.gov/gis/assets/images/solar-annual-ghi-2018-usa-scale-01.jpg



https://atb.nrel.gov/electricity/2023/utility-scale_pv

Utility-Scale PV Resource Classes

Resource Class	GHI Bin (kWh/m²/day)	Mean AC Capacity Factor	Area (sq. km)
1	>5.75	34.0%	285,955
2	5.5–5.75	32.9%	405,147
3	5.25–5.5	31.3%	351,716
4	5–5.25	29.8%	428,289
5	4.75–5	28.3%	469,396
6	4.5–4.75	26.9%	687,604
7	4.25–4.5	25.5%	646,344
8	4–4.25	24.5%	697,356
9	3.75–4	23.3%	537,441
10	<3.75	21.4%	97,193

Utility-Scale Solar

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real Dollars Factor (2023 = 1)	0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Overnight Capital Cost (Nominal $/kW)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$0	$1,246	$1,358	$1,350	$1,340	$1,329	$1,317	$1,303	$1,287	$1,270	$1,252	$1,231	$1,209	$1,185	$1,159	$1,131	$1,141	$1,150	$1,160	$1,169	$1,178	$1,187	$1,195	$1,203	$1,211	$1,219	$1,226	$1,232	$1,238	$1,244	$1,249
NREL Advanced	$0	$1,246	$1,358	$1,335	$1,309	$1,281	$1,251	$1,218	$1,183	$1,146	$1,106	$1,063	$1,017	$969	$917	$863	$874	$885	$896	$907	$919	$930	$941	$952	$963	$974	$985	$996	$1,007	$1,018	$1,029
NREL Conservative	$0	$1,246	$1,358	$1,371	$1,384	$1,396	$1,408	$1,420	$1,432	$1,443	$1,454	$1,464	$1,474	$1,484	$1,493	$1,502	$1,514	$1,526	$1,538	$1,549	$1,559	$1,570	$1,580	$1,589	$1,598	$1,606	$1,614	$1,621	$1,627	$1,633	$1,638

Year-Over-Year % Change

NREL Moderate	#DIV/0!	9%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
NREL Advanced	#DIV/0!	9%	-2%	-2%	-2%	-2%	-2%	-3%	-3%	-3%	-3%	-4%	-4%	-5%	-5%	-6%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
NREL Conservative	#DIV/0!	9%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%

Percent Difference from Moderate

NREL Advanced	#DIV/0!	0.0%	0.0%	-1.1%	-2.3%	-3.6%	-5.0%	-6.5%	-8.1%	-9.8%	-11.7%	-13.7%	-15.9%	-18.2%	-20.8%	-23.7%	-23.4%	-23.1%	-22.7%	-22.4%	-22.0%	-21.7%	-21.3%	-20.9%	-20.5%	-20.0%	-19.6%	-19.1%	-18.6%	-18.1%	-17.6%
NREL Conservative	#DIV/0!	0.0%	0.0%	1.6%	3.2%	5.0%	6.9%	9.0%	11.2%	13.6%	16.1%	18.9%	21.9%	25.2%	28.8%	32.8%	32.7%	32.6%	32.6%	32.5%	32.4%	32.2%	32.1%	32.0%	31.9%	31.8%	31.7%	31.5%	31.4%	31.3%	31.1%

LCOE (Nominal $/MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$29.05	$35.96	$38.29	$38.13	$37.94	$37.72	$37.48	$37.20	$36.89	$36.54	$36.14	$35.69	$35.19	$34.64	$36.97	$39.52	$46.12	$46.58	$47.05	$47.51	$47.96	$48.40	$48.84	$49.27	$49.69	$50.10	$50.50	$50.88	$51.26	$51.62	$51.97
NREL Advanced	$29.05	$35.96	$38.29	$37.72	$37.10	$36.43	$35.72	$34.95	$34.12	$33.22	$32.26	$31.22	$30.10	$28.92	$29.97	$30.97	$36.14	$36.64	$37.15	$37.65	$38.16	$38.67	$39.19	$39.70	$40.22	$40.74	$41.25	$41.77	$42.29	$42.81	$43.33
NREL Conservative	$29.05	$35.96	$38.29	$38.69	$39.08	$39.47	$39.87	$40.27	$40.66	$41.05	$41.43	$41.78	$42.12	$42.46	$46.56	$51.23	$59.92	$60.47	$61.01	$61.54	$62.06	$62.56	$63.05	$63.53	$63.99	$64.43	$64.86	$65.26	$65.65	$66.02	$66.36
Range	*$0.00*	*$0.00*	*$0.00*	*$0.97*	*$1.98*	*$3.04*	*$4.16*	*$5.32*	*$6.55*	*$7.83*	*$9.17*	*$10.56*	*$12.02*	*$13.54*	*$16.59*	*$20.26*	*$23.78*	*$23.83*	*$23.86*	*$23.88*	*$23.89*	*$23.88*	*$23.86*	*$23.82*	*$23.77*	*$23.70*	*$23.60*	*$23.49*	*$23.36*	*$23.21*	*$23.03*

LCOE (Real 2023 $/MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$31.34	$37.83	$39.28	$38.13	$37.02	$35.90	$34.80	$33.70	$32.60	$31.50	$30.40	$29.29	$28.17	$27.06	$28.18	$29.39	$33.45	$32.97	$32.49	$32.00	$31.52	$31.03	$30.55	$30.07	$29.58	$29.10	$28.62	$28.13	$27.65	$27.16	$26.68
NREL Advanced	$31.34	$37.83	$39.28	$37.72	$36.20	$34.67	$33.17	$31.66	$30.15	$28.65	$27.14	$25.62	$24.11	$22.59	$22.84	$23.03	$26.22	$25.93	$25.65	$25.37	$25.08	$24.80	$24.51	$24.23	$23.95	$23.66	$23.38	$23.09	$22.81	$22.53	$22.24
NREL Conservative	$31.34	$37.83	$39.28	$38.69	$38.13	$37.57	$37.02	$36.48	$35.94	$35.40	$34.85	$34.29	$33.73	$33.17	$35.48	$38.09	$43.47	$42.80	$42.13	$41.45	$40.78	$40.11	$39.44	$38.77	$38.10	$37.43	$36.75	$36.08	$35.41	$34.74	$34.07
Range	*$0.00*	*$0.00*	*$0.00*	*$0.97*	*$1.93*	*$2.89*	*$3.86*	*$4.82*	*$5.79*	*$6.75*	*$7.71*	*$8.67*	*$9.62*	*$10.58*	*$12.64*	*$15.06*	*$17.25*	*$16.86*	*$16.48*	*$16.09*	*$15.70*	*$15.31*	*$14.93*	*$14.54*	*$14.15*	*$13.76*	*$13.38*	*$12.99*	*$12.60*	*$12.21*	*$11.82*

Contract PPA Price (Nominal $/MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Hoosier RFP - Mid								$50.00																							
Hoosier RFP - Low								$45.00																							
Hoosier RFP - High								$60.00																							
								$55.00																							
								$10.00																							

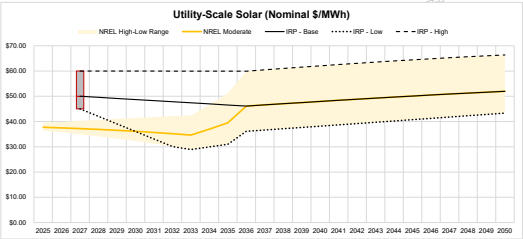
Sapphire Mid % Difference from NREL Moderate LCOE	34%
Sapphire Low % Difference from NREL Advanced LCOE	29%
Sapphire High % Difference from NREL Conservative LCOE	49%

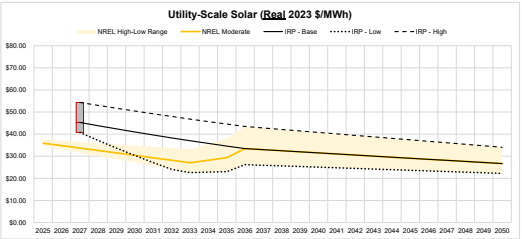
PWP 2023 IRP - Utility-Scale Solar Costs NOMINAL $/MWh

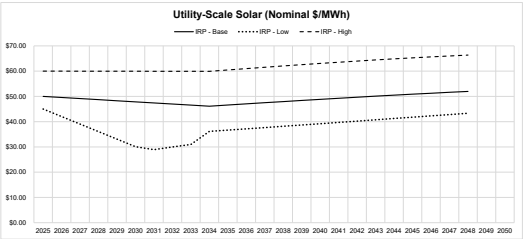
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base								$50.00	$49.57	$49.14	$48.71	$48.27	$47.84	$47.41	$46.98	$46.55	$46.12	$46.58	$47.05	$47.51	$47.96	$48.40	$48.84	$49.27	$49.69	$50.10	$50.50	$50.88	$51.26	$51.62	$51.97
IRP - Low								$45.00	$42.02	$39.04	$36.06	$33.08	$30.10	$28.92	$29.97	$30.97	$36.14	$36.64	$37.15	$37.65	$38.16	$38.67	$39.19	$39.70	$40.22	$40.74	$41.25	$41.77	$42.29	$42.81	$43.33
IRP - High								$60.00	$59.99	$59.98	$59.97	$59.96	$59.96	$59.95	$59.94	$59.93	$59.92	$60.47	$61.01	$61.54	$62.06	$62.56	$63.05	$63.53	$63.99	$64.43	$64.86	$65.26	$65.65	$66.02	$66.36
								34%	34%	34%	35%	35%	36%	37%	27%	18%	0%														

PWP 2023 IRP - Utility-Scale Solar Costs REAL 2023 $/MWh

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base								$45.30	$43.81	$42.37	$40.97	$39.62	$38.31	$37.04	$35.80	$34.61	$33.45	$32.97	$32.49	$32.00	$31.52	$31.03	$30.55	$30.07	$29.58	$29.10	$28.62	$28.13	$27.65	$27.16	$26.68
IRP - Low								$40.77	$37.14	$33.67	$30.34	$27.15	$24.11	$22.59	$22.84	$23.03	$26.22	$25.93	$25.65	$25.37	$25.08	$24.80	$24.51	$24.23	$23.95	$23.66	$23.38	$23.09	$22.81	$22.53	$22.24
IRP - High								$54.36	$53.02	$51.72	$50.45	$49.22	$48.01	$46.83	$45.68	$44.56	$43.47	$42.80	$42.13	$41.45	$40.78	$40.11	$39.44	$38.77	$38.10	$37.43	$36.75	$36.08	$35.41	$34.74	$34.07
								$54.33																							







INTENTIONALLY LEFT BLANK

Utility-Scale 4-Hour Battery Storage

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/5885/2023_atb_workbook_07_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/utility-scale_battery_storage

NREL Moderate

Variable	Units	Direct from NREL Calculation / Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,727	$1,587	$1,784	$1,716	$1,639	$1,436	$1,390	$1,343	$1,297	$1,250	$1,204	$1,185	$1,167	$1,148	$1,130	$1,111	$1,092	$1,074	$1,055	$1,037	$1,018	$1,000	$981	$963	$944	$925	$907	$888	$870	$851	$833
Fixed O&M	$/kW-year	Real 2021$	$43.18	$39.68	$44.60	$42.89	$40.97	$35.90	$34.74	$33.58	$32.42	$31.26	$30.10	$29.63	$29.17	$28.70	$28.24	$27.78	$27.31	$26.85	$26.38	$25.92	$25.46	$24.99	$24.53	$24.06	$23.60	$23.14	$22.67	$22.21	$21.74	$21.28	$20.82
Capital Cost	$/kW-AC	Nominal	$1,684	$1,587	$1,829	$1,802	$1,765	$1,585	$1,572	$1,558	$1,541	$1,523	$1,503	$1,517	$1,531	$1,544	$1,557	$1,570	$1,582	$1,594	$1,606	$1,617	$1,628	$1,638	$1,648	$1,657	$1,666	$1,674	$1,681	$1,688	$1,694	$1,699	$1,704
Fixed O&M	$/kW-AC-year	Nominal	$42.10	$39.68	$45.72	$45.06	$44.12	$39.63	$39.31	$38.94	$38.54	$38.08	$37.59	$37.93	$38.27	$38.60	$38.93	$39.25	$39.55	$39.85	$40.15	$40.42	$40.69	$40.95	$41.20	$41.43	$41.64	$41.85	$42.03	$42.20	$42.35	$42.49	$42.60

NREL Advanced

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,727	$1,587	$1,784	$1,283	$1,211	$1,150	$1,101	$1,052	$1,003	$955	$906	$890	$874	$858	$842	$826	$810	$795	$779	$763	$747	$731	$715	$699	$683	$668	$652	$636	$620	$604	$588
Fixed O&M	$/kW-year	Real 2021$	$43.18	$39.68	$44.60	$32.09	$30.28	$28.74	$27.52	$26.30	$25.08	$23.86	$22.64	$22.25	$21.85	$21.45	$21.06	$20.66	$20.26	$19.86	$19.47	$19.07	$18.67	$18.28	$17.88	$17.48	$17.08	$16.69	$16.29	$15.89	$15.50	$15.10	$14.70
Capital Cost	$/kW	Nominal	$1,684	$1,587	$1,829	$1,348	$1,305	$1,269	$1,240	$1,220	$1,193	$1,163	$1,131	$1,139	$1,147	$1,154	$1,161	$1,168	$1,174	$1,180	$1,185	$1,190	$1,194	$1,198	$1,201	$1,204	$1,206	$1,207	$1,208	$1,208	$1,207	$1,206	$1,203
Fixed O&M	$/kW-AC-year	Nominal	$42.10	$39.68	$45.72	$33.71	$32.61	$31.73	$31.14	$30.50	$29.82	$29.08	$28.28	$28.48	$28.67	$28.85	$29.02	$29.19	$29.34	$29.49	$29.62	$29.74	$29.85	$29.95	$30.03	$30.10	$30.15	$30.18	$30.20	$30.20	$30.18	$30.15	$30.09

NREL Conservative

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,727	$1,587	$1,784	$1,850	$1,863	$1,837	$1,768	$1,699	$1,630	$1,562	$1,493	$1,483	$1,472	$1,462	$1,452	$1,442	$1,432	$1,421	$1,411	$1,401	$1,391	$1,380	$1,370	$1,360	$1,350	$1,340	$1,329	$1,319	$1,309	$1,299	$1,288
Fixed O&M	$/kW-year	Real 2021$	$43.18	$39.68	$44.60	$46.25	$46.58	$45.92	$44.20	$42.48	$40.76	$39.04	$37.32	$37.07	$36.81	$36.56	$36.30	$36.05	$35.79	$35.53	$35.28	$35.02	$34.77	$34.51	$34.26	$34.00	$33.75	$33.49	$33.23	$32.98	$32.72	$32.47	$32.21
Capital Cost	$/kW	Nominal	$1,684	$1,587	$1,829	$1,944	$2,007	$2,028	$2,000	$1,971	$1,938	$1,903	$1,864	$1,898	$1,932	$1,967	$2,002	$2,037	$2,073	$2,110	$2,147	$2,185	$2,223	$2,262	$2,301	$2,341	$2,382	$2,423	$2,465	$2,507	$2,550	$2,593	$2,637
Fixed O&M	$/kW-year	Nominal	$42.10	$39.68	$45.72	$48.59	$50.16	$50.69	$50.01	$49.27	$48.45	$47.57	$46.61	$47.45	$48.30	$49.16	$50.04	$50.93	$51.83	$52.75	$53.68	$54.62	$55.58	$56.55	$57.54	$58.53	$59.55	$60.57	$61.61	$62.67	$63.74	$64.82	$65.92

Inputs
Calculated

Levelized Cost of Storage (LCOS) used for battery storage, with units of $/kW-month.

4-Hour Battery Storage (Utility-Scale)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046	2.098
Inflation Rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Tax Rate (Federal & State)	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Present Value - Depreciation (PV-Dep)	0.829																														
Interest During Construction	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.7%	3.9%	4.1%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
WACC	5%																														
Recovery Life (years)	20																														
Capital Recovery Factor (CRF)	8.0%																														
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

NREL Case
Conservative

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NOMINAL	Overnight Capital Cost ($/kW-AC)	$1,684.05	$1,587.25	$1,828.60	$1,943.74	$2,006.56	$2,027.54	$2,000.40	$1,970.63	$1,938.13	$1,902.78	$1,864.44	$1,897.97	$1,932.01	$1,966.56	$2,001.63	$2,037.23	$2,073.36	$2,110.02	$2,147.21	$2,184.95	$2,223.23	$2,262.07	$2,301.45	$2,341.39	$2,381.89	$2,422.95	$2,464.57	$2,506.76	$2,549.52	$2,592.85	$2,636.75
NOMINAL	Fixed O&M ($/kW-yr-AC)	$42.10	$39.68	$45.72	$48.59	$50.16	$50.69	$50.01	$49.27	$48.45	$47.57	$46.61	$47.45	$48.30	$49.16	$50.04	$50.93	$51.83	$52.75	$53.68	$54.62	$55.58	$56.55	$57.54	$58.53	$59.55	$60.57	$61.61	$62.67	$63.74	$64.82	$65.92
	Variable O&M ($/MWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capacity Factor (%)	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
NOMINAL	LCOS ($/kW-mo)	$ 14.77	$ 13.92	$ 16.04	$ 17.05	$ 17.60	$ 17.78	$ 17.54	$ 17.28	$ 17.00	$ 16.69	$ 16.35	$ 16.65	$ 16.94	$ 17.25	$ 17.55	$ 17.87	$ 18.18	$ 18.51	$ 18.83	$ 19.16	$ 19.50	$ 19.84	$ 20.18	$ 20.53	$ 20.89	$ 21.25	$ 21.61	$ 21.98	$ 22.36	$ 22.74	$ 23.12
	Project Finance Factor (No ITC)	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Project Finance Factor (w/ITC)	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.782	0.879	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Construction Finance Factor	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
	LCOS Calcs ($/kW-month)																															
NOMINAL	No ITC	$15.59	$14.69	$16.93	$17.99	$18.57	$18.77	$18.53	$18.26	$17.97	$17.65	$17.31	$17.62	$17.93	$18.25	$18.58	$18.91	$19.25	$19.59	$19.93	$20.28	$20.64	$21.00	$21.36	$21.73	$22.11	$22.49	$22.88	$23.27	$23.67	$24.07	$24.48
NOMINAL	ITC (Model)	**$11.47**	**$10.81**	**$12.46**	**$13.24**	**$13.67**	**$13.81**	**$13.63**	**$13.44**	**$13.22**	**$12.99**	**$12.73**	**$12.96**	**$13.19**	**$13.43**	**$14.82**	**$16.41**	**$19.25**	**$19.59**	**$19.93**	**$20.28**	**$20.64**	**$21.00**	**$21.36**	**$21.73**	**$22.11**	**$22.49**	**$22.88**	**$23.27**	**$23.67**	**$24.07**	**$24.48**
Real 2020 $	No ITC (2020 Real $)	$15.59	$14.33	$16.11	$16.71	$16.83	$16.59	$15.98	$15.36	$14.75	$14.13	$13.52	$13.43	$13.33	$13.24	$13.15	$13.06	$12.96	$12.87	$12.78	$12.69	$12.59	$12.50	$12.41	$12.32	$12.22	$12.13	$12.04	$11.95	$11.85	$11.76	$11.67
Real 2020 $	ITC (2020 Real $)	$11.47	$10.55	$11.86	$12.30	$12.38	$12.21	$11.76	$11.31	$10.85	$10.40	$9.95	$9.88	$9.81	$9.74	$10.49	$11.33	$12.96	$12.87	$12.78	$12.69	$12.59	$12.50	$12.41	$12.32	$12.22	$12.13	$12.04	$11.95	$11.85	$11.76	$11.67
	Effective Capital Costs																															
NOMINAL	No ITC (Nominal $)	$1,684	$1,587	$1,829	$1,944	$2,007	$2,028	$2,000	$1,971	$1,938	$1,903	$1,864	$1,898	$1,932	$1,967	$2,002	$2,037	$2,073	$2,110	$2,147	$2,185	$2,223	$2,262	$2,301	$2,341	$2,382	$2,423	$2,465	$2,507	$2,550	$2,593	$2,637
NOMINAL	ITC (Nominal $)	$1,110	$1,046	$1,206	$1,281	$1,323	$1,337	$1,319	$1,299	$1,278	$1,254	$1,229	$1,251	$1,274	$1,297	$1,479	$1,690	$2,073	$2,110	$2,147	$2,185	$2,223	$2,262	$2,301	$2,341	$2,382	$2,423	$2,465	$2,507	$2,550	$2,593	$2,637
Real 2020 $	Solar No ITC (Real 2020 $)	$1,684	$1,549	$1,740	$1,805	$1,818	$1,792	$1,725	$1,658	$1,591	$1,524	$1,456	$1,447	$1,437	$1,427	$1,417	$1,407	$1,397	$1,387	$1,377	$1,367	$1,357	$1,347	$1,337	$1,327	$1,317	$1,307	$1,297	$1,287	$1,277	$1,267	$1,257
Real 2020 $	Solar ITC (Real 2020 $)	$1,110	$1,021	$1,147	$1,190	$1,198	$1,181	$1,137	$1,093	$1,049	$1,004	$960	$954	$947	$941	$1,047	$1,167	$1,397	$1,387	$1,377	$1,367	$1,357	$1,347	$1,337	$1,327	$1,317	$1,307	$1,297	$1,287	$1,277	$1,267	$1,257

MACRS Yr.	1	2	3	4	5	6
Depreciation Fraction	0.2000	0.3200	0.1920	0.1152	0.1152	0.0576
Depreciation Factor	0.9337	0.8718	0.8140	0.7600	0.7097	0.6626

Construction Duration yrs		3																														
Year	Capital Fraction	Accumulated Interest																														
0	1	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
1	0	1.039	1.039	1.039	1.039	1.039	1.039	1.042	1.044	1.046	1.048	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.053
2	0	1.067	1.067	1.067	1.067	1.067	1.067	1.071	1.075	1.078	1.082	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086

Utility-Scale 4-Hour Battery Storage

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real Dollars Factor (2023 = 1)	0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Overnight Capital Cost (Nominal $/kW)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$1,684	$1,587	$1,829	$1,802	$1,765	$1,585	$1,572	$1,558	$1,541	$1,523	$1,503	$1,517	$1,531	$1,544	$1,557	$1,570	$1,582	$1,594	$1,606	$1,617	$1,628	$1,638	$1,648	$1,657	$1,666	$1,674	$1,681	$1,688	$1,694	$1,699	$1,704
NREL Advanced	$1,684	$1,587	$1,829	$1,348	$1,305	$1,269	$1,246	$1,220	$1,193	$1,163	$1,131	$1,139	$1,147	$1,154	$1,161	$1,168	$1,174	$1,180	$1,185	$1,190	$1,194	$1,198	$1,201	$1,204	$1,206	$1,207	$1,208	$1,208	$1,207	$1,206	$1,203
NREL Conservative	$1,684	$1,587	$1,829	$1,944	$2,007	$2,028	$2,000	$1,971	$1,938	$1,903	$1,864	$1,898	$1,932	$1,967	$2,002	$2,037	$2,073	$2,110	$2,147	$2,185	$2,223	$2,262	$2,301	$2,341	$2,382	$2,423	$2,465	$2,507	$2,550	$2,593	$2,637

Year-Over-Year % Change

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate		-6%	15%	-1%	-2%	-10%	-1%	-1%	-1%	-1%	-1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%
NREL Advanced		-6%	15%	-26%	-3%	-3%	-2%	-2%	-2%	-2%	-3%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Conservative		-6%	15%	6%	3%	1%	-1%	-1%	-2%	-2%	-2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Percent Difference from Moderate

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Advanced	0.0%	0.0%	0.0%	-25.2%	-26.1%	-19.9%	-20.8%	-21.7%	-22.6%	-23.7%	-24.8%	-24.9%	-25.1%	-25.3%	-25.4%	-25.6%	-25.8%	-26.0%	-26.2%	-26.4%	-26.6%	-26.9%	-27.1%	-27.3%	-27.6%	-27.9%	-28.1%	-28.4%	-28.7%	-29.0%	-29.4%
NREL Conservative	0.0%	0.0%	0.0%	7.8%	13.7%	27.9%	27.2%	26.5%	25.7%	24.9%	24.0%	25.1%	26.2%	27.4%	28.5%	29.8%	31.0%	32.4%	33.7%	35.1%	36.6%	38.1%	39.7%	41.3%	43.0%	44.8%	46.6%	48.5%	50.5%	52.6%	54.7%

LCOS (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$11.47	$10.81	$12.46	$12.28	$12.02	$10.80	$10.72	$10.62	$10.52	$10.40	$10.27	$10.36	$10.45	$10.55	$11.53	$12.65	$14.69	$14.80	$14.91	$15.01	$15.11	$15.20	$15.30	$15.38	$15.46	$15.54	$15.61	$15.67	$15.73	$15.77	$15.82
NREL Advanced	$11.47	$10.81	$12.46	$9.19	$8.89	$8.65	$8.49	$8.32	$8.14	$7.94	$7.73	$7.78	$7.83	$7.88	$8.59	$9.41	$10.90	$10.95	$11.00	$11.04	$11.08	$11.12	$11.15	$11.17	$11.19	$11.21	$11.21	$11.21	$11.21	$11.19	$11.17
NREL Conservative	$11.47	$10.81	$12.46	$13.24	$13.67	$13.81	$13.63	$13.44	$13.22	$12.99	$12.73	$12.96	$13.19	$13.43	$14.82	$16.41	$19.25	$19.59	$19.93	$20.28	$20.64	$21.00	$21.36	$21.73	$22.11	$22.49	$22.88	$23.27	$23.67	$24.07	$24.48
Range	*$0.00*	*$0.00*	*$0.00*	*$4.06*	*$4.78*	*$5.17*	*$5.14*	*$5.12*	*$5.09*	*$5.05*	*$5.01*	*$5.18*	*$5.36*	*$5.55*	*$6.22*	*$7.01*	*$8.35*	*$8.64*	*$8.93*	*$9.24*	*$9.55*	*$9.88*	*$10.21*	*$10.56*	*$10.92*	*$11.28*	*$11.66*	*$12.05*	*$12.46*	*$12.88*	*$13.30*

LCOS (Real 2023 $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$12.38	$11.37	$12.78	$12.28	$11.73	$10.28	$9.95	$9.62	$9.30	$8.97	$8.64	$8.50	$8.37	$8.24	$8.78	$9.40	$10.65	$10.47	$10.29	$10.11	$9.93	$9.75	$9.57	$9.39	$9.21	$9.02	$8.84	$8.66	$8.48	$8.30	$8.12
NREL Advanced	$12.38	$11.37	$12.78	$9.19	$8.67	$8.23	$7.88	$7.54	$7.19	$6.85	$6.50	$6.39	$6.27	$6.16	$6.55	$6.99	$7.90	$7.75	$7.59	$7.44	$7.28	$7.13	$6.97	$6.82	$6.66	$6.51	$6.35	$6.20	$6.04	$5.89	$5.74
NREL Conservative	$12.38	$11.37	$12.78	$13.24	$13.34	$13.15	$12.66	$12.17	$11.69	$11.20	$10.71	$10.64	$10.57	$10.49	$11.29	$12.20	$13.96	$13.86	$13.76	$13.66	$13.56	$13.46	$13.36	$13.26	$13.16	$13.06	$12.96	$12.86	$12.77	$12.67	$12.57
Range	*$0.00*	*$0.00*	*$0.00*	*$4.06*	*$4.67*	*$4.92*	*$4.78*	*$4.64*	*$4.50*	*$4.35*	*$4.21*	*$4.25*	*$4.29*	*$4.34*	*$4.74*	*$5.21*	*$6.06*	*$6.11*	*$6.17*	*$6.22*	*$6.28*	*$6.33*	*$6.39*	*$6.44*	*$6.50*	*$6.55*	*$6.61*	*$6.66*	*$6.72*	*$6.78*	*$6.83*

Contract PPA Price (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
4-Hour BESS - Mid								$11.00																							
4-Hour BESS - Low								$8.00																							
4-Hour BESS - High								$14.00																							
								$3.00																							
								$3.00																							

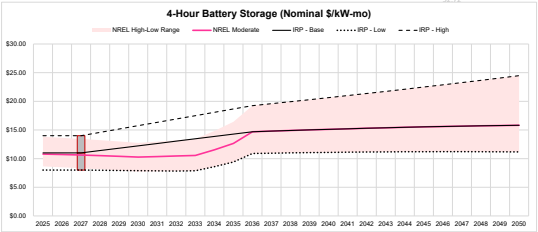
Mid % Difference from NREL Moderate LCOS	4%
Low % Difference from NREL Advanced LCOS	-4%
High % Difference from NREL Conservative LCOS	4%

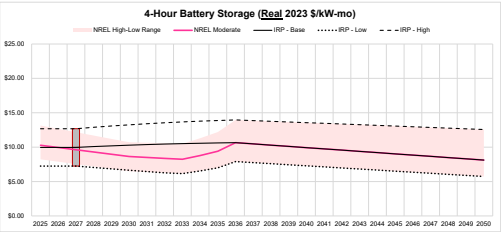
PWP 2023 IRP - Utility-Scale 4-Hour Storage Costs **NOMINAL $/kW-mo**

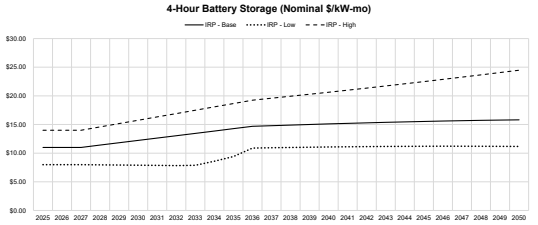
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$11.00	$11.00	$11.00	$11.41	$11.82	$12.23	$12.64	$13.05	$13.46	$13.87	$14.28	$14.69	$14.80	$14.91	$15.01	$15.11	$15.20	$15.30	$15.38	$15.46	$15.54	$15.61	$15.67	$15.73	$15.77	$15.82
IRP - Low						$8.00	$8.00	$8.00	$7.97	$7.93	$7.90	$7.87	$7.83	$7.88	$8.59	$9.41	$10.90	$10.95	$11.00	$11.04	$11.08	$11.12	$11.15	$11.17	$11.19	$11.21	$11.21	$11.21	$11.21	$11.19	$11.17
IRP - High						$14.00	$14.00	$14.00	$14.58	$15.17	$15.75	$16.33	$16.91	$17.50	$18.08	$18.66	$19.25	$19.59	$19.93	$20.28	$20.64	$21.00	$21.36	$21.73	$22.11	$22.49	$22.88	$23.27	$23.67	$24.07	$24.48

PWP 2023 IRP - Utility-Scale 4-Hour Storage Costs **REAL 2023 $/kW-mo**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$9.97	$9.97	$9.97	$10.08	$10.19	$10.29	$10.37	$10.45	$10.51	$10.57	$10.62	$10.65	$10.47	$10.29	$10.11	$9.93	$9.75	$9.57	$9.39	$9.21	$9.02	$8.84	$8.66	$8.48	$8.30	$8.12
IRP - Low						$7.25	$7.25	$7.25	$7.04	$6.84	$6.65	$6.46	$6.27	$6.16	$6.55	$6.99	$7.90	$7.75	$7.59	$7.44	$7.28	$7.13	$6.97	$6.82	$6.66	$6.51	$6.35	$6.20	$6.04	$5.89	$5.74
IRP - High						$12.68	$12.68	$12.68	$12.89	$13.08	$13.25	$13.40	$13.54	$13.67	$13.78	$13.88	$13.96	$13.86	$13.76	$13.66	$13.56	$13.46	$13.36	$13.26	$13.16	$13.06	$12.96	$12.86	$12.77	$12.67	$12.57
								$12.71																							







Utility-Scale 6-Hour Battery Storage

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/5582/2023_atb_workbook_07_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/utility-scale_battery_storage

NREL Moderate

Variable	Units	Direct from NREL Calculation / Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$2,466	$2,231	$2,508	$2,409	$2,298	$2,010	$1,940	$1,870	$1,800	$1,729	$1,659	$1,632	$1,605	$1,578	$1,551	$1,525	$1,498	$1,471	$1,444	$1,417	$1,391	$1,364	$1,337	$1,310	$1,284	$1,257	$1,230	$1,204	$1,177	$1,150	$1,124
Fixed O&M	$/kW-year	Real 2021$	$61.65	$55.78	$62.70	$60.22	$57.44	$50.25	$48.50	$46.74	$44.99	$43.23	$41.47	$40.80	$40.13	$39.46	$38.79	$38.12	$37.45	$36.78	$36.11	$35.44	$34.77	$34.10	$33.43	$32.76	$32.09	$31.43	$30.76	$30.09	$29.43	$28.76	$28.10
Capital Cost	$/kW-AC	Nominal	$2,404	$2,231	$2,571	$2,531	$2,474	$2,219	$2,195	$2,168	$2,139	$2,107	$2,072	$2,089	$2,106	$2,123	$2,139	$2,154	$2,169	$2,184	$2,198	$2,211	$2,223	$2,235	$2,246	$2,256	$2,265	$2,274	$2,281	$2,287	$2,293	$2,297	$2,300
Fixed O&M	$/kW-AC-year	Nominal	$60.11	$55.78	$64.27	$63.26	$61.86	$55.47	$54.87	$54.21	$53.48	$52.67	$51.79	$52.23	$52.65	$53.07	$53.47	$53.86	$54.23	$54.59	$54.94	$55.27	$55.58	$55.88	$56.15	$56.40	$56.63	$56.84	$57.03	$57.19	$57.32	$57.42	$57.50

NREL Advanced

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$2,466	$2,231	$2,508	$1,804	$1,703	$1,617	$1,548	$1,479	$1,410	$1,342	$1,273	$1,251	$1,229	$1,206	$1,184	$1,162	$1,139	$1,117	$1,095	$1,073	$1,050	$1,027	$1,006	$984	$961	$938	$916	$894	$871	$849	$827
Fixed O&M	$/kW-year	Real 2021$	$61.65	$55.78	$62.70	$45.11	$42.58	$40.42	$38.70	$36.98	$35.26	$33.54	$31.83	$31.28	$30.72	$30.15	$29.59	$29.05	$28.48	$27.93	$27.37	$26.81	$26.24	$25.68	$25.15	$24.59	$24.02	$23.46	$22.91	$22.35	$21.78	$21.22	$20.68
Capital Cost	$/kW	Nominal	$2,404	$2,231	$2,571	$1,896	$1,834	$1,785	$1,751	$1,715	$1,676	$1,635	$1,590	$1,602	$1,612	$1,622	$1,632	$1,642	$1,650	$1,658	$1,666	$1,673	$1,678	$1,684	$1,689	$1,693	$1,695	$1,697	$1,699	$1,699	$1,697	$1,695	$1,693
Fixed O&M	$/kW-AC-year	Nominal	$60.11	$55.78	$64.27	$47.39	$45.85	$44.61	$43.78	$42.88	$41.91	$40.86	$39.76	$40.04	$40.31	$40.55	$40.79	$41.05	$41.25	$41.46	$41.65	$41.82	$41.95	$42.09	$42.23	$42.33	$42.38	$42.43	$42.46	$42.47	$42.42	$42.37	$42.32

NREL Conservative

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$2,466	$2,231	$2,508	$2,601	$2,619	$2,582	$2,482	$2,382	$2,282	$2,183	$2,083	$2,069	$2,054	$2,040	$2,026	$2,012	$1,997	$1,983	$1,969	$1,955	$1,940	$1,926	$1,912	$1,897	$1,883	$1,869	$1,855	$1,840	$1,826	$1,812	$1,798
Fixed O&M	$/kW-year	Real 2021$	$61.65	$55.78	$62.70	$65.03	$65.48	$64.55	$62.05	$59.55	$57.06	$54.56	$52.07	$51.72	$51.36	$51.00	$50.65	$50.29	$49.93	$49.58	$49.22	$48.86	$48.51	$48.15	$47.79	$47.44	$47.08	$46.72	$46.37	$46.01	$45.65	$45.30	$44.94
Capital Cost	$/kW	Nominal	$2,404	$2,231	$2,571	$2,733	$2,821	$2,850	$2,808	$2,763	$2,713	$2,659	$2,601	$2,648	$2,695	$2,744	$2,793	$2,842	$2,893	$2,944	$2,996	$3,048	$3,102	$3,156	$3,211	$3,267	$3,323	$3,380	$3,439	$3,497	$3,557	$3,617	$3,679
Fixed O&M	$/kW-year	Nominal	$60.11	$55.78	$64.27	$68.32	$70.52	$71.25	$70.20	$69.06	$67.82	$66.48	$65.03	$66.20	$67.39	$68.59	$69.82	$71.06	$72.32	$73.60	$74.89	$76.21	$77.55	$78.90	$80.27	$81.67	$83.08	$84.51	$85.96	$87.43	$88.93	$90.44	$91.97

Inputs
Calculated

Levelized Cost of Storage (LCOS) used for battery storage, with units of $/kW-month.

6-Hour Battery Storage (Utility-Scale)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046	2.098
Inflation Rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Tax Rate (Federal & State)	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Present Value - Depreciation (PV-Dep)	0.829																														
Interest During Construction	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.7%	3.9%	4.1%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
WACC	5%																														
Recovery Life (years)	20																														
Capital Recovery Factor (CRF)	8.0%																														
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

NREL Case
Conservative

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NOMINAL	Overnight Capital Cost ($/kW-AC)	$2,404.49	$2,231.35	$2,570.64	$2,732.77	$2,820.76	$2,849.90	$2,808.13	$2,762.54	$2,712.97	$2,659.26	$2,601.24	$2,648.01	$2,695.50	$2,743.71	$2,792.64	$2,842.31	$2,892.71	$2,943.86	$2,995.75	$3,048.40	$3,101.82	$3,155.99	$3,210.94	$3,266.66	$3,323.16	$3,380.45	$3,438.52	$3,497.38	$3,557.04	$3,617.49	$3,678.75
NOMINAL	Fixed O&M ($/kW-yr-AC)	$60.11	$55.78	$64.27	$68.32	$70.52	$71.25	$70.20	$69.06	$67.82	$66.48	$65.03	$66.20	$67.39	$68.59	$69.82	$71.06	$72.32	$73.60	$74.89	$76.21	$77.55	$78.90	$80.27	$81.67	$83.08	$84.51	$85.96	$87.43	$88.93	$90.44	$91.97
	Variable O&M ($/MWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capacity Factor (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
NOMINAL	LCOS ($/kW-mo)	$ 21.09	$ 19.57	$ 22.55	$ 23.97	$ 24.74	$ 24.99	$ 24.63	$ 24.23	$ 23.79	$ 23.32	$ 22.81	$ 23.22	$ 23.64	$ 24.06	$ 24.49	$ 24.93	$ 25.37	$ 25.82	$ 26.27	$ 26.74	$ 27.20	$ 27.68	$ 28.16	$ 28.65	$ 29.14	$ 29.65	$ 30.16	$ 30.67	$ 31.20	$ 31.73	$ 32.26
	Project Finance Factor (No ITC)	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Project Finance Factor (w/ITC)	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.782	0.879	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Construction Finance Factor	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
	LCOS Calcs ($/kW-month)																															
NOMINAL	No ITC	$22.26	$20.65	$23.80	$25.30	$26.11	$26.38	$26.01	$25.60	$25.16	$24.67	$24.15	$24.58	$25.02	$25.47	$25.92	$26.38	$26.85	$27.33	$27.81	$28.30	$28.79	$29.30	$29.81	$30.32	$30.85	$31.38	$31.92	$32.46	$33.02	$33.58	$34.15
NOMINAL	ITC (Model)	**$16.38**	**$15.20**	**$17.51**	**$18.62**	**$19.22**	**$19.42**	**$19.14**	**$18.84**	**$18.51**	**$18.15**	**$17.77**	**$18.08**	**$18.41**	**$18.74**	**$20.67**	**$22.90**	**$26.85**	**$27.33**	**$27.81**	**$28.30**	**$28.79**	**$29.30**	**$29.81**	**$30.32**	**$30.85**	**$31.38**	**$31.92**	**$32.46**	**$33.02**	**$33.58**	**$34.15**
Real 2020 $	No ITC (2020 Real $)	$22.26	$20.15	$22.65	$23.49	$23.66	$23.32	$22.43	$21.54	$20.65	$19.75	$18.86	$18.73	$18.60	$18.48	$18.35	$18.22	$18.09	$17.96	$17.83	$17.70	$17.57	$17.44	$17.31	$17.18	$17.05	$16.93	$16.80	$16.67	$16.54	$16.41	$16.28
Real 2020 $	ITC (2020 Real $)	$16.38	$14.83	$16.67	$17.29	$17.41	$17.16	$16.50	$15.85	$15.19	$14.54	$13.88	$13.78	$13.69	$13.59	$14.63	$15.81	$18.09	$17.96	$17.83	$17.70	$17.57	$17.44	$17.31	$17.18	$17.05	$16.93	$16.80	$16.67	$16.54	$16.41	$16.28
	Effective Capital Costs																															
NOMINAL	No ITC (Nominal $)	$2,404	$2,231	$2,571	$2,733	$2,821	$2,850	$2,808	$2,763	$2,713	$2,659	$2,601	$2,648	$2,695	$2,744	$2,793	$2,842	$2,893	$2,944	$2,996	$3,048	$3,102	$3,156	$3,211	$3,267	$3,323	$3,380	$3,439	$3,497	$3,557	$3,617	$3,679
NOMINAL	ITC (Nominal $)	$1,585	$1,471	$1,695	$1,802	$1,860	$1,879	$1,851	$1,821	$1,789	$1,753	$1,715	$1,746	$1,777	$1,809	$2,063	$2,358	$2,893	$2,944	$2,996	$3,048	$3,102	$3,156	$3,211	$3,267	$3,323	$3,380	$3,439	$3,497	$3,557	$3,617	$3,679
Real 2020 $	Solar No ITC (Real 2020 $)	$2,404	$2,177	$2,447	$2,538	$2,555	$2,519	$2,421	$2,324	$2,227	$2,129	$2,032	$2,018	$2,004	$1,990	$1,976	$1,963	$1,949	$1,935	$1,921	$1,907	$1,893	$1,879	$1,865	$1,851	$1,837	$1,823	$1,809	$1,796	$1,782	$1,768	$1,754
Real 2020 $	Solar ITC (Real 2020 $)	$1,585	$1,435	$1,613	$1,673	$1,685	$1,661	$1,596	$1,532	$1,468	$1,404	$1,340	$1,331	$1,321	$1,312	$1,460	$1,628	$1,949	$1,935	$1,921	$1,907	$1,893	$1,879	$1,865	$1,851	$1,837	$1,823	$1,809	$1,796	$1,782	$1,768	$1,754

MACRS Yr.	1	2	3	4	5	6
Depreciation Fraction	0.2000	0.3200	0.1920	0.1152	0.1152	0.0576
Depreciation Factor	0.9337	0.8718	0.8140	0.7600	0.7097	0.6626

Construction Duration yrs		3																														
Year	Capital Fraction	Accumulated Interest																														
0	1	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
1	0	1.039	1.039	1.039	1.039	1.039	1.039	1.042	1.044	1.046	1.048	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051
2	0	1.067	1.067	1.067	1.067	1.067	1.067	1.071	1.075	1.078	1.082	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086

Utility-Scale 6-Hour Battery Storage

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real Dollars Factor (2023 = 1)	0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Overnight Capital Cost (Nominal $/kW)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$2,404	$2,231	$2,571	$2,531	$2,474	$2,219	$2,195	$2,168	$2,139	$2,107	$2,072	$2,089	$2,106	$2,123	$2,139	$2,154	$2,169	$2,184	$2,198	$2,211	$2,223	$2,235	$2,246	$2,256	$2,265	$2,274	$2,281	$2,287	$2,293	$2,297	$2,300
NREL Advanced	$2,404	$2,231	$2,571	$1,896	$1,834	$1,785	$1,751	$1,715	$1,676	$1,635	$1,590	$1,602	$1,612	$1,622	$1,632	$1,642	$1,650	$1,658	$1,666	$1,673	$1,678	$1,684	$1,689	$1,693	$1,695	$1,697	$1,699	$1,699	$1,697	$1,695	$1,693
NREL Conservative	$2,404	$2,231	$2,571	$2,733	$2,821	$2,850	$2,808	$2,763	$2,713	$2,659	$2,601	$2,648	$2,695	$2,744	$2,793	$2,842	$2,893	$2,944	$2,996	$3,048	$3,102	$3,156	$3,211	$3,267	$3,323	$3,380	$3,439	$3,497	$3,557	$3,617	$3,679

Year-Over-Year % Change

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate		-7%	15%	-2%	-2%	-10%	-1%	-1%	-1%	-2%	-2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Advanced		-7%	15%	-26%	-3%	-3%	-2%	-2%	-2%	-3%	-3%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Conservative		-7%	15%	6%	3%	1%	-1%	-2%	-2%	-2%	-2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Percent Difference from Moderate

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Advanced	0.0%	0.0%	0.0%	-25.1%	-25.9%	-19.6%	-20.2%	-20.9%	-21.6%	-22.4%	-23.2%	-23.3%	-23.4%	-23.6%	-23.7%	-23.8%	-23.9%	-24.1%	-24.2%	-24.3%	-24.5%	-24.7%	-24.8%	-24.9%	-25.2%	-25.3%	-25.5%	-25.7%	-26.0%	-26.2%	-26.4%
NREL Conservative	0.0%	0.0%	0.0%	8.0%	14.0%	28.4%	27.9%	27.4%	26.8%	26.2%	25.6%	26.8%	28.0%	29.3%	30.6%	31.9%	33.3%	34.8%	36.3%	37.9%	39.5%	41.2%	43.0%	44.8%	46.7%	48.7%	50.7%	52.9%	55.1%	57.5%	60.0%

LCOS (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$16.38	$15.20	$17.51	$17.24	$16.86	$15.12	$14.96	$14.79	$14.59	$14.38	$14.15	$14.27	$14.38	$14.50	$15.83	$17.36	$20.14	$20.27	$20.40	$20.52	$20.64	$20.75	$20.85	$20.94	$21.03	$21.11	$21.17	$21.23	$21.28	$21.32	$21.35
NREL Advanced	$16.38	$15.20	$17.51	$12.91	$12.50	$12.16	$11.94	$11.70	$11.44	$11.16	$10.86	$10.94	$11.01	$11.08	$12.08	$13.23	$15.32	$15.39	$15.46	$15.53	$15.58	$15.63	$15.68	$15.72	$15.74	$15.76	$15.77	$15.77	$15.75	$15.73	$15.71
NREL Conservative	$16.38	$15.20	$17.51	$18.62	$19.22	$19.42	$19.14	$18.84	$18.51	$18.15	$17.77	$18.08	$18.41	$18.74	$20.67	$22.90	$26.85	$27.33	$27.81	$28.30	$28.79	$29.30	$29.81	$30.32	$30.85	$31.38	$31.92	$32.46	$33.02	$33.58	$34.15
Range	*$0.00*	*$0.00*	*$0.00*	*$5.70*	*$6.72*	*$7.26*	*$7.20*	*$7.14*	*$7.07*	*$7.00*	*$6.90*	*$7.15*	*$7.40*	*$7.66*	*$8.59*	*$9.67*	*$11.54*	*$11.93*	*$12.34*	*$12.77*	*$13.22*	*$13.67*	*$14.12*	*$14.60*	*$15.11*	*$15.62*	*$16.15*	*$16.70*	*$17.27*	*$17.85*	*$18.43*

LCOS (Real 2023 $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$17.67	$15.99	$17.96	$17.24	$16.44	$14.39	$13.89	$13.40	$12.90	$12.40	$11.90	$11.71	$11.52	$11.32	$12.07	$12.90	$14.61	$14.35	$14.08	$13.82	$13.56	$13.30	$13.04	$12.78	$12.52	$12.26	$12.00	$11.74	$11.48	$11.22	$10.96
NREL Advanced	$17.67	$15.99	$17.96	$12.91	$12.19	$11.57	$11.08	$10.60	$10.11	$9.62	$9.14	$8.98	$8.82	$8.65	$9.21	$9.84	$11.11	$10.89	$10.68	$10.46	$10.24	$10.02	$9.81	$9.59	$9.37	$9.15	$8.94	$8.72	$8.49	$8.28	$8.07
NREL Conservative	$17.67	$15.99	$17.96	$18.62	$18.75	$18.48	$17.77	$17.07	$16.36	$15.65	$14.95	$14.84	$14.74	$14.64	$15.75	$17.03	$19.48	$19.34	$19.20	$19.06	$18.92	$18.78	$18.64	$18.51	$18.37	$18.23	$18.09	$17.95	$17.81	$17.67	$17.53
Range	*$0.00*	*$0.00*	*$0.00*	*$5.70*	*$6.56*	*$6.91*	*$6.69*	*$6.47*	*$6.25*	*$6.03*	*$5.81*	*$5.87*	*$5.92*	*$5.99*	*$6.55*	*$7.19*	*$8.37*	*$8.45*	*$8.52*	*$8.60*	*$8.69*	*$8.76*	*$8.83*	*$8.91*	*$9.00*	*$9.07*	*$9.15*	*$9.23*	*$9.31*	*$9.39*	*$9.46*

Contract PPA Price (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
4-Hour BESS - Mid								$11.00																							
4-Hour BESS - Mid								$8.00																							
4-Hour BESS - Mid								$14.00																							
								$3.00																							
								$3.00																							

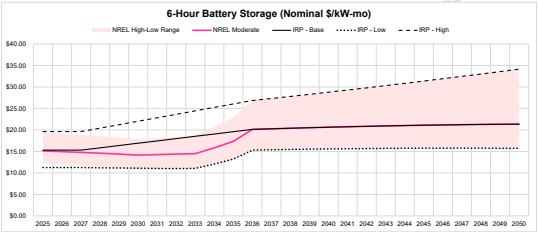
Mid % Difference from NREL Moderate LCOS	4%
Low % Difference from NREL Advanced LCOS	-4%
High % Difference from NREL Conservative LCOS	4%

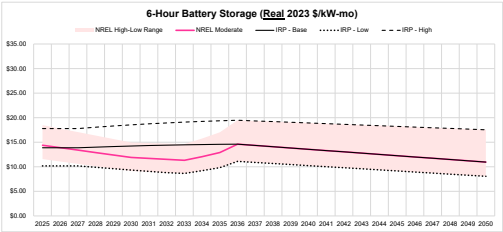
PWP 2023 IRP - Utility-Scale 6-Hour Storage Costs **NOMINAL $/kW-mo**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$15.31	$15.31	$15.31	$15.85	$16.38	$16.92	$17.46	$17.99	$18.53	$19.06	$19.60	$20.14	$20.27	$20.40	$20.52	$20.64	$20.75	$20.85	$20.94	$21.03	$21.11	$21.17	$21.23	$21.28	$21.32	$21.35
IRP - Low						$11.25	$11.25	$11.25	$11.20	$11.15	$11.11	$11.06	$11.01	$11.08	$12.08	$13.23	$15.32	$15.39	$15.46	$15.53	$15.58	$15.63	$15.68	$15.72	$15.74	$15.76	$15.77	$15.77	$15.75	$15.73	$15.71
IRP - High						$19.63	$19.63	$19.63	$20.43	$21.23	$22.03	$22.84	$23.64	$24.44	$25.25	$26.05	$26.85	$27.33	$27.81	$28.30	$28.79	$29.30	$29.81	$30.32	$30.85	$31.38	$31.92	$32.46	$33.02	$33.58	$34.15

PWP 2023 IRP - Utility-Scale 6-Hour Storage Costs **REAL 2023 $/kW-mo**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$13.87	$13.87	$13.87	$14.01	$14.13	$14.23	$14.33	$14.41	$14.47	$14.53	$14.57	$14.61	$14.35	$14.08	$13.82	$13.56	$13.30	$13.04	$12.78	$12.52	$12.26	$12.00	$11.74	$11.48	$11.22	$10.96
IRP - Low						$10.19	$10.19	$10.19	$9.90	$9.62	$9.34	$9.08	$8.82	$8.65	$9.21	$9.84	$11.11	$10.89	$10.68	$10.46	$10.24	$10.02	$9.81	$9.59	$9.37	$9.15	$8.94	$8.72	$8.49	$8.28	$8.07
IRP - High						$17.78	$17.78	$17.78	$18.06	$18.31	$18.54	$18.74	$18.93	$19.09	$19.24	$19.37	$19.48	$19.34	$19.20	$19.06	$18.92	$18.78	$18.64	$18.51	$18.37	$18.23	$18.09	$17.95	$17.81	$17.67	$17.53
								$1.68																							





Utility-Scale 8-Hour Battery Storage

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/5882/2023_atb_workbook_07_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/utility-scale_battery_storage

		Direct from NREL Calculation																														
NREL Moderate																																
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$3,205	$2,875	$3,232	$3,302	$2,956	$2,584	$2,490	$2,396	$2,302	$2,208	$2,114	$2,079	$2,044	$2,008	$1,973	$1,938	$1,903	$1,868	$1,833	$1,798	$1,763	$1,728	$1,693	$1,658	$1,624	$1,589	$1,554	$1,519	$1,484	$1,450	$1,415
Fixed O&M	$/kW-year	Real 2021$	$80.13	$71.89	$80.80	$77.54	$73.91	$64.60	$62.26	$59.91	$57.56	$55.20	$52.85	$51.97	$51.09	$50.21	$49.33	$48.46	$47.58	$46.71	$45.83	$44.96	$44.08	$43.21	$42.33	$41.46	$40.59	$39.72	$38.85	$37.98	$37.11	$36.24	$35.38
Capital Cost	$/kW-AC	Nominal	$3,125	$2,875	$3,313	$3,259	$3,184	$2,852	$2,817	$2,779	$2,737	$2,690	$2,640	$2,661	$2,681	$2,701	$2,720	$2,739	$2,756	$2,773	$2,789	$2,805	$2,819	$2,832	$2,844	$2,855	$2,865	$2,874	$2,881	$2,887	$2,891	$2,894	$2,896
Fixed O&M	$/kW-AC-year	Nominal	$78.12	$71.89	$82.82	$81.47	$79.59	$71.31	$70.44	$69.47	$68.42	$67.26	$66.00	$66.52	$67.03	$67.53	$68.01	$68.47	$68.91	$69.33	$69.74	$70.11	$70.47	$70.80	$71.10	$71.38	$71.63	$71.84	$72.02	$72.17	$72.28	$72.36	$72.39

NREL Advanced																																
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$3,205	$2,875	$3,232	$3,352	$3,375	$3,327	$3,196	$3,065	$2,934	$2,803	$2,673	$2,655	$2,636	$2,618	$2,600	$2,581	$2,563	$2,545	$2,526	$2,508	$2,490	$2,472	$2,453	$2,435	$2,417	$2,398	$2,380	$2,362	$2,343	$2,325	$2,307
Fixed O&M	$/kW-year	Real 2021$	$80.13	$71.89	$80.80	$58.13	$54.88	$52.09	$49.87	$47.65	$45.43	$43.21	$41.02	$40.31	$39.59	$38.85	$38.13	$37.45	$36.70	$35.99	$35.27	$34.56	$33.81	$33.09	$32.41	$31.70	$30.95	$30.23	$29.52	$28.80	$28.06	$27.34	$26.66
Capital Cost	$/kW	Nominal	$3,125	$2,875	$3,313	$2,443	$2,364	$2,300	$2,257	$2,211	$2,160	$2,106	$2,049	$2,064	$2,078	$2,090	$2,103	$2,117	$2,126	$2,137	$2,147	$2,156	$2,162	$2,169	$2,178	$2,183	$2,185	$2,187	$2,189	$2,189	$2,186	$2,184	$2,182
Fixed O&M	$/kW-AC-year	Nominal	$78.12	$71.89	$82.82	$61.07	$59.09	$57.50	$56.43	$55.26	$54.01	$52.65	$51.23	$51.60	$51.95	$52.24	$52.56	$52.91	$53.16	$53.42	$53.67	$53.90	$54.05	$54.23	$54.44	$54.57	$54.62	$54.69	$54.73	$54.74	$54.65	$54.59	$54.56

NREL Conservative																																
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$3,205	$2,875	$3,232	$3,352	$3,375	$3,327	$3,196	$3,065	$2,934	$2,803	$2,673	$2,655	$2,636	$2,618	$2,600	$2,581	$2,563	$2,545	$2,526	$2,508	$2,490	$2,472	$2,453	$2,435	$2,417	$2,398	$2,380	$2,362	$2,343	$2,325	$2,307
Fixed O&M	$/kW-year	Real 2021$	$80.13	$71.89	$80.80	$83.80	$84.39	$83.17	$79.90	$76.62	$73.35	$70.09	$66.82	$66.36	$65.91	$65.45	$64.99	$64.53	$64.08	$63.62	$63.16	$62.70	$62.25	$61.79	$61.33	$60.87	$60.42	$59.96	$59.50	$59.04	$58.59	$58.13	$57.67
Capital Cost	$/kW	Nominal	$3,125	$2,875	$3,313	$3,522	$3,635	$3,672	$3,616	$3,554	$3,488	$3,416	$3,338	$3,398	$3,459	$3,521	$3,584	$3,647	$3,712	$3,778	$3,844	$3,912	$3,980	$4,050	$4,120	$4,192	$4,264	$4,338	$4,412	$4,488	$4,565	$4,642	$4,721
Fixed O&M	$/kW-year	Nominal	$78.12	$71.89	$82.82	$88.04	$90.87	$91.81	$90.40	$88.86	$87.20	$85.39	$83.45	$84.95	$86.47	$88.02	$89.59	$91.18	$92.80	$94.44	$96.11	$97.80	$99.51	$101.25	$103.01	$104.80	$106.61	$108.45	$110.31	$112.20	$114.11	$116.05	$118.02

Inputs	
Calculated	

Levelized Cost of Storage (LCOS) used for battery storage, with units of $/kW-month.

8-Hour Battery Storage (Utility-Scale)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046	2.098
Inflation Rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Tax Rate (Federal & State)	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Present Value - Depreciation (PV-Dep)	0.829																														
Interest During Construction	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.7%	3.9%	4.1%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
WACC	5%																														
Recovery Life (years)	20																														
Capital Recovery Factor (CRF)	8.0%																														
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

NREL Case																															
Conservative																															
NOMINAL	Overnight Capital Cost ($/kW-AC)	$3,124.93	$2,875.46	$3,312.68	$3,521.80	$3,634.96	$3,672.26	$3,615.86	$3,554.45	$3,487.81	$3,415.74	$3,338.03	$3,398.05	$3,458.99	$3,520.86	$3,583.65	$3,647.38	$3,712.06	$3,777.70	$3,844.29	$3,911.86	$3,980.40	$4,049.92	$4,120.43	$4,191.94	$4,264.44	$4,337.95	$4,412.47	$4,488.01	$4,564.56	$4,642.14	$4,720.74
NOMINAL	Fixed O&M ($/kW-yr-AC)	$78.12	$71.89	$82.82	$88.04	$90.87	$91.81	$90.40	$88.86	$87.20	$85.39	$83.45	$84.95	$86.47	$88.02	$89.59	$91.18	$92.80	$94.44	$96.11	$97.80	$99.51	$101.25	$103.01	$104.80	$106.61	$108.45	$110.31	$112.20	$114.11	$116.05	$118.02
	Variable O&M ($/MWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capacity Factor (%)	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%
NOMINAL	LCOS ($/kW-mo)	$ 27.41	$ 25.22	$ 29.05	$ 30.89	$ 31.88	$ 32.21	$ 31.71	$ 31.17	$ 30.59	$ 29.96	$ 29.28	$ 29.80	$ 30.34	$ 30.88	$ 31.43	$ 31.99	$ 32.56	$ 33.13	$ 33.72	$ 34.31	$ 34.91	$ 35.52	$ 36.14	$ 36.76	$ 37.40	$ 38.04	$ 38.70	$ 39.36	$ 40.03	$ 40.71	$ 41.40
	Project Finance Factor (No ITC)	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Project Finance Factor (w/ITC)	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.782	0.879	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Construction Finance Factor	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
	LCOS Calcs ($/kW-month)																														
NOMINAL	No ITC	$28.93	$26.62	$30.66	$32.60	$33.65	$33.99	$33.49	$32.94	$32.34	$31.69	$30.99	$31.54	$32.11	$32.68	$33.27	$33.86	$34.46	$35.07	$35.68	$36.31	$36.95	$37.59	$38.25	$38.91	$39.58	$40.27	$40.96	$41.66	$42.37	$43.09	$43.82
NOMINAL	ITC (Model)	**$21.29**	**$19.59**	**$22.57**	**$23.99**	**$24.76**	**$25.02**	**$24.65**	**$24.24**	**$23.80**	**$23.32**	**$22.80**	**$23.21**	**$23.62**	**$24.05**	**$26.53**	**$29.38**	**$34.46**	**$35.07**	**$35.68**	**$36.31**	**$36.95**	**$37.59**	**$38.25**	**$38.91**	**$39.58**	**$40.27**	**$40.96**	**$41.66**	**$42.37**	**$43.09**	**$43.82**
Real 2020 $	No ITC (2020 Real $)	$28.93	$25.97	$29.19	$30.27	$30.48	$30.04	$28.88	$27.71	$26.54	$25.37	$24.21	$24.04	$23.87	$23.71	$23.54	$23.38	$23.21	$23.05	$22.88	$22.71	$22.55	$22.38	$22.22	$22.05	$21.89	$21.72	$21.55	$21.39	$21.22	$21.06	$20.89
Real 2020 $	ITC (2020 Real $)	$21.29	$19.11	$21.48	$22.28	$22.43	$22.11	$21.25	$20.39	$19.53	$18.67	$17.81	$17.69	$17.57	$17.44	$18.77	$20.29	$23.21	$23.05	$22.88	$22.71	$22.55	$22.38	$22.22	$22.05	$21.89	$21.72	$21.55	$21.39	$21.22	$21.06	$20.89
	Effective Capital Costs																														
NOMINAL	No ITC (Nominal $)	$3,125	$2,875	$3,313	$3,522	$3,635	$3,672	$3,616	$3,554	$3,488	$3,416	$3,338	$3,398	$3,459	$3,521	$3,584	$3,647	$3,712	$3,778	$3,844	$3,912	$3,980	$4,050	$4,120	$4,192	$4,264	$4,338	$4,412	$4,488	$4,565	$4,642	$4,721
NOMINAL	ITC (Nominal $)	$2,060	$1,896	$2,184	$2,322	$2,396	$2,421	$2,384	$2,343	$2,299	$2,252	$2,201	$2,240	$2,280	$2,321	$2,648	$3,026	$3,712	$3,778	$3,844	$3,912	$3,980	$4,050	$4,120	$4,192	$4,264	$4,338	$4,412	$4,488	$4,565	$4,642	$4,721
Real 2020 $	Solar No ITC (Real 2020 $)	$3,125	$2,805	$3,153	$3,270	$3,293	$3,246	$3,118	$2,990	$2,863	$2,735	$2,608	$2,590	$2,572	$2,554	$2,536	$2,518	$2,501	$2,483	$2,465	$2,447	$2,429	$2,411	$2,393	$2,376	$2,358	$2,340	$2,322	$2,304	$2,286	$2,268	$2,251
Real 2020 $	Solar ITC (Real 2020 $)	$2,060	$1,849	$2,079	$2,156	$2,171	$2,140	$2,056	$1,971	$1,887	$1,803	$1,719	$1,707	$1,696	$1,684	$1,874	$2,089	$2,501	$2,483	$2,465	$2,447	$2,429	$2,411	$2,393	$2,376	$2,358	$2,340	$2,322	$2,304	$2,286	$2,268	$2,251

MACRS Yr.	**1**	**2**	**3**	**4**	**5**	**6**
Depreciation Fraction	0.2000	0.3200	0.1920	0.1152	0.1152	0.0576
Depreciation Factor	0.9337	0.8718	0.8140	0.7600	0.7097	0.6626

Construction Duration yrs		**3**																														
Year	Capital Fraction	Accumulated Interest																														
0	1	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
1	0	1.039	1.039	1.039	1.039	1.039	1.039	1.042	1.044	1.046	1.048	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051
2	0	1.067	1.067	1.067	1.067	1.067	1.067	1.071	1.075	1.078	1.082	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086

Utility-Scale 8-Hour Battery Storage

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real Dollars Factor (2023 = 1)	0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Overnight Capital Cost (Nominal $/kW)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$3,125	$2,875	$3,313	$3,259	$3,184	$2,852	$2,817	$2,779	$2,737	$2,690	$2,640	$2,661	$2,681	$2,701	$2,720	$2,739	$2,756	$2,773	$2,789	$2,805	$2,819	$2,832	$2,844	$2,855	$2,865	$2,874	$2,881	$2,887	$2,891	$2,894	$2,896
NREL Advanced	$3,125	$2,875	$3,313	$2,443	$2,364	$2,300	$2,257	$2,211	$2,160	$2,106	$2,049	$2,064	$2,078	$2,090	$2,103	$2,117	$2,126	$2,137	$2,147	$2,156	$2,162	$2,169	$2,178	$2,183	$2,185	$2,187	$2,189	$2,189	$2,186	$2,184	$2,182
NREL Conservative	$3,125	$2,875	$3,313	$3,522	$3,635	$3,672	$3,616	$3,554	$3,488	$3,416	$3,338	$3,398	$3,459	$3,521	$3,584	$3,647	$3,712	$3,778	$3,844	$3,912	$3,980	$4,050	$4,120	$4,192	$4,264	$4,338	$4,412	$4,488	$4,565	$4,642	$4,721

Year-Over-Year % Change

NREL Moderate		-8%	15%	-2%	-2%	-10%	-1%	-1%	-2%	-2%	-2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Advanced		-8%	15%	-26%	-3%	-3%	-2%	-2%	-2%	-3%	-3%	1%	1%	1%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Conservative		-8%	15%	6%	3%	1%	-2%	-2%	-2%	-2%	-2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Percent Difference from Moderate

NREL Advanced	0.0%	0.0%	0.0%	-25.0%	-25.8%	-19.4%	-19.9%	-20.5%	-21.1%	-21.7%	-22.4%	-22.4%	-22.5%	-22.6%	-22.7%	-22.7%	-22.9%	-22.9%	-23.0%	-23.1%	-23.3%	-23.4%	-23.4%	-23.6%	-23.7%	-23.9%	-24.0%	-24.2%	-24.4%	-24.6%	-24.6%
NREL Conservative	0.0%	0.0%	0.0%	8.1%	14.2%	28.7%	28.3%	27.9%	27.4%	27.0%	26.4%	27.7%	29.0%	30.3%	31.7%	33.2%	34.7%	36.2%	37.8%	39.5%	41.2%	43.0%	44.9%	46.8%	48.8%	51.0%	53.2%	55.5%	57.9%	60.4%	63.0%

LCOS (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$21.29	$19.59	$22.57	$22.20	$21.69	$19.43	$19.20	$18.95	$18.67	$18.36	$18.03	$18.17	$18.31	$18.45	$20.14	$22.06	$25.59	$25.74	$25.89	$26.03	$26.17	$26.29	$26.40	$26.50	$26.59	$26.67	$26.74	$26.80	$26.84	$26.87	$26.88
NREL Advanced	$21.29	$19.59	$22.57	$16.64	$16.10	$15.67	$15.38	$15.07	$14.74	$14.38	$14.00	$14.10	$14.19	$14.27	$15.56	$17.05	$19.74	$19.84	$19.93	$20.01	$20.07	$20.14	$20.21	$20.26	$20.28	$20.31	$20.32	$20.32	$20.29	$20.27	$20.26
NREL Conservative	$21.29	$19.59	$22.57	$23.99	$24.76	$25.02	$24.65	$24.24	$23.80	$23.32	$22.80	$23.21	$23.62	$24.05	$26.53	$29.38	$34.46	$35.07	$35.68	$36.31	$36.95	$37.59	$38.25	$38.91	$39.58	$40.27	$40.96	$41.66	$42.37	$43.09	$43.82
Range	*$0.00*	*$0.00*	*$0.00*	*$7.35*	*$8.66*	*$9.35*	*$9.26*	*$9.16*	*$9.06*	*$8.94*	*$8.80*	*$9.11*	*$9.43*	*$9.77*	*$10.96*	*$12.33*	*$14.72*	*$15.23*	*$15.76*	*$16.30*	*$16.88*	*$17.46*	*$18.03*	*$18.65*	*$19.31*	*$19.96*	*$20.64*	*$21.34*	*$22.08*	*$22.82*	*$23.56*

LCOS (Real 2023 $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$22.97	$20.61	$23.15	$22.20	$21.16	$18.50	$17.83	$17.17	$16.50	$15.84	$15.17	$14.92	$14.66	$14.41	$15.35	$16.41	$18.56	$18.22	$17.88	$17.54	$17.20	$16.85	$16.51	$16.17	$15.83	$15.49	$15.15	$14.82	$14.48	$14.14	$13.80
NREL Advanced	$22.97	$20.61	$23.15	$16.64	$15.71	$14.91	$14.29	$13.66	$13.03	$12.40	$11.77	$11.57	$11.36	$11.15	$11.86	$12.68	$14.32	$14.04	$13.76	$13.48	$13.19	$12.91	$12.64	$12.36	$12.07	$11.79	$11.52	$11.24	$10.94	$10.67	$10.40
NREL Conservative	$22.97	$20.61	$23.15	$23.99	$24.16	$23.81	$22.89	$21.96	$21.03	$20.11	$19.18	$19.05	$18.92	$18.78	$20.22	$21.85	$25.00	$24.82	$24.64	$24.46	$24.28	$24.10	$23.93	$23.75	$23.57	$23.39	$23.21	$23.03	$22.85	$22.68	$22.50
Range	*$0.00*	*$0.00*	*$0.00*	*$7.35*	*$8.45*	*$8.90*	*$8.60*	*$8.30*	*$8.01*	*$7.71*	*$7.40*	*$7.48*	*$7.55*	*$7.64*	*$8.36*	*$9.17*	*$10.68*	*$10.78*	*$10.88*	*$10.98*	*$11.09*	*$11.19*	*$11.28*	*$11.38*	*$11.49*	*$11.60*	*$11.70*	*$11.80*	*$11.91*	*$12.01*	*$12.10*

Contract PPA Price (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
8-Hour BESS - Mid								$11.00																							
8-Hour BESS - Low								$8.00																							
8-Hour BESS - High								$14.00																							
								$3.00																							
								$3.00																							

Mid % Difference from NREL Moderate LCOS	4%
Low % Difference from NREL Advanced LCOS	-4%
High % Difference from NREL Conservative LCOS	4%

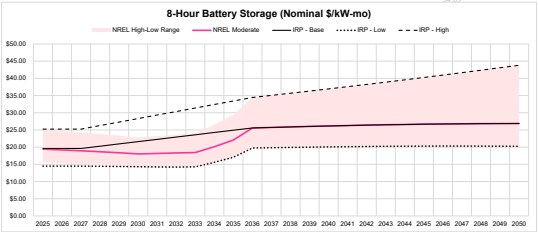
Sapphire BESS premium/discount to NREL LCOE is applied to other battery technologies

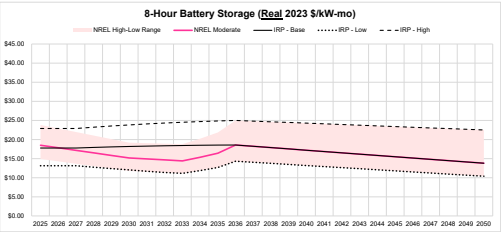
PWP 2023 IRP - Utility-Scale 8-Hour Storage Costs **NOMINAL $/kW-mo**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$19.62	$19.62	$19.62	$20.29	$20.95	$21.61	$22.27	$22.94	$23.60	$24.26	$24.92	$25.59	$25.74	$25.89	$26.03	$26.17	$26.29	$26.40	$26.50	$26.59	$26.67	$26.74	$26.80	$26.84	$26.87	$26.88
IRP - Low						$14.49	$14.49	$14.49	$14.43	$14.37	$14.31	$14.25	$14.19	$14.27	$15.56	$17.05	$19.74	$19.84	$19.93	$20.01	$20.07	$20.14	$20.21	$20.26	$20.28	$20.31	$20.32	$20.32	$20.29	$20.27	$20.26
IRP - High						$25.25	$25.25	$25.25	$26.27	$27.30	$28.32	$29.34	$30.37	$31.39	$32.41	$33.43	$34.46	$35.07	$35.68	$36.31	$36.95	$37.59	$38.25	$38.91	$39.58	$40.27	$40.96	$41.66	$42.37	$43.09	$43.82

PWP 2023 IRP - Utility-Scale 8-Hour Storage Costs **REAL 2023 $/kW-mo**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$17.78	$17.78	$17.78	$17.93	$18.06	$18.18	$18.28	$18.37	$18.44	$18.49	$18.53	$18.56	$18.22	$17.88	$17.54	$17.20	$16.85	$16.51	$16.17	$15.83	$15.49	$15.15	$14.82	$14.48	$14.14	$13.80
IRP - Low						$13.13	$13.13	$13.13	$12.76	$12.39	$12.04	$11.70	$11.36	$11.15	$11.86	$12.68	$14.32	$14.04	$13.76	$13.48	$13.19	$12.91	$12.64	$12.36	$12.07	$11.79	$11.52	$11.24	$10.94	$10.67	$10.40
IRP - High						$22.88	$22.88	$22.88	$23.22	$23.54	$23.82	$24.08	$24.31	$24.52	$24.70	$24.86	$25.00	$24.82	$24.64	$24.46	$24.28	$24.10	$23.93	$23.75	$23.57	$23.39	$23.21	$23.03	$22.85	$22.68	$22.50
								$4.65																							





Utility-Scale 10-Hour Battery Storage

Source: NREL 2023 Annual Technology Baseline (ATB)
Link: https://data.openei.org/files/5582/2023_atb_workbook_07_20_23.xlsx
ATB Detail: https://atb.nrel.gov/electricity/2023/utility-scale_battery_storage

		Direct from NREL Calculation																														
NREL Moderate																																
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$3,944	$3,520	$3,956	$3,795	$3,615	$3,158	$3,040	$2,923	$2,805	$2,687	$2,569	$2,525	$2,482	$2,439	$2,395	$2,352	$2,309	$2,265	$2,222	$2,179	$2,136	$2,093	$2,050	$2,006	$1,963	$1,920	$1,877	$1,835	$1,792	$1,749	$1,706
Fixed O&M	$/kW-year	Real 2021$	$98.60	$87.99	$98.90	$94.87	$90.38	$78.95	$76.01	$73.07	$70.12	$67.17	$64.22	$63.13	$62.05	$60.97	$59.88	$58.80	$57.72	$56.63	$55.55	$54.47	$53.39	$52.32	$51.24	$50.16	$49.09	$48.01	$46.94	$45.86	$44.79	$43.72	$42.65
Capital Cost	$/kW-AC	Nominal	$3,845	$3,520	$4,055	$3,987	$3,893	$3,486	$3,440	$3,390	$3,334	$3,274	$3,208	$3,233	$3,257	$3,280	$3,302	$3,323	$3,344	$3,363	$3,381	$3,398	$3,414	$3,429	$3,442	$3,454	$3,465	$3,474	$3,481	$3,486	$3,490	$3,492	$3,492
Fixed O&M	$/kW-AC-year	Nominal	$96.13	$87.99	$101.37	$99.68	$97.33	$87.15	$86.00	$84.74	$83.36	$81.85	$80.20	$80.82	$81.41	$81.99	$82.55	$83.08	$83.59	$84.07	$84.53	$84.96	$85.36	$85.72	$86.06	$86.36	$86.62	$86.84	$87.02	$87.16	$87.25	$87.29	$87.29

NREL Advanced																																
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$3,944	$3,520	$3,956	$2,846	$2,687	$2,551	$2,441	$2,333	$2,224	$2,116	$2,009	$1,974	$1,939	$1,902	$1,867	$1,834	$1,797	$1,762	$1,727	$1,692	$1,655	$1,620	$1,587	$1,552	$1,515	$1,480	$1,445	$1,410	$1,373	$1,339	$1,306
Fixed O&M	$/kW-year	Real 2021$	$98.60	$87.99	$98.90	$71.15	$67.17	$63.77	$61.05	$58.33	$55.61	$52.89	$50.21	$49.34	$48.46	$47.54	$46.67	$45.84	$44.92	$44.05	$43.17	$42.30	$41.38	$40.50	$39.68	$38.80	$37.88	$37.01	$36.13	$35.26	$34.34	$33.46	$32.64
Capital Cost	$/kW	Nominal	$3,845	$3,520	$4,055	$2,890	$2,893	$2,815	$2,763	$2,706	$2,644	$2,578	$2,508	$2,526	$2,544	$2,558	$2,573	$2,591	$2,602	$2,616	$2,628	$2,639	$2,646	$2,655	$2,666	$2,672	$2,674	$2,678	$2,680	$2,680	$2,675	$2,672	$2,672
Fixed O&M	$/kW-AC-year	Nominal	$96.13	$87.99	$101.37	$74.76	$72.34	$70.39	$69.07	$67.65	$66.10	$64.44	$62.71	$63.16	$63.59	$63.94	$64.33	$64.78	$65.06	$65.39	$65.69	$65.97	$66.15	$66.37	$66.64	$66.80	$66.85	$66.94	$66.99	$67.00	$66.88	$66.81	$66.80

NREL Conservative																																
Variable	**Units**	**Real/Nominal**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021 =1)	0.00	-	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$3,944	$3,520	$3,956	$4,103	$4,131	$4,072	$3,910	$3,748	$3,586	$3,424	$3,263	$3,240	$3,218	$3,196	$3,173	$3,151	$3,129	$3,106	$3,084	$3,062	$3,039	$3,017	$2,995	$2,972	$2,950	$2,928	$2,905	$2,883	$2,861	$2,838	$2,816
Fixed O&M	$/kW-year	Real 2021$	$98.60	$87.99	$98.90	$102.58	$103.29	$101.80	$97.75	$93.70	$89.65	$85.61	$81.57	$81.01	$80.45	$79.90	$79.34	$78.78	$78.22	$77.66	$77.10	$76.54	$75.99	$75.43	$74.87	$74.31	$73.75	$73.19	$72.63	$72.08	$71.52	$70.96	$70.40
Capital Cost	$/kW	Nominal	$3,845	$3,520	$4,055	$4,311	$4,449	$4,495	$4,424	$4,346	$4,263	$4,172	$4,075	$4,148	$4,222	$4,298	$4,375	$4,452	$4,531	$4,612	$4,693	$4,775	$4,859	$4,944	$5,030	$5,117	$5,206	$5,295	$5,386	$5,479	$5,572	$5,667	$5,763
Fixed O&M	$/kW-year	Nominal	$96.13	$87.99	$101.37	$107.77	$111.23	$112.37	$110.59	$108.66	$106.57	$104.31	$101.87	$103.70	$105.56	$107.45	$109.37	$111.31	$113.29	$115.29	$117.32	$119.38	$121.47	$123.60	$125.75	$127.93	$130.14	$132.39	$134.66	$136.97	$139.30	$141.67	$144.07

Inputs
Calculated

Levelized Cost of Storage (LCOS) used for battery storage, with units of $/kW-month.

10-Hour Battery Storage (Utility-Scale)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046	2.098
Inflation Rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Tax Rate (Federal & State)	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Present Value - Depreciation (PV-Dep)	0.829																														
Interest During Construction	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.7%	3.9%	4.1%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
WACC	5%																														
Recovery Life (years)	20																														
Capital Recovery Factor (CRF)	8.0%																														
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

NREL Case
Conservative

NOMINAL	Overnight Capital Cost ($/kW-AC)	$3,845.37	$3,519.56	$4,054.72	$4,310.83	$4,449.15	$4,494.61	$4,423.60	$4,346.36	$4,262.68	$4,172.23	$4,074.82	$4,148.10	$4,222.49	$4,298.00	$4,374.66	$4,452.46	$4,531.42	$4,611.54	$4,692.83	$4,775.31	$4,858.98	$4,943.85	$5,029.92	$5,117.21	$5,205.72	$5,295.46	$5,386.43	$5,478.63	$5,572.09	$5,666.79	$5,762.74
NOMINAL	Fixed O&M ($/kW-yr-AC)	$96.13	$87.99	$101.37	$107.77	$111.23	$112.37	$110.59	$108.66	$106.57	$104.31	$101.87	$103.70	$105.56	$107.45	$109.37	$111.31	$113.29	$115.29	$117.32	$119.38	$121.47	$123.60	$125.75	$127.93	$130.14	$132.39	$134.66	$136.97	$139.30	$141.67	$144.07
	Variable O&M ($/MWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capacity Factor (%)	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
NOMINAL	LCOS ($/kW-mo)	$ 33.72	$ 30.87	$ 35.56	$ 37.81	$ 39.02	$ 39.42	$ 38.80	$ 38.12	$ 37.38	$ 36.59	$ 35.74	$ 36.38	$ 37.03	$ 37.69	$ 38.37	$ 39.05	$ 39.74	$ 40.44	$ 41.16	$ 41.88	$ 42.61	$ 43.36	$ 44.11	$ 44.88	$ 45.66	$ 46.44	$ 47.24	$ 48.05	$ 48.87	$ 49.70	$ 50.54
	Project Finance Factor (No ITC)	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Project Finance Factor (w/ITC)	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.698	0.782	0.879	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059
	Construction Finance Factor	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
	LCOS Calcs ($/kW-month)																														
NOMINAL	No ITC	$35.60	$32.58	$37.53	$39.90	$41.18	$41.61	$40.97	$40.28	$39.52	$38.71	$37.82	$38.50	$39.20	$39.90	$40.61	$41.33	$42.06	$42.81	$43.56	$44.33	$45.10	$45.89	$46.69	$47.50	$48.32	$49.15	$50.00	$50.86	$51.72	$52.60	$53.49
NOMINAL	ITC (Model)	**$26.20**	**$23.98**	**$27.62**	**$29.37**	**$30.31**	**$30.62**	**$30.15**	**$29.64**	**$29.08**	**$28.48**	**$27.83**	**$28.33**	**$28.84**	**$29.35**	**$32.38**	**$35.87**	**$42.06**	**$42.81**	**$43.56**	**$44.33**	**$45.10**	**$45.89**	**$46.69**	**$47.50**	**$48.32**	**$49.15**	**$50.00**	**$50.86**	**$51.72**	**$52.60**	**$53.49**
Real 2020 $	No ITC (2020 Real $)	$35.60	$31.78	$35.72	$37.05	$37.31	$36.77	$35.33	$33.88	$32.44	$30.99	$29.55	$29.35	$29.14	$28.94	$28.74	$28.54	$28.33	$28.13	$27.93	$27.73	$27.53	$27.32	$27.12	$26.92	$26.72	$26.51	$26.31	$26.11	$25.91	$25.70	$25.50
Real 2020 $	ITC (2020 Real $)	$26.20	$23.39	$26.29	$27.27	$27.46	$27.06	$26.00	$24.93	$23.87	$22.81	$21.74	$21.59	$21.44	$21.29	$22.92	$24.77	$28.33	$28.13	$27.93	$27.73	$27.53	$27.32	$27.12	$26.92	$26.72	$26.51	$26.31	$26.11	$25.91	$25.70	$25.50
	Effective Capital Costs																														
NOMINAL	No ITC (Nominal $)	$3,845	$3,520	$4,055	$4,311	$4,449	$4,495	$4,424	$4,346	$4,263	$4,172	$4,075	$4,148	$4,222	$4,298	$4,375	$4,452	$4,531	$4,612	$4,693	$4,775	$4,859	$4,944	$5,030	$5,117	$5,206	$5,295	$5,386	$5,479	$5,572	$5,667	$5,763
NOMINAL	ITC (Nominal $)	$2,535	$2,320	$2,673	$2,842	$2,933	$2,963	$2,916	$2,865	$2,810	$2,751	$2,686	$2,735	$2,784	$2,834	$3,232	$3,694	$4,531	$4,612	$4,693	$4,775	$4,859	$4,944	$5,030	$5,117	$5,206	$5,295	$5,386	$5,479	$5,572	$5,667	$5,763
Real 2020 $	Solar No ITC (Real 2020 $)	$3,845	$3,434	$3,859	$4,003	$4,031	$3,973	$3,814	$3,656	$3,499	$3,341	$3,183	$3,161	$3,140	$3,118	$3,096	$3,074	$3,052	$3,031	$3,009	$2,987	$2,965	$2,943	$2,922	$2,900	$2,878	$2,856	$2,835	$2,813	$2,791	$2,769	$2,747
Real 2020 $	Solar ITC (Real 2020 $)	$2,535	$2,264	$2,544	$2,639	$2,657	$2,619	$2,515	$2,411	$2,307	$2,203	$2,099	$2,084	$2,070	$2,056	$2,287	$2,551	$3,052	$3,031	$3,009	$2,987	$2,965	$2,943	$2,922	$2,900	$2,878	$2,856	$2,835	$2,813	$2,791	$2,769	$2,747

MACRS Yr.	**1**	**2**	**3**	**4**	**5**	**6**
Depreciation Fraction	0.2000	0.3200	0.1920	0.1152	0.1152	0.0576
Depreciation Factor	0.9337	0.8718	0.8140	0.7600	0.7097	0.6626

Construction Duration yrs		**3**																													
Year	Capital Fraction	Accumulated Interest																													
0	1	1.013	1.013	1.013	1.013	1.013	1.013	1.014	1.014	1.015	1.016	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017	1.017
1	0	1.039	1.039	1.039	1.039	1.039	1.039	1.042	1.044	1.046	1.048	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051
2	0	1.067	1.067	1.067	1.067	1.067	1.067	1.071	1.075	1.078	1.082	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086	1.086

Utility-Scale 10-Hour Battery Storage

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real Dollars Factor (2023 = 1)	0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
ITC (Model Schedule)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	23%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Overnight Capital Cost (Nominal $/kW)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$3,845	$3,520	$4,055	$3,987	$3,893	$3,486	$3,440	$3,390	$3,334	$3,274	$3,208	$3,233	$3,257	$3,280	$3,302	$3,323	$3,344	$3,363	$3,381	$3,398	$3,414	$3,429	$3,442	$3,454	$3,465	$3,474	$3,481	$3,486	$3,490	$3,492	$3,492
NREL Advanced	$3,845	$3,520	$4,055	$2,990	$2,893	$2,815	$2,763	$2,706	$2,644	$2,578	$2,508	$2,526	$2,544	$2,558	$2,573	$2,591	$2,602	$2,616	$2,628	$2,639	$2,646	$2,655	$2,666	$2,672	$2,674	$2,678	$2,680	$2,680	$2,675	$2,672	$2,672
NREL Conservative	$3,845	$3,520	$4,055	$4,311	$4,449	$4,495	$4,424	$4,346	$4,263	$4,172	$4,075	$4,148	$4,222	$4,298	$4,375	$4,452	$4,531	$4,612	$4,693	$4,775	$4,859	$4,944	$5,030	$5,117	$5,206	$5,295	$5,386	$5,479	$5,572	$5,667	$5,763

Year-Over-Year % Change

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate		-8%	15%	-2%	-2%	-10%	-1%	-1%	-2%	-2%	-2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Advanced		-8%	15%	-26%	-3%	-3%	-2%	-2%	-2%	-3%	-3%	1%	1%	1%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NREL Conservative		-8%	15%	6%	3%	1%	-2%	-2%	-2%	-2%	-2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Percent Difference from Moderate

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Advanced	0.0%	0.0%	0.0%	-25.0%	-25.7%	-19.2%	-19.7%	-20.2%	-20.7%	-21.3%	-21.8%	-21.9%	-21.9%	-22.0%	-22.1%	-22.0%	-22.2%	-22.2%	-22.3%	-22.3%	-22.5%	-22.6%	-22.6%	-22.6%	-22.8%	-22.9%	-23.0%	-23.1%	-23.3%	-23.5%	-23.5%
NREL Conservative	0.0%	0.0%	0.0%	8.1%	14.3%	28.9%	28.6%	28.2%	27.8%	27.4%	27.0%	28.3%	29.7%	31.1%	32.5%	34.0%	35.5%	37.1%	38.8%	40.5%	42.3%	44.2%	46.1%	48.1%	50.3%	52.5%	54.7%	57.1%	59.7%	62.3%	65.0%

LCOS (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$26.20	$23.98	$27.62	$27.16	$26.52	$23.75	$23.45	$23.11	$22.75	$22.35	$21.91	$22.08	$22.24	$22.40	$24.44	$26.77	$31.04	$31.22	$31.39	$31.55	$31.69	$31.83	$31.95	$32.06	$32.16	$32.24	$32.31	$32.36	$32.40	$32.41	$32.41
NREL Advanced	$26.20	$23.98	$27.62	$20.37	$19.71	$19.18	$18.83	$18.45	$18.04	$17.59	$17.13	$17.25	$17.37	$17.47	$19.05	$20.87	$24.16	$24.28	$24.39	$24.50	$24.56	$24.64	$24.74	$24.80	$24.82	$24.85	$24.87	$24.88	$24.83	$24.81	$24.80
NREL Conservative	$26.20	$23.98	$27.62	$29.37	$30.31	$30.62	$30.15	$29.64	$29.08	$28.48	$27.83	$28.33	$28.84	$29.35	$32.38	$35.87	$42.06	$42.81	$43.56	$44.33	$45.10	$45.89	$46.69	$47.50	$48.32	$49.15	$50.00	$50.86	$51.72	$52.60	$53.49
Range	*$0.00*	*$0.00*	*$0.00*	*$9.00*	*$10.60*	*$11.44*	*$11.32*	*$11.19*	*$11.04*	*$10.89*	*$10.70*	*$11.08*	*$11.47*	*$11.89*	*$13.33*	*$15.00*	*$17.91*	*$18.53*	*$19.17*	*$19.83*	*$20.54*	*$21.25*	*$21.95*	*$22.70*	*$23.50*	*$24.30*	*$25.13*	*$25.98*	*$26.89*	*$27.80*	*$28.69*

LCOS (Real 2023 $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$28.26	$25.22	$28.33	$27.16	$25.88	$22.60	$21.77	$20.94	$20.11	$19.27	$18.43	$18.12	$17.81	$17.50	$18.63	$19.91	$22.51	$22.09	$21.67	$21.25	$20.83	$20.41	$19.99	$19.57	$19.15	$18.73	$18.31	$17.89	$17.47	$17.06	$16.64
NREL Advanced	$28.26	$25.22	$28.33	$20.37	$19.23	$18.26	$17.49	$16.72	$15.94	$15.17	$14.41	$14.16	$13.91	$13.65	$14.52	$15.52	$17.52	$17.18	$16.84	$16.50	$16.14	$15.80	$15.48	$15.14	$14.78	$14.44	$14.10	$13.75	$13.39	$13.05	$12.73
NREL Conservative	$28.26	$25.22	$28.33	$29.37	$29.57	$29.14	$28.00	$26.85	$25.71	$24.56	$23.41	$23.25	$23.09	$22.93	$24.68	$26.67	$30.51	$30.30	$30.08	$29.86	$29.64	$29.42	$29.21	$28.99	$28.77	$28.55	$28.33	$28.12	$27.90	$27.68	$27.46
Range	*$0.00*	*$0.00*	*$0.00*	*$9.00*	*$10.34*	*$10.89*	*$10.51*	*$10.14*	*$9.76*	*$9.39*	*$9.00*	*$9.09*	*$9.18*	*$9.29*	*$10.16*	*$11.15*	*$12.99*	*$13.11*	*$13.24*	*$13.36*	*$13.50*	*$13.62*	*$13.73*	*$13.85*	*$13.99*	*$14.12*	*$14.24*	*$14.36*	*$14.50*	*$14.63*	*$14.73*

Contract PPA Price (Nominal $/kW-mo)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
10-Hour BESS - Mid								$11.00																							
10-Hour BESS - Low								$8.00																							
10-Hour BESS - High								$14.00																							
								$3.00																							
								$3.00																							

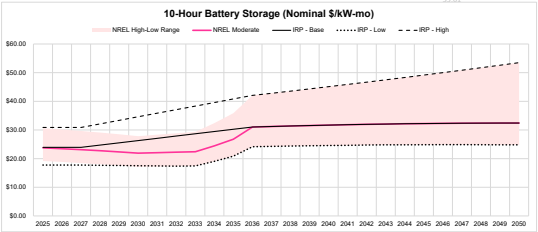
Mid % Difference from NREL Moderate LCOS	4%
Low % Difference from NREL Advanced LCOS	-4%
High % Difference from NREL Conservative LCOS	4%

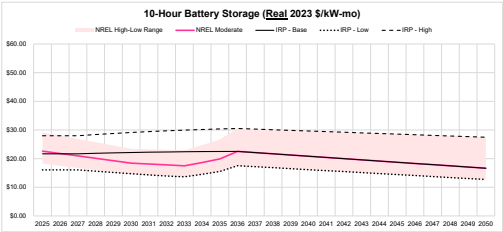
PWP 2023 IRP - Utility-Scale 10-Hour Storage Costs NOMINAL $/kW-mo

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$23.94	$23.94	$23.94	$24.72	$25.51	$26.30	$27.09	$27.88	$28.67	$29.46	$30.25	$31.04	$31.22	$31.39	$31.55	$31.69	$31.83	$31.95	$32.06	$32.16	$32.24	$32.31	$32.36	$32.40	$32.41	$32.41
IRP - Low						$17.74	$17.74	$17.74	$17.67	$17.59	$17.52	$17.45	$17.37	$17.47	$19.05	$20.87	$24.16	$24.28	$24.39	$24.50	$24.56	$24.64	$24.74	$24.80	$24.82	$24.85	$24.87	$24.88	$24.83	$24.81	$24.80
IRP - High						$30.88	$30.88	$30.88	$32.12	$33.36	$34.61	$35.85	$37.09	$38.33	$39.58	$40.82	$42.06	$42.81	$43.56	$44.33	$45.10	$45.89	$46.69	$47.50	$48.32	$49.15	$50.00	$50.86	$51.72	$52.60	$53.49

PWP 2023 IRP - Utility-Scale 10-Hour Storage Costs REAL 2023 $/kW-mo

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$21.68	$21.68	$21.68	$21.85	$22.00	$22.13	$22.24	$22.32	$22.40	$22.45	$22.49	$22.51	$22.09	$21.67	$21.25	$20.83	$20.41	$19.99	$19.57	$19.15	$18.73	$18.31	$17.89	$17.47	$17.06	$16.64
IRP - Low						$16.07	$16.07	$16.07	$15.61	$15.17	$14.74	$14.32	$13.91	$13.65	$14.52	$15.52	$17.52	$17.18	$16.84	$16.50	$16.14	$15.80	$15.48	$15.14	$14.78	$14.44	$14.10	$13.75	$13.39	$13.05	$12.73
IRP - High						$27.97	$27.97	$27.97	$28.39	$28.77	$29.11	$29.42	$29.70	$29.95	$30.16	$30.35	$30.51	$30.30	$30.08	$29.86	$29.64	$29.42	$29.21	$28.99	$28.77	$28.55	$28.33	$28.12	$27.90	$27.68	$27.46
								$5.61																							





INTENTIONALLY LEFT BLANK

Land-Based Wind

Source: NREL 2022 Annual Technology Baseline (ATB)
Link: 2022 ATB Annual Technology Baseline Workbook (AEO year update 2-23-2022).xlsx
ATB Details: https://atb.nrel.gov/electricity/2022/land_based_wind

NREL Moderate

Variable	Units	Real/Nominal	Direct from NREL Calculation	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-		2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021->1)	0.00	-		0.975	1.000	1.025	1.050	1.077	1.104	1.131	1.160	1.189	1.218	1.248	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$		$1,405	$1,356	$1,307	$1,258	$1,208	$1,159	$1,110	$1,061	$1,011	$962	$913	$863	$814	$765	$716	$667	$618	$569	$520	$471	$422	$373	$324	$275	$226	$177	$128	$078	$029	$980	$931	$882
Fixed O&M	$/kW-year	Real 2021$		$43.00	$42.14	$41.28	$40.42	$39.56	$38.69	$37.83	$36.97	$36.11	$35.25	$34.38	$33.86	$33.35	$32.83	$32.32	$31.80	$31.28	$30.77	$30.25	$29.74	$29.22	$28.71	$28.19	$27.68	$27.16	$26.64	$26.13	$25.61	$25.10	$24.58	$24.07
Capital Cost	$/kW	Nominal		$1,373	$1,356	$1,339	$1,322	$1,301	$1,279	$1,256	$1,230	$1,202	$1,172	$1,140	$1,117	$1,119	$1,106	$1,088	$1,066	$1,040	$1,011	$1,978	$1,946	$1,914	$1,882	$1,850	$1,818	$1,786	$1,754	$1,722	$1,690	$1,658	$1,627	$1,595
Fixed O&M	$/kW-year	Nominal		$43.93	$42.14	$40.31	$38.46	$37.38	$36.71	$34.80	$33.87	$32.92	$32.96	$32.93	$33.25	$33.76	$34.16	$34.55	$34.93	$35.31	$35.68	$36.05	$36.38	$36.72	$37.06	$37.39	$37.73	$37.90	$38.19	$38.46	$38.67	$38.88	$39.08	$39.25

NREL Advanced

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021->1)	0.00	-	0.975	1.000	1.025	1.050	1.077	1.104	1.131	1.160	1.189	1.218	1.248	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,405	$1,352	$1,299	$1,246	$1,192	$1,039	$966	$893	$819	$746	$673	$664	$664	$648	$639	$631	$622	$614	$606	$597	$589	$580	$572	$563	$555	$547	$538	$530	$521	$513	$505
Fixed O&M	$/kW-year	Real 2021$	$43.00	$42.40	$41.79	$41.18	$40.58	$40.57	$39.57	$38.57	$37.56	$36.56	$35.55	$34.66	$33.57	$32.77	$31.97	$31.17	$30.37	$29.57	$28.77	$28.15	$27.52	$26.90	$26.27	$25.65	$25.02	$24.40	$23.77	$23.15	$22.52	$21.90	$21.27
Capital Cost	$/kW	Nominal	$1,373	$1,352	$1,293	$1,233	$1,198	$1,147	$1,093	$1,035	$973	$909	$843	$850	$861	$871	$881	$891	$903	$915	$927	$941	$955	$969	$983	$997	$1,013	$1,029	$1,045	$1,062	$1,080	$1,098	$1,116
Fixed O&M	$/kW-year	Nominal	$43.93	$42.40	$40.24	$38.90	$39.36	$38.23	$35.90	$34.58	$34.18	$33.47	$32.36	$32.68	$33.03	$33.60	$34.02	$34.38	$34.77	$35.17	$35.58	$35.75	$35.91	$36.07	$36.22	$36.36	$36.51	$36.64	$36.76	$36.88	$36.98	$37.08	$37.16

NREL Conservative

Variable	Units	Real/Nominal	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	%	-	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Nominal Escalator (2021->1)	0.00	-	0.975	1.000	1.025	1.050	1.077	1.104	1.131	1.160	1.189	1.218	1.248	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046
Capital Cost	$/kW	Real 2021$	$1,405	$1,361	$1,316	$1,272	$1,228	$1,193	$1,139	$1,084	$1,030	$1,006	$961	$956	$952	$947	$942	$937	$932	$927	$913	$910	$913	$908	$903	$899	$896	$889	$884	$879	$875	$870	$865
Fixed O&M	$/kW-year	Real 2021$	$43.00	$43.00	$43.00	$43.00	$43.00	$43.00	$43.00	$43.00	$43.00	$43.00	$43.00	$42.90	$42.80	$42.70	$42.60	$42.50	$42.40	$42.31	$42.22	$42.12	$42.12	$42.12	$41.98	$41.83	$41.73	$41.68	$41.54	$41.40	$41.28	$41.20	$41.15
Capital Cost	$/kW	Nominal	$1,373	$1,361	$1,349	$1,336	$1,322	$1,306	$1,288	$1,269	$1,248	$1,225	$1,200	$1,216	$1,238	$1,275	$1,298	$1,324	$1,350	$1,377	$1,404	$1,432	$1,460	$1,488	$1,517	$1,547	$1,577	$1,608	$1,639	$1,671	$1,703	$1,737	$1,770
Fixed O&M	$/kW-year	Nominal	$43.93	$43.00	$42.08	$41.18	$39.31	$37.28	$35.65	$33.97	$31.12	$32.28	$32.70	$33.52	$34.58	$35.62	$36.76	$38.07	$39.41	$41.22	$42.87	$44.23	$45.72	$47.18	$48.70	$50.26	$51.88	$53.52	$55.21	$56.95	$58.73	$60.55	$62.42

NREL Case

Moderate

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inputs																																
Calculated																																
Inflation Index	-	1.000	1.029	1.061	1.077	1.104	1.131	1.160	1.189	1.218	1.248	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948	1.996	2.046	2.096
Reference #	Tax Rate (Federal & State)	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%	25.75%
	PV Day	0.42																														
	Interest During Construction	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
	WACC	5.000%	5.000%																													
	Recovery Life (years)	30	30																													
		20 yr.	30 yr.																													
	Capital Recovery Factor (CRF)	6.5%	5.5%																													
	PTC Inflation Multiplier	1.6759	1.7178	1.7607	1.8047	1.8498	1.8961	1.9435	1.9921	2.0419	2.0929	2.1452	2.1988	2.2538	2.3102	2.3679	2.4271	2.4878	2.5500	2.6138	2.6791	2.7461	2.8147	2.8851	2.9572	3.0312	3.1070	3.1848	3.2642	3.3458	3.4295	3.5152
	PTC Sch. Harbor (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	50%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
							PTC																									

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NOMINAL	Overnight Capital Cost ($/kW)	$1,370.00	$1,393.96	$1,339.42	$1,321.20	$1,301.20	$2,189.00	$1,256.76	$1,230.00	$1,202.32	$1,172.40	$1,140.30	$1,117.12	$1,119.07	$1,105.92	$1,088.33	$1,065.78	$1,039.80	$1,010.88	$1,977.61	$1,945.78	$1,914.00	$1,882.22	$1,850.44	$1,818.67	$1,786.89	$1,755.11	$1,723.33	$1,691.56	$1,659.78	$1,628.00	$1,596.23
NOMINAL	Fixed O&M ($/kW-yr)	$43.93	$42.14	$40.31	$38.46	$37.38	$36.71	$34.80	$33.87	$32.92	$32.96	$32.93	$33.25	$33.76	$34.16	$34.55	$34.93	$35.31	$35.68	$36.05	$36.38	$36.72	$37.06	$37.39	$37.73	$37.90	$38.19	$38.46	$38.67	$38.88	$39.08	$39.25
	Variable O&M ($/MWh)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	PTC Sch. Harbor ($/MWh)	$ (27.00)	$ (27.81)	$ (27.46)	$ (28.32)	$ (28.75)	$ (28.28)	$ (28.72)	$ (29.23)	$ (30.03)	$ (31.38)	$ (16.79)	$ (12.61)	$ (12.87)	$ (13.18)	$ (13.50)	$ (12.81)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Fuel Cost ($/MWh)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capacity Factor (%)	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
	Project Finance Factor	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063
	Construction Finance Factor	1.021	1.021	1.021	1.021	1.021	1.021	1.022	1.023	1.025	1.026	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027	1.027

UCOE Calc (Nominal $/MWh)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
No PTC	$ 49.21	$ 49.86	$ 49.49	$ 49.94	$ 49.85	$ 55.57	$ 47.49	$ 47.47	$ 45.77	$ 45.12	$ 40.11	$ 40.93	$ 41.04	$ 41.08	$ 41.11	$ 41.04	$ 40.96	$ 40.88	$ 46.09	$ 46.02	$ 45.95	$ 45.88	$ 45.80	$ 45.73	$ 47.72	$ 47.70	$ 48.23	$ 48.75	$ 49.27	$ 49.79	$ 50.30
PTC	$ 28.25	$ 27.53	$ 26.77	$ 26.06	$ 25.28	$ 26.48	$ 24.58	$ 23.25	$ 21.08	$ 19.09	$ 18.44	$ 14.62	$ 14.03	$ 14.38	$ 14.69	$ 20.69	$ 20.72	$ 20.76	$ 22.36	$ 22.39	$ 22.42	$ 22.45	$ 22.48	$ 22.51	$ 23.85	$ 23.86	$ 24.11	$ 24.37	$ 24.63	$ 24.89	$ 25.15

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Effective Capital Cost																															
No PTC (Nominal $/kW)	$ 1,370	$ 1,394	$ 1,339	$ 1,321	$ 1,301	$ 2,189	$ 1,256	$ 1,230	$ 1,202	$ 1,172	$ 1,140	$ 1,117	$ 1,119	$ 1,105	$ 1,088	$ 1,066	$ 1,040	$ 1,010	$ 1,978	$ 1,946	$ 1,914	$ 1,882	$ 1,850	$ 1,819	$ 1,787	$ 1,755	$ 1,724	$ 1,692	$ 1,660	$ 1,628	$ 1,596
PTC (Nominal $/kW)	$ 691	$ 709	$ 763	$ 726	$ 696	$ 1,403	$ 690	$ 854	$ 909	$ 256	$ 260	$ 194	$ 187	$ 179	$ 430	$ 684	$ 1,248	$ 1,241	$ 1,235	$ 1,228	$ 1,221	$ 1,214	$ 1,207	$ 1,200	$ 1,188	$ 1,186	$ 1,203	$ 1,222	$ 1,240	$ 1,258	$ 1,277
Capital Cost (2020 Real $)																															
Wind No PTC (Real 2020 $/kW)	$ 1,370	$ 1,323	$ 1,275	$ 1,227	$ 1,179	$ 1,979	$ 1,093	$ 1,035	$ 967	$ 930	$ 891	$ 862	$ 873	$ 866	$ 855	$ 836	$ 837	$ 828	$ 820	$ 811	$ 802	$ 793	$ 784	$ 775	$ 766	$ 757	$ 748	$ 739	$ 730	$ 722	$ 713
Wind PTC (Real 2020 $/kW)	$ 691	$ 684	$ 726	$ 668	$ 618	$ 1,268	$ 595	$ 736	$ 751	$ 206	$ 197	$ 147	$ 139	$ 132	$ 316	$ 478															

	MACRS Yr.	1	2	3	4	5	6
	Depreciation Fraction	0.3750	0.6094	0.1875	0.1172	0.1172	0.0586
	Depreciation Factor	0.9250	0.8656	0.8125	0.7563	0.6875	0.6016

Construction Duration =>>		1																																			
Year	Capital Fraction	Accumulated Interest																																			
1	0.5	1.000	1.010	1.020	1.031	1.041	1.052	1.062	1.073	1.084	1.095	1.106	1.117	1.128	1.140	1.151	1.163	1.175	1.187	1.199	1.211	1.223	1.236	1.248	1.261	1.274	1.287	1.300	1.313	1.326	1.340	1.353	1.367	1.381	1.395	1.409	1.423
2	0.5	1.010	1.020	1.031	1.041	1.052	1.062	1.073	1.084	1.095	1.106	1.117	1.128	1.140	1.151	1.163	1.175	1.187	1.199	1.211	1.223	1.236	1.248	1.261	1.274	1.287	1.300	1.313	1.326	1.340	1.353	1.367	1.381	1.395	1.409	1.423	1.438
Total	1.0	1.005	1.015	1.025	1.036	1.046	1.057	1.068	1.079	1.089	1.101	1.112	1.123	1.134	1.146	1.157	1.169	1.181	1.193	1.205	1.217	1.230	1.242	1.255	1.268	1.281	1.294	1.307	1.320	1.333	1.347	1.360	1.374	1.388	1.402	1.416	1.430

Land-Based Wind

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Inflation	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real Dollars Factor (2023 = 1)	0.927	0.951	0.975	1.000	1.025	1.051	1.077	1.104	1.131	1.160	1.189	1.218	1.249	1.280	1.312	1.345	1.379	1.413	1.448	1.485	1.522	1.560	1.599	1.639	1.680	1.722	1.765	1.809	1.854	1.900	1.948
PTC (Model Schedule)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Overnight Capital Cost (Nominal $/kW)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$1,370	$1,356	$1,339	$1,321	$1,301	$1,279	$1,256	$1,230	$1,202	$1,172	$1,140	$1,157	$1,174	$1,191	$1,208	$1,226	$1,243	$1,261	$1,278	$1,296	$1,314	$1,332	$1,350	$1,368	$1,386	$1,404	$1,422	$1,440	$1,458	$1,477	$1,495
NREL Advanced	$1,370	$1,332	$1,290	$1,245	$1,198	$1,147	$1,093	$1,035	$974	$909	$840	$850	$861	$871	$881	$891	$901	$911	$921	$931	$941	$951	$961	$970	$979	$989	$998	$1,007	$1,016	$1,024	$1,033
NREL Conservative	$1,370	$1,361	$1,349	$1,336	$1,322	$1,306	$1,288	$1,269	$1,248	$1,225	$1,200	$1,224	$1,248	$1,273	$1,298	$1,324	$1,350	$1,377	$1,404	$1,432	$1,460	$1,488	$1,517	$1,547	$1,577	$1,608	$1,639	$1,671	$1,704	$1,737	$1,770

Year-Over-Year % Change

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate		-1%	-1%	-1%	-2%	-2%	-2%	-2%	-2%	-2%	-3%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
NREL Advanced		-3%	-3%	-3%	-4%	-4%	-5%	-5%	-6%	-7%	-8%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
NREL Conservative		-1%	-1%	-1%	-1%	-1%	-1%	-1%	-2%	-2%	-2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Percent Difference from Moderate

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Advanced	0.0%	-1.8%	-3.7%	-5.7%	-8.0%	-10.4%	-13.0%	-15.9%	-19.0%	-22.5%	-26.3%	-26.5%	-26.7%	-26.9%	-27.1%	-27.3%	-27.5%	-27.7%	-27.9%	-28.1%	-28.4%	-28.6%	-28.8%	-29.1%	-29.3%	-29.6%	-29.8%	-30.1%	-30.4%	-30.6%	-30.9%
NREL Conservative	0.0%	0.4%	0.7%	1.1%	1.6%	2.1%	2.6%	3.2%	3.8%	4.5%	5.3%	5.8%	6.3%	6.9%	7.5%	8.0%	8.6%	9.2%	9.8%	10.5%	11.1%	11.8%	12.4%	13.1%	13.8%	14.6%	15.3%	16.0%	16.8%	17.6%	18.4%

LCOE (Nominal $/MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$29.37	$28.65	$27.88	$27.06	$26.18	$25.23	$24.26	$23.21	$22.10	$20.92	$19.65	$19.65	$19.63	$19.59	$25.55	$31.80	$44.65	$45.19	$45.73	$46.27	$46.80	$47.33	$47.86	$48.39	$48.91	$49.43	$49.95	$50.45	$50.96	$51.45	$51.94
NREL Advanced	$29.37	$28.24	$27.04	$25.75	$24.39	$22.94	$21.44	$19.84	$18.14	$16.34	$14.44	$14.42	$14.39	$14.35	$20.31	$26.55	$39.40	$39.95	$40.49	$41.04	$41.59	$42.15	$42.70	$43.26	$43.81	$44.37	$44.93	$45.49	$46.05	$46.60	$47.16
NREL Conservative	$29.37	$29.06	$28.71	$28.33	$27.90	$27.45	$26.98	$26.48	$25.92	$25.32	$24.68	$25.11	$25.54	$25.98	$32.44	$39.20	$52.59	$53.68	$54.80	$55.94	$57.11	$58.29	$59.50	$60.74	$62.00	$63.28	$64.59	$65.93	$67.29	$68.68	$70.10
Range	*$0.00*	*$0.82*	*$1.67*	*$2.57*	*$3.51*	*$4.50*	*$5.54*	*$6.64*	*$7.78*	*$8.98*	*$10.24*	*$10.69*	*$11.15*	*$11.63*	*$12.13*	*$12.65*	*$13.18*	*$13.73*	*$14.31*	*$14.90*	*$15.51*	*$16.15*	*$16.80*	*$17.48*	*$18.19*	*$18.91*	*$19.67*	*$20.44*	*$21.25*	*$22.08*	*$22.94*

LCOE (Real 2023 $/MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
NREL Moderate	$31.69	$30.14	$28.60	$27.06	$25.54	$24.01	$22.52	$21.03	$19.53	$18.04	$16.53	$16.12	$15.72	$15.31	$19.48	$23.65	$32.39	$31.98	$31.57	$31.17	$30.76	$30.35	$29.94	$29.53	$29.12	$28.71	$28.30	$27.89	$27.49	$27.08	$26.67
NREL Advanced	$31.69	$29.71	$27.73	$25.75	$23.80	$21.84	$19.91	$17.97	$16.04	$14.09	$12.15	$11.83	$11.52	$11.21	$15.48	$19.74	$28.58	$28.27	$27.96	$27.65	$27.33	$27.02	$26.71	$26.40	$26.09	$25.77	$25.46	$25.15	$24.84	$24.52	$24.21
NREL Conservative	$31.69	$30.56	$29.44	$28.33	$27.22	$26.12	$25.06	$23.99	$22.91	$21.84	$20.76	$20.61	$20.45	$20.30	$24.72	$29.14	$38.15	$37.99	$37.84	$37.68	$37.53	$37.38	$37.22	$37.07	$36.91	$36.76	$36.61	$36.45	$36.30	$36.14	$35.99
Range	*$0.00*	*$0.86*	*$1.72*	*$2.57*	*$3.43*	*$4.29*	*$5.15*	*$6.01*	*$6.88*	*$7.74*	*$8.61*	*$8.77*	*$8.93*	*$9.09*	*$9.25*	*$9.40*	*$9.56*	*$9.72*	*$9.88*	*$10.04*	*$10.20*	*$10.35*	*$10.51*	*$10.67*	*$10.83*	*$10.99*	*$11.14*	*$11.30*	*$11.46*	*$11.62*	*$11.78*

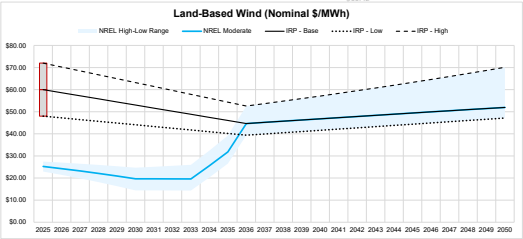
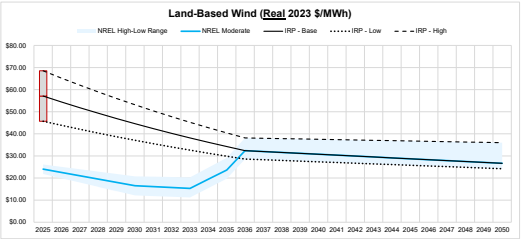
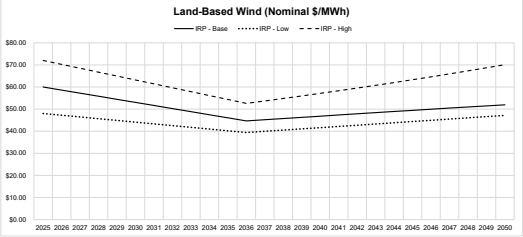
Contract PPA Price (Nominal $/MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Wind Indicative Bid - Mid						$60.00																									
Wind Bid - Low (-20%)						$48.00																									
Wind Bid - High (+20%)						$72.00																									
						$12.00																									
						$12.00																									

Wind Bid % Difference from NREL Moderate LCOE	158%
Wind Bid Low % Difference from NREL Advanced LCOE	142%
Wind Bid High % Difference from NREL Conservative LCOE	172%

PWP 2023 IRP - Land-Based Wind Costs NOMINAL $/MWh

	2020	2021	2022	2023	2024	2025	2028	2028	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$60.00	$58.60	$57.21	$55.81	$54.42	$53.02	$51.63	$50.23	$48.84	$47.44	$46.05	$44.65	$45.19	$45.73	$46.27	$46.80	$47.33	$47.86	$48.39	$48.91	$49.43	$49.95	$50.45	$50.96	$51.45	$51.94
IRP - Low						$48.00	$47.22	$46.44	$45.66	$44.87	$44.09	$43.31	$42.53	$41.75	$40.97	$40.19	$39.40	$39.95	$40.49	$41.04	$41.59	$42.15	$42.70	$43.26	$43.81	$44.37	$44.93	$45.49	$46.05	$46.60	$47.16
IRP - High						$72.00	$70.24	$68.47	$66.71	$64.94	$63.18	$61.41	$59.65	$57.88	$56.12	$54.35	$52.59	$53.68	$54.80	$55.94	$57.11	$58.29	$59.50	$60.74	$62.00	$63.28	$64.59	$65.93	$67.29	$68.68	$70.10

PWP 2023 IRP - Land-Based Wind Costs REAL 2023 $/MWh

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
IRP - Base						$57.11	$54.42	$51.83	$49.33	$46.93	$44.61	$42.37	$40.22	$38.15	$36.16	$34.24	$32.39	$31.98	$31.57	$31.17	$30.76	$30.35	$29.94	$29.53	$29.12	$28.71	$28.30	$27.89	$27.49	$27.08	$26.67
IRP - Low						$45.69	$43.85	$42.07	$40.35	$38.69	$37.09	$35.55	$34.05	$32.61	$31.22	$29.88	$28.58	$28.27	$27.96	$27.65	$27.33	$27.02	$26.71	$26.40	$26.09	$25.77	$25.46	$25.15	$24.84	$24.52	$24.21
IRP - High						$68.53	$65.22	$62.03	$58.96	$56.00	$53.15	$50.40	$47.76	$45.22	$42.77	$40.41	$38.15	$37.99	$37.84	$37.68	$37.53	$37.38	$37.22	$37.07	$36.91	$36.76	$36.61	$36.45	$36.30	$36.14	$35.99
						$11.42