

TABLE A.1: Technical parameters of existing thermal generators

Fuel Type	Technology	Capacity (MW)	Heat Rate (Btu/kWh)	Min. Output(p.u.)	Total Number
Nuclear	Steam	1020	11000	0.8	1
Coal	Steam	440	9247	0.5	17
Coal	Steam	320	9247	0.5	12
Coal	Steam	150	9247	0.5	11
Natural Gas	Combined Cycle	960	7667	0.3	10
Natural Gas	Combined Cycle	480	7667	0.3	14
Natural Gas	Open Cycle	320	10935	0.3	39
Natural Gas	Open Cycle	160	10935	0.3	12
90% CCUS-Retrofit*					
Fuel Type	Technology	Original Capacity (MW)	Modified Capacity (MW)	Original Heat Rate (Btu/kWh)	Modified Heat Rate (Btu/kWh)
Coal	Steam	440	395	9247	11900
Coal	Steam	320	285	9247	11900
Coal	Steam	150	134	9247	11900
Natural Gas	Combined Cycle	960	851	7667	8487
Natural Gas	Combined Cycle	480	426	7667	8487

TABLE A.2: Economic parameters of existing thermal generating units

Fuel Type	Technology	Fuel Price(\$/MBtu)	Fixed O&M Cost(\$/kw-yr)	Variable O&M Cost(\$/MWh)	CO ₂ Emission Factor (kgCO ₂ /MBtu)
Nuclear	Steam	0.85	115	0.75	0
Coal	Steam	1.45	71.5	4.3	95.52
Coal	Steam	1.45	71.9	4.7	95.52
Coal	Steam	1.45	72.3	5	95.52
Natural Gas	Combined Cycle	3.45	5.7	3.2	53.06
Natural Gas	Combined Cycle	3.45	6	3.5	53.06
Natural Gas	Open Cycle	3.45	17.8	4.4	53.06
Natural Gas	Open Cycle	3.45	18.1	4.7	53.06
90% CCUS-Retrofit					
Fuel Type	CCUS Capital Cost(\$/kw)	Fuel Price(\$/MBtu)	Fixed O&M Cost(\$/kw-yr)	Variable O&M Cost(\$/MWh)	CO ₂ Emission Factor (kgCO ₂ /MBtu)
Coal-Steam	1840	1.45	117.3	7	9.552
Coal-Steam	1840	1.45	118	7.7	9.552
Coal-Steam	1840	1.45	118.6	8.2	9.552
NG-CC*	1840	3.45	11.7	7.53	5.306
NG-CC*	1840	3.45	12.33	8.23	5.306

TABLE A.3: Techno-Economic parameters of candidate generating units

Fuel Type	Technology	Capacity (MW)	Heat Rate (Btu/kWh)	Tunnel limit	Capital cost(\$/kw)	Fuel Price(\$/MBtu)	Fixed O&M Cost(\$/kw-yr)	Variable O&M Cost(\$/MWh)	CO ₂ Emission Factor (kgCO ₂ /MBtu)
Nuclear	Steam	2200	10460	5	6500	0.85	115	0.75	0
NG *	Steam	320	7754	20	6900	3.45	5.7	3.2	53.06
NG	Steam	160	8124	20	7500	3.45	3.5	5	53.06
NG	CC**	960	6350	40	999	3.45	5.7	3.2	53.06
NG	CC + 90% CCUS	852	7156	40	2159	3.45	11.7	7.53	5.306
NG	CC	480	6750	40	1200	3.45	6	3.5	53.06
NG	CC + 90% CCUS	426	7556	40	2593	3.45	12.33	8.23	5.306
NG	OC***	320	8500	60	800	3.45	17.8	4.4	53.06
NG	OC	160	9600	60	950	3.45	18.1	4.7	53.06

TABLE A.4: Techno-Economic parameters of Renewable and Battery Storage units

Storage Units											
Type	Pmax (MW)	Emax (MWh)	Efficiency (%)	Variable OM (\$/MW)	Fixed OM (\$/kW-year)	Self discharge (%)	Tunnel limit	(years)	Power section Cost(\$/kw)	Storage section Cost(\$/kWh)	DOD (p.u)
Na-S	100	600	0.85	5	5	0	200	15	420	540	0.8
Li-ion	40	10	0.9	3.5	9	0	200	15	520	900	0.8
Renewable Units											
Technology	Capacity (MW)	Life (years)	Capacity Factor (p.u.)	Capital Cost(\$/kW)	Fixed O&M Cost(\$/kw-yr)	Variable O&M Cost(\$/MWh)					
Wind	175	20	0.33	1200	30	0					
PV(Utility Scale)	150	30	0.2	1250	10	0					

TABLE A.5: Operational Characteristics of Thermal Generating Units

Technology-Fuel	Size (MW)	Min. output (p.u.)	1-hour Ramp Up/Down (p.u.)	Contingency-Ramp Up/Down (p.u.)	10-Min flexible ramp Up/Down (p.u.)	Minimum Up/Down Time (hr)	Start-up Cost (\$/MW)
Existing Units							
ST-NUC	1020	0.8	0.1	0	0	24	200
ST-CL	440	0.5	0.3	0	0.15	12	147
ST-CL	320	0.5	0.3	0	0.15	10	147
ST-CL	150	0.5	0.3	0	0.15	8	147
CC-NG	960	0.3	0.5	0.5	0.25	6	88
CC-NG	480	0.3	0.5	0.5	0.25	5	88
OC-NG	320	0.3	0.7	0.7	0.5	1	88
OC-NG	160	0.3	0.7	0.7	0.5	1	88
Candidate Units							
ST-NUC	2200	0.8	0.1	0	0	24	200
ST-NG	320	0.5	0.3	0	0.15	10	147
ST-NG	160	0.5	0.3	0	0.15	8	147
CC-NG	960	0.3	0.5	0.5	0.25	6	88
CC-NG	480	0.3	0.5	0.5	0.25	5	88
OC-NG	320	0.25	0.75	0.75	0.55	1	88
OC-NG	160	0.25	0.75	0.75	0.55	1	88