

Assumptions Matrix for 2021-2040 System & Resource Outlook

Draft for Discussion at March 8, 2022 ESPWG

Preliminary Assumptions in Capacity Expansion Model for Policy

Reference Case

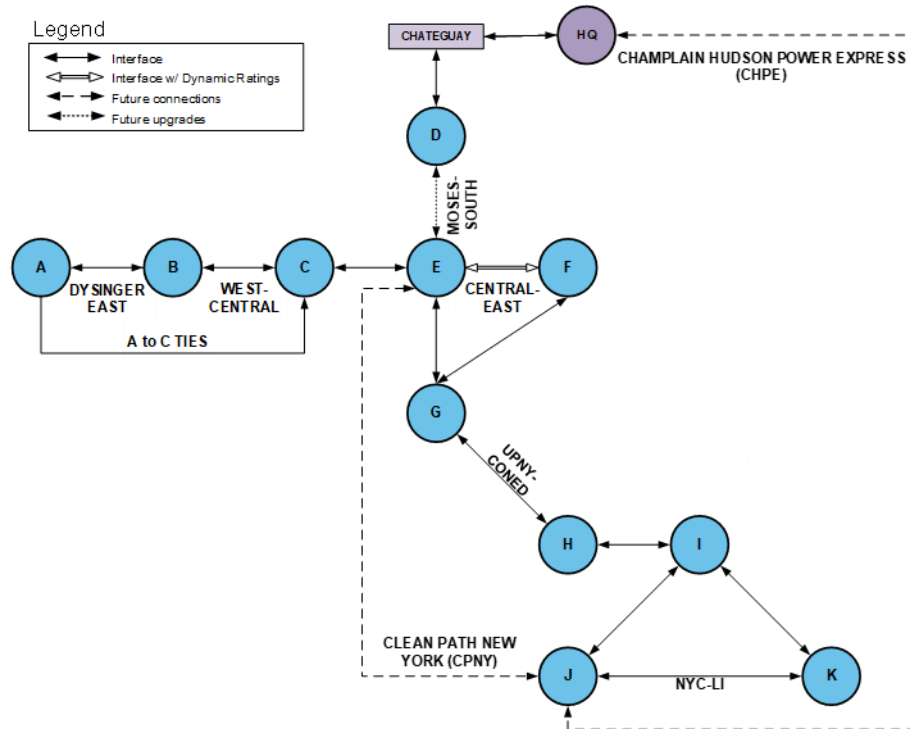
Existing Generation	Consistent with Policy Case production cost simulation database, noting that the model simulates optimal retirement decisions which may differ from production cost database.																																																																																																																																																																																													
Existing Generation FOM Costs	Fixed O&M costs for existing generators assumed per 2018 documentation for EPA Platform, Chapter 4: Generating Resources																																																																																																																																																																																													
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Energy Demand & Profile	<p>Energy Forecast based on 2021 Load & Capacity Data Report (“Gold Book”) CLCPA Case Forecast of Annual Energy, with modifications to account for the following:</p> <ul style="list-style-type: none"> • 10 GW BTM-PV by 2030 CLCPA target, • Removal of impact from energy storage resources, and • Smoothed annual electrification forecasts through 2040, maintaining the original forecast for 2040. <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> <p>Outlook CLCPA Case Annual Energy Forecast - GWh</p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.8em;"> <thead> <tr style="background-color: #ffffcc;"> <th>Year</th> <th>Base Shape</th> <th>BTM PV</th> <th>EV</th> <th>Electrification</th> <th>Annual Energy</th> </tr> </thead> <tbody> <tr><td>2021</td><td>149,637</td><td>-3,577</td><td>612</td><td>5,022</td><td>151,694</td></tr> <tr><td>2022</td><td>147,128</td><td>-4,461</td><td>878</td><td>6,088</td><td>149,633</td></tr> <tr><td>2023</td><td>144,774</td><td>-5,478</td><td>1,176</td><td>7,094</td><td>147,566</td></tr> <tr><td>2024</td><td>142,723</td><td>-6,487</td><td>1,543</td><td>8,096</td><td>145,875</td></tr> <tr><td>2025</td><td>139,863</td><td>-7,483</td><td>1,922</td><td>10,402</td><td>144,704</td></tr> <tr><td>2026</td><td>138,459</td><td>-8,433</td><td>2,430</td><td>12,731</td><td>145,187</td></tr> <tr><td>2027</td><td>137,196</td><td>-9,318</td><td>3,111</td><td>15,131</td><td>146,120</td></tr> <tr><td>2028</td><td>136,515</td><td>-10,066</td><td>3,878</td><td>17,587</td><td>147,914</td></tr> <tr><td>2029</td><td>135,185</td><td>-10,684</td><td>4,674</td><td>20,076</td><td>149,251</td></tr> <tr><td>2030</td><td>133,856</td><td>-11,068</td><td>5,488</td><td>22,633</td><td>150,909</td></tr> <tr><td>2031</td><td>133,122</td><td>-11,325</td><td>6,373</td><td>25,368</td><td>153,538</td></tr> <tr><td>2032</td><td>132,810</td><td>-11,526</td><td>7,313</td><td>28,491</td><td>157,088</td></tr> <tr><td>2033</td><td>131,801</td><td>-11,694</td><td>8,230</td><td>33,199</td><td>161,536</td></tr> <tr><td>2034</td><td>131,239</td><td>-11,846</td><td>9,249</td><td>38,171</td><td>166,813</td></tr> <tr><td>2035</td><td>130,775</td><td>-11,983</td><td>10,322</td><td>43,452</td><td>172,566</td></tr> <tr><td>2036</td><td>130,766</td><td>-12,100</td><td>11,415</td><td>48,963</td><td>179,044</td></tr> <tr><td>2037</td><td>130,000</td><td>-12,204</td><td>12,577</td><td>54,954</td><td>185,327</td></tr> <tr><td>2038</td><td>129,646</td><td>-12,300</td><td>13,795</td><td>61,440</td><td>192,581</td></tr> <tr><td>2039</td><td>129,322</td><td>-12,378</td><td>15,048</td><td>68,243</td><td>200,235</td></tr> <tr><td>2040</td><td>129,178</td><td>-12,454</td><td>16,361</td><td>75,594</td><td>208,679</td></tr> </tbody> </table> </div> <div style="text-align: center;"> <p>Outlook CLCPA Case Peak Forecasts - MW</p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.8em;"> <thead> <tr style="background-color: #d9ead3;"> <th>Year</th> <th>Summer Peak</th> <th>Winter Peak</th> </tr> </thead> <tbody> <tr><td>2021</td><td>32,111</td><td>25,303</td></tr> <tr><td>2022</td><td>31,978</td><td>25,428</td></tr> <tr><td>2023</td><td>31,785</td><td>25,631</td></tr> <tr><td>2024</td><td>31,590</td><td>25,788</td></tr> <tr><td>2025</td><td>31,679</td><td>26,491</td></tr> <tr><td>2026</td><td>32,056</td><td>27,258</td></tr> <tr><td>2027</td><td>32,541</td><td>28,343</td></tr> <tr><td>2028</td><td>33,155</td><td>29,410</td></tr> <tr><td>2029</td><td>33,820</td><td>30,527</td></tr> <tr><td>2030</td><td>34,416</td><td>31,717</td></tr> <tr><td>2031</td><td>35,200</td><td>33,095</td></tr> <tr><td>2032</td><td>36,091</td><td>34,503</td></tr> <tr><td>2033</td><td>37,318</td><td>36,802</td></tr> <tr><td>2034</td><td>38,644</td><td>39,206</td></tr> <tr><td>2035</td><td>40,033</td><td>41,681</td></tr> <tr><td>2036</td><td>41,429</td><td>44,288</td></tr> <tr><td>2037</td><td>43,058</td><td>47,130</td></tr> <tr><td>2038</td><td>44,738</td><td>50,350</td></tr> <tr><td>2039</td><td>46,479</td><td>53,641</td></tr> <tr><td>2040</td><td>48,253</td><td>57,144</td></tr> </tbody> </table> </div> </div> <p style="margin-top: 10px;">Each year is represented by 17 load blocks. For each year, 16 of the load blocks are represented by slicing hours of the year by season (Spring, Summer, Fall, Winter) and time of day (overnight, morning, afternoon, evening) and one load block per year represents a period of peak load hours. The seasonal/time of day blocks are based on 2018 NREL ReEDS documentation and the peak load hours are based on the input hourly load data.</p>	Year	Base Shape	BTM PV	EV	Electrification	Annual Energy	2021	149,637	-3,577	612	5,022	151,694	2022	147,128	-4,461	878	6,088	149,633	2023	144,774	-5,478	1,176	7,094	147,566	2024	142,723	-6,487	1,543	8,096	145,875	2025	139,863	-7,483	1,922	10,402	144,704	2026	138,459	-8,433	2,430	12,731	145,187	2027	137,196	-9,318	3,111	15,131	146,120	2028	136,515	-10,066	3,878	17,587	147,914	2029	135,185	-10,684	4,674	20,076	149,251	2030	133,856	-11,068	5,488	22,633	150,909	2031	133,122	-11,325	6,373	25,368	153,538	2032	132,810	-11,526	7,313	28,491	157,088	2033	131,801	-11,694	8,230	33,199	161,536	2034	131,239	-11,846	9,249	38,171	166,813	2035	130,775	-11,983	10,322	43,452	172,566	2036	130,766	-12,100	11,415	48,963	179,044	2037	130,000	-12,204	12,577	54,954	185,327	2038	129,646	-12,300	13,795	61,440	192,581	2039	129,322	-12,378	15,048	68,243	200,235	2040	129,178	-12,454	16,361	75,594	208,679	Year	Summer Peak	Winter Peak	2021	32,111	25,303	2022	31,978	25,428	2023	31,785	25,631	2024	31,590	25,788	2025	31,679	26,491	2026	32,056	27,258	2027	32,541	28,343	2028	33,155	29,410	2029	33,820	30,527	2030	34,416	31,717	2031	35,200	33,095	2032	36,091	34,503	2033	37,318	36,802	2034	38,644	39,206	2035	40,033	41,681	2036	41,429	44,288	2037	43,058	47,130	2038	44,738	50,350	2039	46,479	53,641	2040	48,253	57,144
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Existing Transmission

Nodal to zonal reduction performed by PLEXOS to create a pipe-and-bubble equivalent model, where intra-zonal lines are collapsed.

Voltage and stability limited interface limits consistent with Policy Case production cost simulation database. Thermally limited interface pipe limits set to sum of thermal normal ratings of each interface line (N-0 normal limit).

Applicable N-X contingencies modeled specifically explicitly in production cost simulation.



Years	Interface/Interzonal Pipes	+ Limit (MW)	- Limit (MW)	Source
All	DYSINGER EAST	2,700	*	2020 ATR
All	A to C Ties	550	0	2021 CRP limit
All	WEST-CENTRAL	1,475	*	2020 ATR
2021-2024	MOSES-SOUTH	3,050	-1,500	1/2015 Ops study stability limit ¹
2025-2040	MOSES-SOUTH	4,050	-1,500	Tier 4 contract ²
2021-2023	CENTRAL-EAST (summer)	2,380	-2,380	Operational nomogram ³
2021-2023	CENTRAL-EAST (winter)	2,615	-2,615	Operational nomogram ³
2024-2040	CENTRAL-EAST (summer)	3,255	-3,255	Operational nomogram ³
2024-2040	CENTRAL-EAST (winter)	3,490	-3,490	Operational nomogram ³
2021-2023	UPNY-CONED	6,150	*	2021 CRP limit
2024-2040	UPNY-CONED	6,525	*	2021 CRP limit
All	DUNWOODI-NYC	*	*	
All	DUNWOODI-LI	*	*	
All	NYC-LI	0	-350	Wheel contract
2027-2040	CLEAN PATH NEW YORK	1,300	-1,300	Tier 4 contracts ⁴
2025-2040	CHAMPLAIN HUDSON POWER EXPRESS	1,250	-1,250	Tier 4 contracts ⁴

<p>New Generation Types</p>	<p>Updated to include units with financial contracts, including state sponsored programs, per firm builds as noted in large-scale renewable projects reported by NYSERDA. Specific generation added to the Contract Case was assumed firm build in the Policy Case.</p> <p>Updated to include units to support achievement of state and federal policies, per 2021 EIA Energy Outlook. Capacity expansion is limited to the NYCA, where each zone assumes one candidate generator per technology.</p> <p>Generation types from 2021 EIA Energy Outlook Table 3 assumed in model:</p> <ul style="list-style-type: none"> land based wind offshore wind utility PV 4-hour battery storage combined cycle combined cycle with 90% CCS nuclear internal combustion engine combustion turbine <p>In addition to the generator types noted above, Dispatchable Emission Free Resource (DEFER) has been added as a candidate technology type for years 2035 and beyond, with additional details below.</p>
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New Generation Costs

Overnight (capital) costs, fixed O&M, and variable O&M costs assumed per [2021 EIA Energy Outlook](#).

Overnight costs, fixed O&M and variable O&M costs for Dispatchable Emission Free Resource (DEFR) options will represent a range of costs and are still under consideration. Preliminary costs for the Dispatchable Emission Free Resource (DEFR) options are:

Candidate Capacity Expansion Technology	Capital Cost (\$/kW)	Variable O&M Costs (\$/MWh)	Fuel Cost (\$/mmBtu)	Heat Rate (mmBtu/MWh)
High Operating/Low Capital	1,000	16	40	6.37
Medium Operating/Medium Capital	4,500	9	23	6.37
Low Operating/High Capital	8,000	2	5	6.37

Regional multipliers assumed for candidate generators by zone are based on the [2021 EIA Energy Outlook](#) and the Climate Action Council Integration Analysis Assumptions (Accessed Assumptions at <https://climate.ny.gov/Climate-Resources> December 10, 2021).

Candidate Technology	Base Capital Cost (2020\$/kW)	Zonal Multiplier for Capital Costs										
		A	B	C	D	E	F	G	H	I	J	K
Combined Cycle	957	1.47	1.47	1.47	1.47	1.47	1.47	1.67	1.67	1.67	2.05	1.91
Combined Cycle with 90% CCS	2,471	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.20	1.20
Internal combustion engine	1,813	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.37	1.37
Combustion turbine	709	1.01	1.01	1.01	1.01	1.01	1.48	1.53	1.53	1.53	1.91	1.65
Nuclear	6,183	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.47	1.47
Utility PV	1,248	1.05	1.04	1.04	1.01	1.01	1.04	1.20	-	-	-	1.39
Land based wind	1,846	0.98	0.96	1.02	1.06	1.03	1.06	1.14	-	-	-	-
Offshore wind	4,362	-	-	-	-	-	-	-	-	-	1.01	1.01
4-hour battery storage	1,165	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.03

Technological optimism factors applied to capital costs per NREL [2020-ATB-data](#).

Candidate Technology	Technology Optimism Factors by Year				
	2020	2025	2030	2035	2040
Combined Cycle	1	1	1	1	1
Combined Cycle with 90% CCS	1	0.97	0.95	0.91	0.88
Internal combustion engine	1	1	1	1	1
Combustion turbine	1	1	1	1	1
Nuclear	1	0.97	0.95	0.91	0.88
Utility PV	1	0.81	0.62	0.59	0.56
Land based wind	1	0.90	0.79	0.75	0.71
Offshore wind	1	0.81	0.70	0.63	0.59
4-hour battery storage	1	0.69	0.56	0.53	0.49

New Generation Properties	<p>Unit heat rates per 2021 EIA Energy Outlook. The heat rates for the Dispatchable Emission Free Resource (DEFER) option are consistent with the combined cycle technology option in the 2021 EIA Energy Outlook. The Dispatchable Emission Free Resource (DEFER) technologies are modeled as flexible resources with parameters consistent with the combined cycle technology option in the 2021 EIA Energy Outlook.</p> <p>Linear capacity expansion by technology-zone. Maximum allowable capacities are enforced for applicable generator types based on 2040 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan.</p> <p>Firm capacity (i.e., UCAP) values for combined cycle, nuclear, internal combustion engine, and combustion turbine units are based on default derating factor values from the NERC GADS database, as applicable to generator type. The firm capacity values for the Dispatchable Emission Free Resource (DEFER) option are consistent with the combined cycle technology option.</p> <p>Firm capacity values for Land based wind, offshore wind, utility PV, and battery storage units are modeled as having a declining capacity value as a function of that generator type's installed capacity. These values are based on the 2020 Grid in Evolution Study.</p>
New Transmission	<p>Transmission expansion not enabled in PLEXOS as a modeling option.</p> <p>New policy-based transmission projects included:</p> <ul style="list-style-type: none"> -NYPA Northern New York Priority Transmission Project -Champlain Hudson Power Express -Clean Path New York
Capacity Reserve Margin	<p>Capacity reserve margins (IRM and LCRs) for 2021-2022 Capability Year translated to UCAP equivalent for model years, per NYISO ICAP to UCAP translation.</p> <p>Minimum UCAP requirements by capacity zone are as follows:</p> <ul style="list-style-type: none"> • NYCA: 110.11% summer, 110.56% winter • Zones G-J: 84.43% summer, 83.69% winter • Zone J: 78.14% summer, 78.31% winter • Zone K: 97.85% summer, 95.48% winter
Policy Targets and Other Model Constraints	<p>CLCPA targets and other state policy mandates modeled include:</p> <ul style="list-style-type: none"> • 6 GW BTM-PV by 2025 • 70% renewable energy by 2030 • 3 GW energy storage by 2030 • 10 GW BTM-PV by 2030 • 9 GW offshore wind by 2035 • 100% emission free by 2040 <p>As noted above, maximum allowable capacities are enforced for applicable generator types by zone based on 2040 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan.</p>