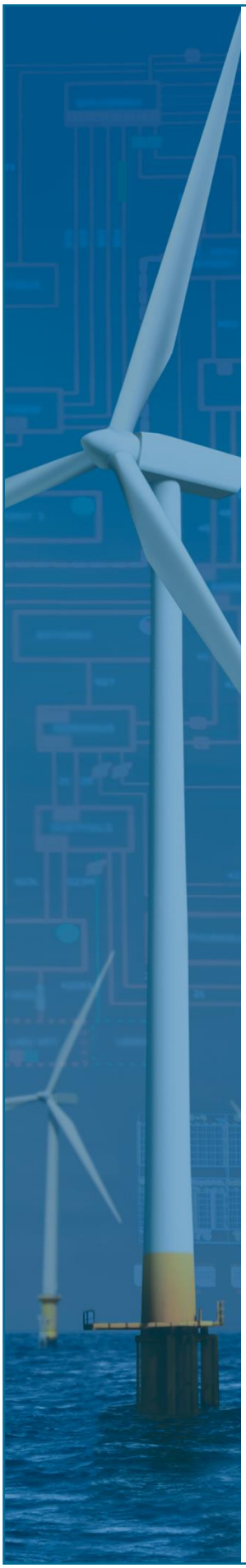


New York ISO
Independent System Operator

Appendix [ ]: Production Cost & Performance

Long Island Offshore Wind Export Public Policy Transmission Need Evaluation

A Report from the New York Independent System Operator

DRAFT for May 5, 2023 ESPWG

Appendix [ ]: Production Cost Benefits

NYISO Production Cost Model

In analyzing the production cost metric, the NYISO utilizes production cost models developed in MAPS (Multi-Area Production Simulation) to analyze system congestion under various future scenarios and system conditions. The software performs a security-constrained economic commitment and dispatch and optimizes for the minimum hourly production cost of supply resources to meet the load plus losses.

The NYISO's production cost model optimizes 4-pool (NYISO, PJM, ISO-NE and IESO) generation to match the load in each hour with the aim of minimizing the overall system production cost.

Production cost models require input data to develop cost curves for the resources that the model will commit and dispatch to serve the load, subject to the constraints included in the model. Generator inputs to the model include generator heat rates, fuel price forecasts, emission price forecasts, and hourly generation profiles for renewable resources. Transmission inputs include an explicit nodal model and individual constraints, contingencies, and interface limitations. Peak and annual demand forecasts for each area/zone in each pool, as well as hourly load patterns, are the key inputs to formulate the load representation in the production cost model.

The NYISO's production cost simulations provide estimates of future system behavior based on the detailed inputs to the model. Results are available up to an hourly resolution and include metrics such as generation, load, LBMP, generator production cost, imports/exports, renewable generation curtailment, etc. System production cost is an industry recognized metric that can be used to measure the economic cost of meeting electricity demand with generation.

Project Evaluation Using Production Cost Models

Production cost simulations can be utilized to gauge the effectiveness of a proposed transmission project in reducing NYCA wide production cost. A pre-project case is first simulated without a project in place to establish a baseline for comparison with all of the assumptions included for the model. A post-project case with the transmission project added to the underlying transmission model is then simulated and metrics are compared to the pre-project case. Production cost savings for a project is calculated as the difference between the pre-project and post-project results over the duration of a project's study period, starting at the estimated in-service date and extending 20 years.

NYCA production cost is the total generation cost of producing power to serve NYCA load. The

total cost includes the following components:

1. Fuel cost (fuel consumption mmBtu multiplied by fuel cost $/mmBtu);
2. Variable operations and maintenance (O&M) cost (VOM adder $/MWh);
3. Emission cost (emission allowance price multiplied by total allowance);
4. Start-up cost (number of starts multiplied by start-up cost); and
5. NYCA Imports and Exports evaluated at the solution case proxy bus LBMP values.

   NYCA wide Production Cost = $\sum_{n=1}^{8760}\{NYCA\ Generator\ Costs_n + Import\ Costs_n - Export\ Costs_n\}$

Generation resources with no variable cost (*e.g.*, solar, wind, and hydro) do not contribute to production cost given that they produce energy for $0/MWh. Any Renewable Energy Credit (REC) subsidies for each of these resource types are modeled as a negative "bid adder" and are solely used to create a dispatch order and do not contribute to production cost.

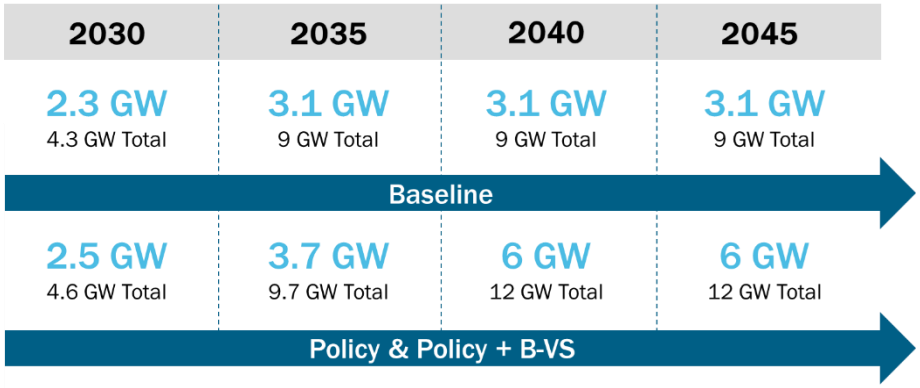
Assumptions for Production Cost Analysis

The production cost model used for the Long Island Offshore Wind Export Public Policy Transmission Need (Long Island PPTN) evaluation utilizes the 2021-2040 System and Resource Outlook (Outlook) Contract Case as the starting point for the "Baseline" Scenario. The "Policy" Scenario for the Long Island PPTN evaluation is largely derived from the Outlook Policy S2 Case. The "Policy + Barrett-Valley Stream (B-VS)" Scenario is the Policy Scenario with the inclusion of the Barrett-Valley Stream constraint. The Outlook study period is from 2021 to 2040, whereas the Long Island PPTN study period is from 2030-2050. The NYISO simulated discrete years at 5-year intervals to provide a reasonable representation of the twenty-year study period without simulating each year of production cost data.

The following key changes were applied to the Long Island PPTN pre-project cases compared to the Outlook' Contract and Policy S2 cases:

- Extended load forecast, fuel price forecast, and emission price forecast to 2045 to be modeled in production cost simulations. 2045 is considered as the proxy year to represent system conditions from 2045-2050.
- Increased offshore wind capacity and points of interconnection in both the Baseline and Policy Scenarios for the Long Island PPTN compared to the Outlook Contract and Policy S2 cases. The following figure shows the increased capacity and timeline of offshore wind resource installation.

Figure 1: Timeline of Offshore Wind Installation in Production Cost Analyses



- Lower kV constraints (less than 115 kV) are relaxed in Long Island for the Baseline Scenario.
- Constraints lower than 69 kV are relaxed in New York City and Long Island for the Policy Scenario. For all other zones in the Policy Scenario, all constraints lower than 230 kV are relaxed beyond 2040.
- Barrett – Valley Stream, Valley Stream – East Garden City (secure for the reverse direction from East Garden City – Valley Stream), Barrett – Freeport, and Freeport – Newbridge 138 kV lines are relaxed for the Policy Scenario (However, the Policy + B-VS Scenario removes this assumption).

Pre-Project Case Results

The pre-project cases were run for the Long Island PPTN Baseline Scenario, the Long Island PPTN Policy Scenario, and the Long Island PPTN Policy + B-VS Scenario. The pre-project case results provide a reference set of data points which can be compared against the results produced after the project is put in-service. The pre-project cases show that there is significant curtailment, especially in the Policy and Policy + B-VS Scenarios, of offshore wind resources in Long Island. Curtailment of low-cost resources, such as offshore wind, can be caused by constraints either local or on the bulk level. This curtailment can cause other higher cost resources to be dispatched to serve load either on Long Island or in the neighboring regions.

Figure 2: Pre-Project Production Cost Results

Area	Values	Baseline				Policy				Policy + B-VS			
		2030	2035	2040	2045	2030	2035	2040	2045	2030	2035	2040	2045
Long Island	OSW Capacity (MW)	2,279	3,079	3,079	3,079	2,539	3,689	5,989	5,989	2,539	3,689	5,989	5,989
	Potential Energy Production (GWh)	8,927	12,153	12,190	12,145	9,974	14,622	24,048	23,965	9,974	14,622	24,048	23,965
	Curtailment (GWh)	49	520	345	147	173	538	3,131	2,473	2,440	2,358	3,823	3,273
	Curtailment Rate (%)	1%	4%	3%	1%	2%	4%	13%	10%	24%	16%	16%	14%
NYC	OSW Capacity (MW)	2,046	5,976	5,976	5,976	2,046	5,976	5,976	5,976	2,046	5,976	5,976	5,976
	Potential Energy Production (GWh)	8,368	22,929	23,020	22,928	8,368	22,931	23,022	22,929	8,368	22,931	23,022	22,929
	Curtailment (GWh)	4	83	3	0	1	2	2	16	2	2	2	19
	Curtailment Rate (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Long Island has five tie interfaces, including connections to Dunwoodie (Y49 and Y50), PJM

(Neptune), NY City (Jamaica-Corona), Cross Sound Cable, and Northport Norwalk (ISONE). Two of the interfaces (Neptune and Cross Sound Cable) are only scheduled to import energy into Long Island. The limited export capability from Long Island in the pre-project cases limits the amount of low-cost energy produced by offshore wind resources to serve load outside of Long Island in periods when the output from these resources is high. The Dunwoodie-Long Island interface is consistently one of the most congested interfaces in the NYCA. The two tie-lines (Y49 and Y50) transfer power from the lower Hudson Valley to Long Island. The flow is higher in the Baseline Scenario compared to the Policy Scenarios due to the difference in the assumed offshore wind injections in Long Island. The Policy Scenarios have higher offshore wind injections in Long Island that push back on the imports from this interface.

The Long Island PPTN post-project cases all improve the export capability of Long Island by adding tie-lines between Long Island and the lower Hudson Valley. This added transfer capacity/headroom and upgrades to the internal Long Island system reduces the amount of curtailment from offshore wind resources that can be used to offset more expensive generation in New York or Imports from neighboring regions.

Post-Project Results

Production cost savings for each project is calculated by taking the difference between the pre- and post-project NYCA-wide production costs. Production cost savings are achieved when transmission projects unbottle cheaper resources in the system that replace more expensive generation, resulting in the reduction of the overall cost of serving load. Transmission projects provide additional electrical pathways that may be used by generators to serve load and, therefore, can decrease transmission congestion.

Production cost savings are also achieved by offsetting higher cost energy imports from neighboring regions with lower cost internal generation previously inaccessible due to transmission congestion. In general, all of the proposed projects to address the Long Island PPTN produce savings by unbottling offshore wind resources in Long Island and reducing the amount of imports from neighboring regions. The figures below show the estimated production cost savings for each project over a 20-year period in 2022 real million dollars. [placeholder for NPV calculation description]

Figure 3: Estimated 20-year Production Cost Savings (2022 $M)

Estimated Total 20-Year Savings (2022 $M)			
Project	Baseline	Policy	Policy + B-VS
T035 - LS Power	104	340	906
T036 - NextEra Core 1	108	303	291
T037 - NextEra Core 2	108	364	378
T038 - NextEra Core 3	109	380	402
T039 - NextEra Core 4	39	305	307
T040 - NextEra Core 5	107	339	332
T041 - NextEra Core 6	110	291	308
T042 - NextEra Core 7	110	291	308
T043 - NextEra Enh 1	87	458	745
T044 - NextEra Enh 2	81	441	582
T047 - Propel Base 1	109	337	568
T048 - Propel Base 2	99	313	513
T049 - Propel Base 3	102	344	902
T051 - Propel Alt 5	104	341	609
T052 - Propel Alt 6	96	352	618
T053 - Propel Alt 7	108	360	622

Figure 4: Production Cost Savings Over 20 Years (2022 $M)

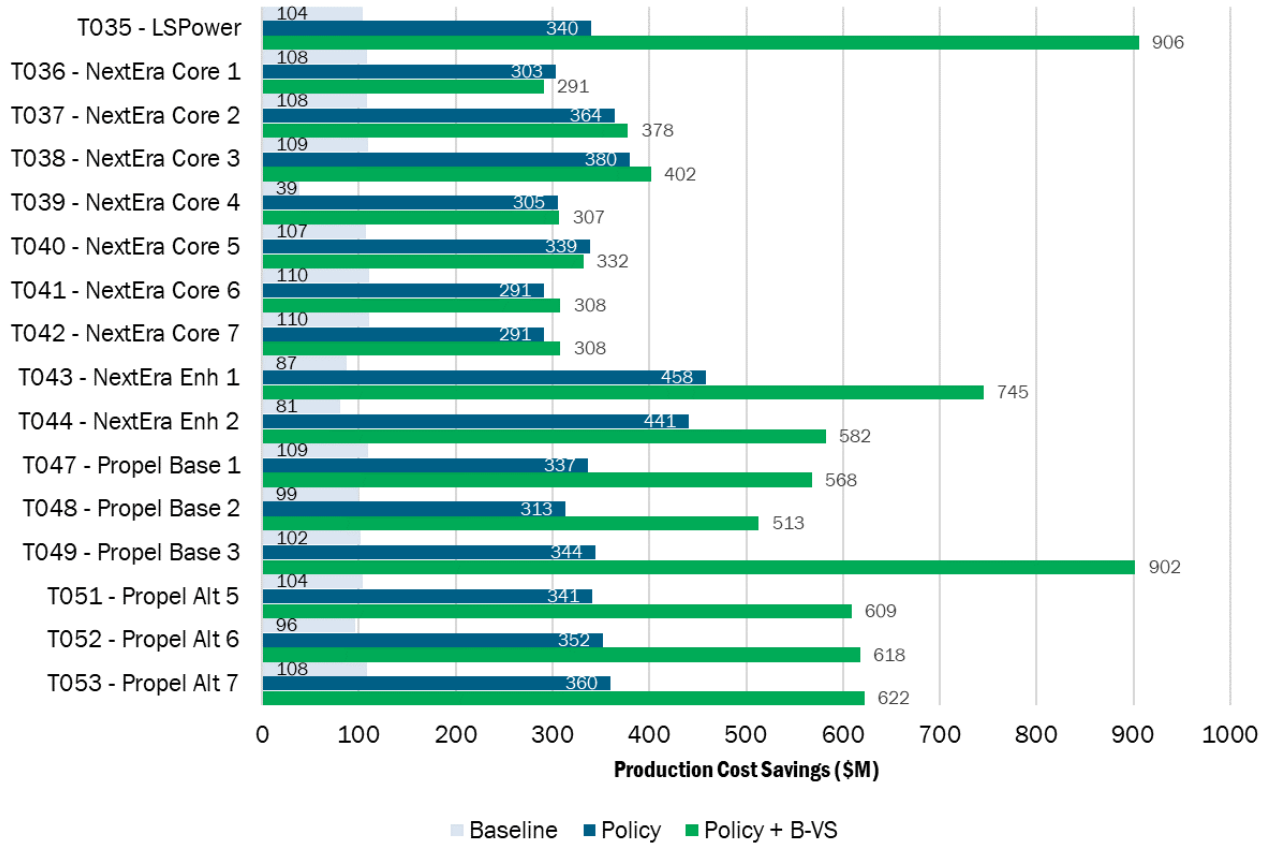
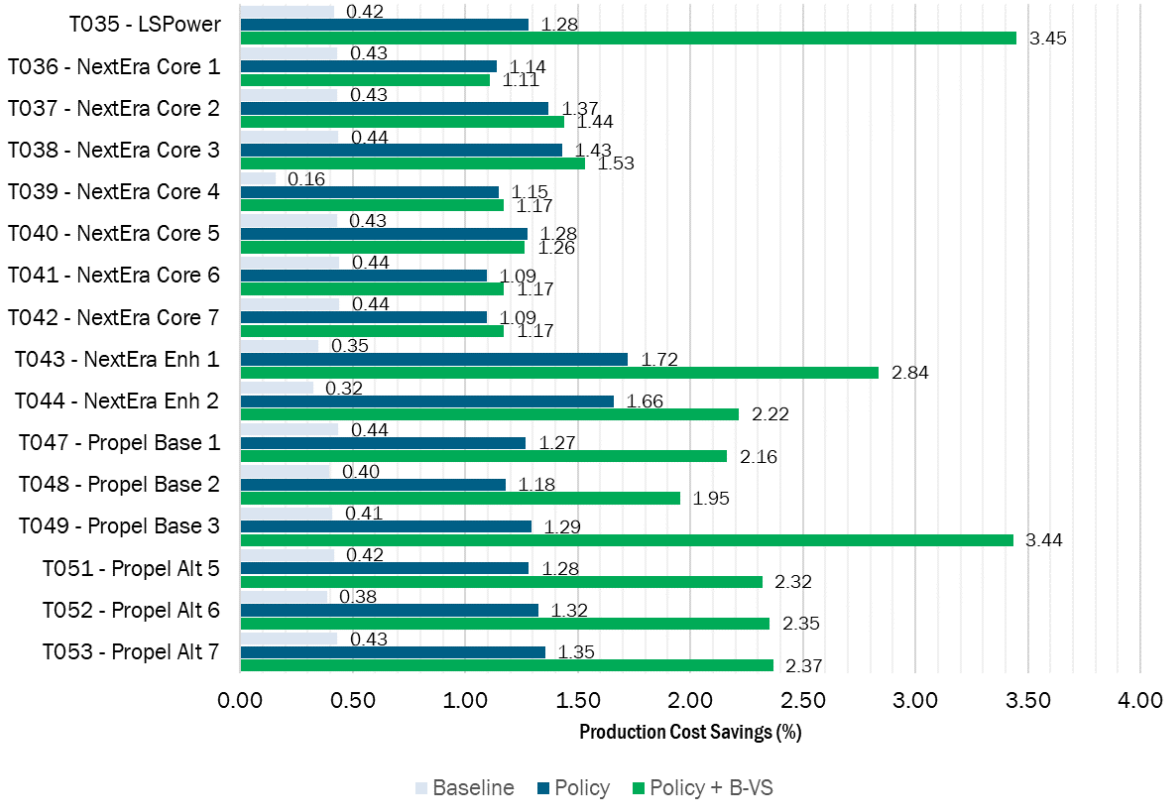


Figure 5: Savings As Percentage of Total NYCA-Wide Production Cost



Performance Evaluation

The performance evaluation leverages the same models and simulations from the production cost analysis but evaluates several metrics related to the performance of the system. The transmission utilization, energy deliverability, and CO_2 emissions assessments help to quantify the impacts that projects may have on the NYCA.

Transmission Utilization

The performance of a project is evaluated based on its ability to efficiently utilize the transmission network to increase energy transfers between Long Island and the rest of NYCA. The transmission utilization metric is the total annual energy transferred (MWh) over an interface. The results help determine the effectiveness of a transmission project to export offshore wind energy off Long Island and to import energy when needed.

For the purposes of this analysis, transmission utilization is measured as the total annual energy transacted across existing and proposed project inter-zonal transmission paths that interconnect to the Long Island (Zone K). This also includes transmission paths that connect to other areas within the NYCA and external to the NYCA.

Flows across the tie-lines from Long Island to the rest of NYCA and neighboring regions are divided into import and export energy, which are netted on an hourly basis and summed over each year. The 20-year flow estimates are calculated assuming equal flows over the 5-year period in between the simulation years.

Figure 6: 20-Year Transmission Utilization

Project	LI Import (GWh)			LI Export (GWh)		
	Baseline	Policy	Policy + B-VS	Baseline	Policy	Policy + B-VS
Pre-Project	128,203	137,924	150,138	36,543	45,638	29,773
T035 - LSPower	134,901	145,977	145,684	42,958	74,206	74,441
T036 - NextEra Core 1	135,401	146,953	157,176	43,372	76,282	47,112
T037 - NextEra Core 2	135,356	146,562	155,695	43,332	75,632	46,960
T038 - NextEra Core 3	135,257	146,038	154,698	43,332	77,270	49,252
T039 - NextEra Core 4	137,528	147,944	157,249	43,277	77,443	48,935
T040 - NextEra Core 5	135,255	146,126	155,461	43,330	77,349	48,845
T041 - NextEra Core 6	135,221	145,736	154,695	43,398	77,666	49,683
T042 - NextEra Core 7	135,221	145,736	154,695	43,398	77,666	49,683
T043 - NextEra Enh 1	136,582	148,041	151,887	43,504	78,588	62,645
T044 - NextEra Enh 2	135,766	147,394	153,636	43,633	78,598	59,281
T047 - Propel Base 1	134,827	146,389	150,252	43,290	75,872	56,366
T048 - Propel Base 2	134,912	146,323	149,796	43,349	72,302	55,344
T049 - Propel Base 3	134,971	146,754	146,604	43,260	76,075	73,178
T051 - Propel Alt 5	135,539	148,786	149,989	43,216	60,499	59,505
T052 - Propel Alt 6	135,243	146,662	150,333	43,271	77,269	59,574
T053 - Propel Alt 7	134,975	145,721	149,130	43,409	77,148	59,591

Energy Deliverability

The performance analysis also considers the energy deliverability impact of proposed projects on projected offshore wind resources Energy deliverability represents the ability of renewable generation (*e.g.*, wind, solar, and hydro) to inject energy into the grid to serve end-use consumers without curtailment. It is expressed as the ratio of energy generated to total potential energy for those resources. Generally, energy deliverability is reduced as more renewable capacity is added to the system due to the transmission constraints in the system. The greater the renewable generation curtailment in a specific location, the greater the opportunity for transmission investment.

$$Energy\ Deliverability\ (\%) = \frac{Annual\ Energy\ Production\ (GWh)}{Potential\ Annual\ Energy\ Production\ (GWh)}$$

$$Energy\ Deliverability\ (\%) = 100\% - \ Curtailment\ (\%)$$

Constraints in the existing system and new constraints that may be binding in a scenario with high penetration of offshore wind limit the amount of renewable energy that can be utilized to serve load. To enable effective use of these resources, proposed projects need to address congestion at the local and bulk transmission levels to increase energy deliverability. Projects that enable high energy deliverability (and thus lower curtailments) displace more costly generation dispatch in the system or imports from neighboring regions. This is reflected in the total production cost savings achieved by the project.

Figure 7: Baseline Scenario LI OSW Curtailment and Energy Deliverability

Project	Sum of Scheduled Energy (GWh)				Sum of Curtailed Energy (GWh)				20-year Energy Deliverability
	2030	2035	2040	2045	2030	2035	2040	2045	
Baseline Case (Pre-Project)	8,927	12,153	12,190	12,145	49	520	345	147	98%
T035 - LS Power	8,927	12,153	12,190	12,145	0	0	0	0	100%
T036 - NextEra Core 1	8,927	12,153	12,190	12,145	4	0	1	1	100%
T037 - NextEra Core 2	8,927	12,153	12,190	12,145	3	0	0	0	100%
T038 - NextEra Core 3	8,927	12,153	12,190	12,145	3	0	0	0	100%
T039 - NextEra Core 4	8,927	12,153	12,190	12,145	4	0	1	2	100%
T040 - NextEra Core 5	8,927	12,153	12,190	12,145	4	0	0	1	100%
T041 - NextEra Core 6	8,927	12,153	12,190	12,145	3	0	0	1	100%
T042 - NextEra Core 7	8,927	12,153	12,190	12,145	3	0	0	1	100%
T043 - NextEra Enh 1	8,927	12,153	12,190	12,145	0	1	0	0	100%
T044 - NextEra Enh 2	8,927	12,153	12,190	12,145	0	0	0	0	100%
T047 - Propel Base 1	8,927	12,153	12,190	12,145	3	1	0	1	100%
T048 - Propel Base 2	8,927	12,153	12,190	12,145	3	0	0	1	100%
T049 - Propel Base 3	8,927	12,153	12,190	12,145	3	0	0	1	100%
T051 - Propel Alt 5	8,927	12,153	12,190	12,145	2	0	0	0	100%
T052 - Propel Alt 6	8,927	12,153	12,190	12,145	2	0	0	1	100%
T053 - Propel Alt 7	8,927	12,153	12,190	12,145	3	0	0	0	100%

Figure 8: Policy Scenario LI OSW Curtailment and Energy Deliverability

Project	Sum of Scheduled Energy (GWh)				Sum of Curtailed Energy (GWh)				20-year Energy Deliverability
	2030	2035	2040	2045	2030	2035	2040	2045	
Policy Case (Pre-Project)	9,974	14,622	24,048	23,965	173	538	3,131	2,473	91%
T035 - LS Power	9,974	14,622	24,048	23,965	48	9	383	388	99%
T036 - NextEra Core 1	9,974	14,622	24,048	23,965	103	20	206	178	99%
T037 - NextEra Core 2	9,974	14,622	24,048	23,965	99	19	215	224	99%
T038 - NextEra Core 3	9,974	14,622	24,048	23,965	97	18	44	59	100%
T039 - NextEra Core 4	9,974	14,622	24,048	23,965	101	22	87	41	100%
T040 - NextEra Core 5	9,974	14,622	24,048	23,965	103	22	85	90	100%
T041 - NextEra Core 6	9,974	14,622	24,048	23,965	94	16	58	54	100%
T042 - NextEra Core 7	9,974	14,622	24,048	23,965	94	16	58	54	100%
T043 - NextEra Enh 1	9,974	14,622	24,048	23,965	0	0	3	7	100%
T044 - NextEra Enh 2	9,974	14,622	24,048	23,965	0	1	5	4	100%
T047 - Propel Base 1	9,974	14,622	24,048	23,965	94	17	212	148	99%
T048 - Propel Base 2	9,974	14,622	24,048	23,965	95	18	651	469	98%
T049 - Propel Base 3	9,974	14,622	24,048	23,965	95	16	209	106	99%
T051 - Propel Alt 5	9,974	14,622	24,048	23,965	76	14	52	46	100%
T052 - Propel Alt 6	9,974	14,622	24,048	23,965	84	14	53	29	100%
T053 - Propel Alt 7	9,974	14,622	24,048	23,965	93	19	67	77	100%

Figure 9: Policy + B-VS Scenario LI OSW Curtailment and Energy Deliverability

Project	Sum of Scheduled Energy (GWh)				Sum of Curtailed Energy (GWh)				20-year Energy Deliverability
	2030	2035	2040	2045	2030	2035	2040	2045	
Policy Case + B-VS (Pre-Project)	9,974	14,622	24,048	23,965	2,440	2,358	3,823	3,273	84%
T035 - LS Power	9,974	14,622	24,048	23,965	47	10	387	376	99%
T036 - NextEra Core 1	9,974	14,622	24,048	23,965	2,057	1,910	2,001	1,891	89%
T037 - NextEra Core 2	9,974	14,622	24,048	23,965	2,005	1,852	1,918	1,848	90%
T038 - NextEra Core 3	9,974	14,622	24,048	23,965	1,947	1,782	1,745	1,700	90%
T039 - NextEra Core 4	9,974	14,622	24,048	23,965	2,030	1,856	1,838	1,747	90%
T040 - NextEra Core 5	9,974	14,622	24,048	23,965	2,031	1,857	1,854	1,794	90%
T041 - NextEra Core 6	9,974	14,622	24,048	23,965	2,000	1,853	1,728	1,664	90%
T042 - NextEra Core 7	9,974	14,622	24,048	23,965	2,000	1,853	1,728	1,664	90%
T043 - NextEra Enh 1	9,974	14,622	24,048	23,965	1,038	955	842	780	95%
T044 - NextEra Enh 2	9,974	14,622	24,048	23,965	1,816	1,707	1,563	4	93%
T047 - Propel Base 1	9,974	14,622	24,048	23,965	1,239	1,114	1,385	1,212	93%
T048 - Propel Base 2	9,974	14,622	24,048	23,965	1,389	1,252	1,530	1,457	92%
T049 - Propel Base 3	9,974	14,622	24,048	23,965	104	26	551	348	99%
T051 - Propel Alt 5	9,974	14,622	24,048	23,965	1,134	1,002	1,079	1,009	94%
T052 - Propel Alt 6	9,974	14,622	24,048	23,965	1,245	1,092	1,001	892	94%
T053 - Propel Alt 7	9,974	14,622	24,048	23,965	1,213	1,076	1,046	1,015	94%

CO_2 Emissions

Figure 10: Annual NYCA CO_2 Emissions in Policy Scenarios

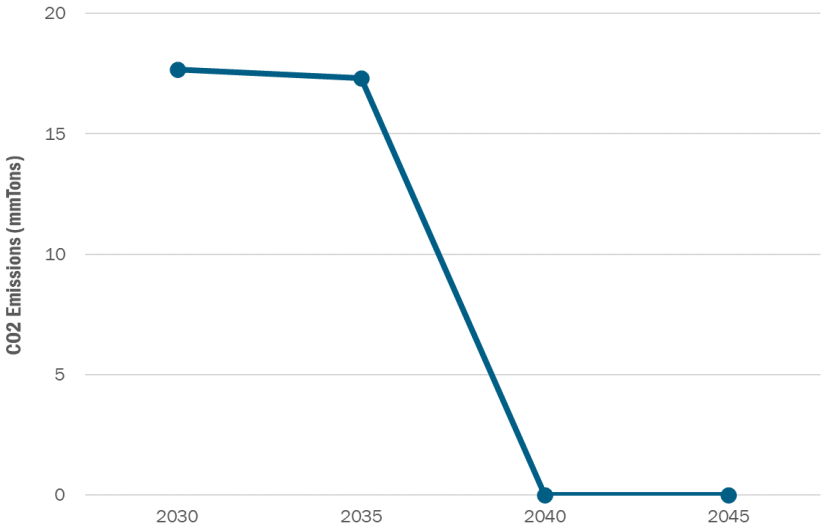

20
15
10
5
0
CO2 Emissions (mmTons)
2030
2035
2040
2045

Figure 11: Baseline Scenario CO_2 Emissions

20-Year Estimated CO_2 Emissions (Million Tons)				
Project	**LI**	**NYC**	**NYCA**	**Regional**
Baseline Case (Pre-Project)	53	194	450	8,248
T035 - LS Power	49	197	451	8,246
T036 - NextEra Core 1	49	197	451	8,246
T037 - NextEra Core 2	49	196	451	8,245
T038 - NextEra Core 3	49	196	451	8,246
T039 - NextEra Core 4	48	201	452	8,246
T040 - NextEra Core 5	49	197	451	8,246
T041 - NextEra Core 6	49	197	451	8,246
T042 - NextEra Core 7	49	197	451	8,246
T043 - NextEra Enh 1	48	198	451	8,247
T044 - NextEra Enh 2	49	199	453	8,245
T047 - Propel Base 1	49	197	451	8,244
T048 - Propel Base 2	49	197	451	8,245
T049 - Propel Base 3	49	197	453	8,244
T051 - Propel Alt 5	49	197	451	8,245
T052 - Propel Alt 6	49	197	451	8,245
T053 - Propel Alt 7	49	197	451	8,245

Figure 12: Policy Scenario CO_2 Emissions

20-Year Estimated CO2 Emissions (Million Tons)				
Project	**LI**	**NYC**	**NYCA**	**Regional**
Policy Case (Pre-Project)	24	70	175	8,060
T035 - LS Power	22	72	176	8,056
T036 - NextEra Core 1	22	71	175	8,057
T037 - NextEra Core 2	22	72	176	8,056
T038 - NextEra Core 3	22	72	176	8,057
T039 - NextEra Core 4	22	72	177	8,054
T040 - NextEra Core 5	22	72	176	8,057
T041 - NextEra Core 6	22	71	175	8,058
T042 - NextEra Core 7	22	71	175	8,058
T043 - NextEra Enh 1	22	71	177	8,053
T044 - NextEra Enh 2	22	72	177	8,052
T047 - Propel Base 1	22	72	176	8,051
T048 - Propel Base 2	22	72	176	8,056
T049 - Propel Base 3	22	72	176	8,052
T051 - Propel Alt 5	22	72	176	8,056
T052 - Propel Alt 6	22	72	176	8,056
T053 - Propel Alt 7	22	72	176	8,056

Figure 13: Policy + Barrett–Valley Stream Scenario CO_2 Emissions

20-Year Estimated CO2 Emissions (Million Tons)				
Project	LI	NYC	NYCA	Regional
Policy Case + B-VS (Pre-Project)	24	72	179	8,072
T035 - LS Power	22	72	176	8,056
T036 - NextEra Core 1	21	72	179	8,071
T037 - NextEra Core 2	21	73	180	8,069
T038 - NextEra Core 3	21	73	179	8,069
T039 - NextEra Core 4	21	73	179	8,066
T040 - NextEra Core 5	21	73	179	8,070
T041 - NextEra Core 6	21	72	178	8,070
T042 - NextEra Core 7	21	72	178	8,070
T043 - NextEra Enh 1	22	72	178	8,061
T044 - NextEra Enh 2	22	73	181	8,062
T047 - Propel Base 1	22	72	178	8,058
T048 - Propel Base 2	22	72	178	8,063
T049 - Propel Base 3	22	72	176	8,052
T051 - Propel Alt 5	22	72	178	8,063
T052 - Propel Alt 6	22	72	178	8,063
T053 - Propel Alt 7	22	72	178	8,063

Additional Production Cost Results

NYCA Import/Export

The NYCA-wide production cost savings are also impacted by changes in the Import and Export flows on the NYCA ties with neighboring regions. Therefore, an overall reduction in net Imports (Imports – Exports) amounts due to the addition of a project results to higher production cost savings. Reduction in net Imports also represents higher utilization of in-state resources (*e.g.*, offshore wind) that displaces Imports from neighboring regions to serve load. The following tables show the Import, Export and net Import flows to all four neighboring regions for New York. Projects with larger reductions in net-Imports correspond to higher production cost savings.

Figure 14: Baseline Scenario NYCA Import/Export Delta Flows

Project	20-Year Export Energy (GWh)				20-Year Import Energy (GWh)				20-Year Net-Import Energy (GWh)			
	HQ	IESO	PJM	ISONE	HQ	IESO	PJM	ISONE	HQ	IESO	PJM	ISONE
Baseline Case (Pre-Project)	226	82,519	18,104	164,557	230,067	11,027	230,607	22,170	229,841	(71,492)	212,502	(142,387)
T035 - LS Power	0	168	874	(5,283)	(432)	(375)	(2,496)	(8,520)	(432)	(543)	(3,370)	(3,237)
T036 - NextEra Core 1	0	251	1,043	(6,105)	(600)	(388)	(2,731)	(8,650)	(600)	(639)	(3,774)	(2,545)
T037 - NextEra Core 2	0	258	990	(5,823)	(691)	(426)	(2,404)	(8,604)	(691)	(685)	(3,395)	(2,781)
T038 - NextEra Core 3	(0)	170	1,094	(6,041)	(695)	(374)	(2,678)	(8,594)	(695)	(543)	(3,773)	(2,552)
T039 - NextEra Core 4	(0)	307	844	(5,238)	(653)	(419)	(1,805)	(9,930)	(653)	(726)	(2,650)	(4,691)
T040 - NextEra Core 5	0	173	1,022	(5,865)	(603)	(360)	(2,866)	(8,548)	(603)	(533)	(3,888)	(2,684)
T041 - NextEra Core 6	0	220	1,096	(6,086)	(606)	(384)	(2,913)	(8,556)	(606)	(604)	(4,009)	(2,471)
T042 - NextEra Core 7	0	220	1,096	(6,086)	(606)	(384)	(2,913)	(8,556)	(606)	(604)	(4,009)	(2,471)
T043 - NextEra Enh 1	0	88	802	(6,654)	(664)	(426)	(3,814)	(9,606)	(664)	(514)	(4,616)	(2,952)
T044 - NextEra Enh 2	0	126	873	(7,544)	(657)	(825)	(8,914)	(8,981)	(657)	(950)	(9,787)	(1,437)
T047 - Propel Base 1	0	182	1,022	(5,801)	(432)	(386)	(3,300)	(8,685)	(432)	(568)	(4,322)	(2,884)
T048 - Propel Base 2	0	153	992	(6,156)	(440)	(430)	(3,404)	(8,704)	(440)	(583)	(4,396)	(2,548)
T049 - Propel Base 3	(0)	981	1,382	(7,419)	(447)	(619)	(8,053)	(8,656)	(447)	(1,600)	(9,435)	(1,237)
T051 - Propel Alt 5	0	187	1,029	(5,854)	(439)	(465)	(3,185)	(8,694)	(439)	(653)	(4,214)	(2,840)
T052 - Propel Alt 6	0	188	1,004	(6,136)	(462)	(475)	(3,471)	(8,697)	(462)	(663)	(4,474)	(2,561)
T053 - Propel Alt 7	0	233	1,004	(6,302)	(470)	(471)	(3,457)	(8,620)	(470)	(704)	(4,461)	(2,318)

Change In Import/Export (GWh)

Figure 15: Policy Scenario NYCA Import/Export Delta Flows

Project	20-Year Export Energy (GWh)				20-Year Import Energy (GWh)				20-Year Net-Import Energy (GWh)			
	HQ	IESO	PJM	ISONE	HQ	IESO	PJM	ISONE	HQ	IESO	PJM	ISONE
Policy Case (Pre-Project)	226	120,144	63,495	120,492	387,404	18,766	259,665	100,514	387,178	(101,378)	196,170	(19,978)
T035 - LS Power	(0)	654	2,230	1,052	(3,936)	(644)	(1,016)	(6,964)	(3,936)	(1,298)	(3,246)	(8,015)
T036 - NextEra Core 1	(0)	812	2,130	1,190	(4,607)	(517)	363	(7,321)	(4,607)	(1,330)	(1,767)	(8,511)
T037 - NextEra Core 2	(0)	462	2,499	291	(3,888)	(457)	(4,178)	(7,228)	(3,888)	(919)	(6,677)	(7,520)
T038 - NextEra Core 3	(0)	581	2,480	313	(4,061)	(430)	(4,169)	(7,964)	(4,061)	(1,011)	(6,648)	(8,277)
T039 - NextEra Core 4	(0)	533	3,078	1,643	(4,004)	(455)	(5,020)	(9,792)	(4,004)	(988)	(8,098)	(11,436)
T040 - NextEra Core 5	(0)	597	2,321	1,034	(4,445)	(509)	(2,440)	(8,160)	(4,445)	(1,106)	(4,761)	(9,193)
T041 - NextEra Core 6	(0)	864	2,277	(498)	(4,695)	(593)	(152)	(7,411)	(4,695)	(1,457)	(2,429)	(6,913)
T042 - NextEra Core 7	(0)	864	2,277	(498)	(4,695)	(593)	(152)	(7,411)	(4,695)	(1,457)	(2,429)	(6,913)
T043 - NextEra Enh 1	(0)	614	3,635	1,077	(3,702)	(556)	(6,614)	(7,910)	(3,702)	(1,170)	(10,249)	(8,987)
T044 - NextEra Enh 2	(0)	853	4,482	1,411	(3,061)	(406)	(9,796)	(8,500)	(3,061)	(1,259)	(14,278)	(9,910)
T047 - Propel Base 1	(0)	1,002	2,370	137	(4,252)	(656)	(3,277)	(7,630)	(4,252)	(1,658)	(5,647)	(7,767)
T048 - Propel Base 2	(0)	657	1,842	1,249	(3,500)	(499)	(1,287)	(7,582)	(3,500)	(1,156)	(3,129)	(8,832)
T049 - Propel Base 3	(0)	1,014	2,327	756	(4,361)	(659)	(3,144)	(7,722)	(4,361)	(1,672)	(5,472)	(8,478)
T051 - Propel Alt 5	(0)	392	1,018	(2,304)	(3,891)	(302)	2,592	(5,124)	(3,891)	(695)	1,574	(2,820)
T052 - Propel Alt 6	(0)	772	2,254	1,104	(4,340)	(565)	(2,008)	(7,794)	(4,340)	(1,336)	(4,262)	(8,898)
T053 - Propel Alt 7	(0)	749	2,295	907	(4,336)	(591)	(2,076)	(7,674)	(4,336)	(1,340)	(4,372)	(8,582)

Change In Import/Export (GWh)

Figure 16: Policy + B-VS Scenario NYCA Import/Export Delta Flows

Project	20-Year Export Energy (GWh)				20-Year Import Energy (GWh)				20-Year Net-Import Energy (GWh)			
	HQ	IESO	PJM	ISONE	HQ	IESO	PJM	ISONE	HQ	IESO	PJM	ISONE
Policy Case + B-VS (Pre-Project)	226	119,872	61,465	117,646	388,171	18,906	267,788	102,041	387,945	(100,966)	206,323	(15,605)
T035 - LS Power	(0)	999	4,338	3,994	(4,813)	(819)	(9,084)	(8,675)	(4,813)	(1,818)	(13,422)	(12,669)
T036 - NextEra Core 1	(0)	525	1,044	538	(2,590)	(390)	980	(6,724)	(2,590)	(915)	(64)	(7,261)
T037 - NextEra Core 2	(0)	142	1,399	(175)	(1,849)	(272)	(3,723)	(6,767)	(1,849)	(414)	(5,122)	(6,592)
T038 - NextEra Core 3	(0)	424	1,501	(420)	(2,058)	(419)	(3,318)	(7,522)	(2,058)	(843)	(4,819)	(7,102)
T039 - NextEra Core 4	(0)	553	2,072	677	(1,978)	(312)	(2,092)	(9,354)	(1,978)	(865)	(4,163)	(10,031)
T040 - NextEra Core 5	(0)	627	1,343	(130)	(2,331)	(469)	375	(7,697)	(2,331)	(1,096)	(968)	(7,567)
T041 - NextEra Core 6	(0)	696	1,534	(1,913)	(2,735)	(481)	1,825	(6,995)	(2,735)	(1,177)	291	(5,082)
T042 - NextEra Core 7	(0)	696	1,534	(1,913)	(2,735)	(481)	1,825	(6,995)	(2,735)	(1,177)	291	(5,082)
T043 - NextEra Enh 1	(0)	625	3,842	2,167	(3,073)	(524)	(9,922)	(8,276)	(3,073)	(1,149)	(13,764)	(10,443)
T044 - NextEra Enh 2	0	749	4,334	1,737	(1,740)	(428)	(12,303)	(9,267)	(1,740)	(1,177)	(16,636)	(11,004)
T047 - Propel Base 1	(0)	819	2,325	626	(2,956)	(586)	(7,496)	(8,006)	(2,956)	(1,405)	(9,821)	(8,632)
T048 - Propel Base 2	(0)	849	2,291	1,788	(2,714)	(593)	(3,690)	(8,214)	(2,714)	(1,442)	(5,981)	(10,003)
T049 - Propel Base 3	(0)	1,132	4,100	3,382	(4,511)	(785)	(11,641)	(9,391)	(4,511)	(1,917)	(15,741)	(12,773)
T051 - Propel Alt 5	(0)	735	2,537	1,439	(3,170)	(511)	(5,226)	(8,374)	(3,170)	(1,246)	(7,763)	(9,813)
T052 - Propel Alt 6	(0)	736	2,542	1,937	(3,371)	(578)	(5,191)	(8,258)	(3,371)	(1,314)	(7,732)	(10,195)
T053 - Propel Alt 7	0	913	2,697	1,592	(3,316)	(712)	(4,535)	(8,265)	(3,316)	(1,625)	(7,231)	(9,857)

Change In Import/Export (GWh)

Zonal Renewable Curtailment

Figure 17: Baseline Scenario 20-Year Zonal Curtailment Delta by Renewable Type (GWh)

Zone	Generation Type	T035 - LS Power	T036 - NextEra Core 1	T037 - NextEra Core 2	T038 - NextEra Core 3	T039 - NextEra Core 4	T040 - NextEra Core 5	T041 - NextEra Core 6	T042 - NextEra Core 7	T043 - NextEra Enh 1	T044 - NextEra Enh 2	T047 - Propel Base 1	T048 - Propel Base 2	T049 - Propel Base 3	T051 - Propel Alt 5	T052 - Propel Alt 6	T053 - Propel Alt 7
West	HYDRO	0	0	0	0	(0)	0	0	0	0	0	0	0	0	0	0	0
	LBW	1	1	1	1	0	1	1	1	1	(0)	1	1	1	1	1	1
	UPV	(0)	(1)	0	0	(3)	0	(0)	(0)	(0)	0	0	0	1	0	0	0
Genesee	HYDRO	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	LBW	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(1)	(1)	(1)	(0)	(0)	(1)	(0)	(0)	(0)
	UPV	3	(3)	2	2	(13)	2	(1)	(1)	(2)	(10)	2	1	(1)	1	1	2
Central	HYDRO	(0)	(0)	(0)	(0)	1	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	LBW	2	4	5	4	3	2	3	3	4	5	1	2	(3)	2	2	1
	UPV	0	(2)	0	0	(7)	0	(0)	(0)	(0)	1	0	0	0	0	0	0
North	HQ IMP	432	600	691	695	653	603	606	606	664	657	432	440	447	438	462	470
	HYDRO	20	23	28	28	28	26	26	26	27	26	20	19	19	20	21	22
	LBW	43	70	81	84	81	73	71	71	77	70	58	45	41	46	43	44
	UPV	0	(0)	0	0	(2)	0	(0)	(0)	0	0	0	0	0	0	0	0
Mohawk Valley	HYDRO	1	2	1	1	0	2	1	1	(1)	(2)	0	1	(0)	1	(0)	1
	LBW	38	55	65	67	66	53	52	52	63	53	40	40	29	42	44	42
	UPV	4	(1)	1	1	(7)	0	(0)	(0)	4	3	2	3	3	2	4	3
Capital	HYDRO	23	26	27	25	26	25	27	27	27	27	23	24	23	23	26	26
	UPV	3	6	5	5	(7)	5	5	5	(3)	(23)	5	5	3	5	4	7
Hudson Valley	HYDRO	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	UPV	2	1	2	2	(4)	1	1	1	(5)	(7)	3	2	1	2	1	1
NY City	OSW	130	(216)	(396)	(397)	(139)	(215)	(214)	(214)	(280)	(302)	123	132	94	116	96	96
Long Island	OSW	(5,306)	(5,282)	(5,285)	(5,289)	(5,275)	(5,282)	(5,286)	(5,286)	(5,304)	(5,309)	(5,285)	(5,287)	(5,285)	(5,296)	(5,294)	(5,291)
	UPV	(181)	(180)	(179)	(180)	(180)	(179)	(181)	(181)	(181)	(181)	(180)	(180)	(180)	(181)	(181)	(181)

Figure 18: Policy Scenario 20-Year Zonal Curtailment Delta by Renewable Type (GWh)

Zone	Generation Type	T035 - LS Power	T036 - NextEra Core 1	T037 - NextEra Core 2	T038 - NextEra Core 3	T039 - NextEra Core 4	T040 - NextEra Core 5	T041 - NextEra Core 6	T042 - NextEra Core 7	T043 - NextEra Enh 1	T044 - NextEra Enh 2	T047 - Propel Base 1	T048 - Propel Base 2	T049 - Propel Base 3	T051 - Propel Alt 5	T052 - Propel Alt 6	T053 - Propel Alt 7
West	HYDRO	1,173	1,149	1,192	1,247	1,195	1,209	1,212	1,212	1,301	1,041	1,197	1,128	1,267	1,200	1,200	1,170
	LBW	252	307	324	327	294	328	298	298	354	457	250	244	265	271	300	293
	UPV	123	153	229	226	116	140	130	130	161	104	65	110	49	119	127	129
Genesee	HYDRO	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0
	LBW	96	108	108	96	144	112	104	104	125	145	88	83	101	110	117	110
	UPV	130	173	183	178	95	140	170	170	61	52	147	110	131	145	191	155
Central	HYDRO	55	61	59	64	66	59	59	59	55	50	62	53	61	61	62	60
	LBW	70	107	92	111	50	90	111	111	11	(199)	44	20	32	72	99	88
	UPV	517	539	518	473	486	516	560	560	453	321	574	459	552	544	570	514
North	HQ IMP	1,115	1,235	1,327	1,384	1,292	1,398	1,233	1,233	1,096	449	1,229	925	1,327	1,296	1,310	1,320
	HYDRO	808	850	803	908	858	901	882	882	745	413	798	702	814	858	889	928
	LBW	272	332	294	319	326	345	385	385	256	119	316	245	316	325	326	349
	UPV	109	89	68	78	140	88	102	102	82	34	89	68	95	94	92	95
Mohawk Valley	HYDRO	227	246	222	220	215	237	257	257	222	144	259	203	271	257	249	254
	LBW	1,413	1,509	1,502	1,632	1,589	1,556	1,593	1,593	1,582	1,370	1,427	1,020	1,429	1,530	1,578	1,594
	UPV	845	828	805	848	1,050	884	911	911	777	629	923	807	889	887	912	891
Capital	HYDRO	351	352	365	382	371	378	344	344	394	304	394	335	389	347	390	387
	LBW	693	723	688	780	731	769	778	778	750	721	655	469	678	764	772	769
	UPV	1,737	1,780	1,696	1,813	1,932	1,815	3,409	3,409	1,775	2,998	2,112	1,498	1,794	3,021	1,885	1,862
Hudson Valley	HYDRO	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	LBW	520	545	535	573	554	561	571	571	561	564	506	399	523	560	568	569
	UPV	192	194	181	191	202	198	176	176	211	193	185	167	197	182	209	208
NY City	OSW	262	289	292	306	310	298	315	315	306	285	262	177	272	304	299	307
Long Island	OSW	(27,439)	(29,042)	(28,799)	(30,494)	(30,326)	(30,083)	(30,467)	(30,467)	(31,531)	(31,534)	(29,227)	(25,419)	(29,453)	(30,640)	(30,681)	(30,305)
	UPV	(539)	(500)	(506)	(502)	(485)	(498)	(505)	(505)	(590)	(590)	(472)	(406)	(465)	(510)	(499)	(496)

Figure 19: Policy + B-VS Scenario 20-Year Zonal Curtailment Delta by Renewable Type (GWh)

Zone	Generation Type	T035 - LS Power	T036 - NextEra Core 1	T037 - NextEra Core 2	T038 - NextEra Core 3	T039 - NextEra Core 4	T040 - NextEra Core 5	T041 - NextEra Core 6	T042 - NextEra Core 7	T043 - NextEra Enh 1	T044 - NextEra Enh 2	T047 - Propel Base 1	T048 - Propel Base 2	T049 - Propel Base 3	T051 - Propel Alt 5	T052 - Propel Alt 6	T053 - Propel Alt 7
West	HYDRO	1,338	682	775	874	685	765	767	767	1,014	869	995	959	1,326	975	1,100	987
	LBW	293	210	239	202	244	220	217	217	318	433	249	243	310	276	278	273
	UPV	166	152	208	188	142	139	152	152	185	153	63	126	102	140	153	138
Genesee	HYDRO	0	1	0	0	1	0	1	1	0	0	0	0	0	(0)	1	0
	LBW	125	61	55	70	104	74	80	80	132	121	89	93	115	85	98	89
	UPV	259	122	187	187	65	158	160	160	138	106	176	183	226	172	231	196
Central	HYDRO	324	140	175	192	167	166	177	177	247	176	223	213	324	256	262	227
	LBW	392	137	294	166	(132)	229	8	8	(41)	(1,545)	(213)	(70)	(277)	(98)	20	63
	UPV	2,662	1,738	1,659	1,397	1,623	1,717	1,999	1,999	2,108	1,468	2,071	2,105	2,760	2,188	2,328	2,232
North	HQ IMP	1,707	433	467	567	454	489	446	446	1,037	(198)	840	714	1,597	847	966	939
	HYDRO	1,083	428	364	442	430	432	452	452	716	139	580	541	990	708	675	713
	LBW	406	172	108	114	165	146	211	211	276	(5)	240	123	402	236	224	240
	UPV	115	37	46	17	103	36	37	37	64	(3)	70	47	93	68	53	65
Mohawk Valley	HYDRO	313	114	110	121	111	117	138	138	212	96	222	191	332	211	222	219
	LBW	1,371	800	813	905	902	851	867	867	1,166	915	750	725	1,049	967	1,075	1,096
	UPV	932	592	671	649	778	711	698	698	876	584	792	644	935	838	776	825
Capital	HYDRO	447	191	199	221	207	220	184	184	356	222	301	268	443	278	312	312
	LBW	702	345	336	389	334	388	401	401	501	431	318	296	519	455	474	493
	UPV	1,845	1,052	1,089	1,217	1,224	1,163	2,757	2,757	1,465	2,696	1,552	1,156	1,638	2,603	1,500	1,476
Hudson Valley	HYDRO	4	2	2	2	2	2	2	2	3	2	2	2	3	2	2	2
	LBW	538	294	308	343	304	323	326	326	418	399	299	304	423	384	410	417
	UPV	202	117	110	129	121	132	106	106	166	155	120	125	175	128	166	166
NY City	OSW	253	106	100	116	116	121	130	130	182	192	117	92	196	167	161	170
Long Island	OSW	(55,377)	(20,185)	(21,363)	(23,601)	(22,123)	(21,799)	(23,254)	(23,254)	(41,403)	(34,029)	(34,728)	(31,337)	(54,330)	(38,354)	(38,326)	(37,727)
	UPV	(348)	(369)	(357)	(348)	(347)	(351)	(351)	(351)	(417)	(432)	(252)	(285)	(213)	(323)	(316)	(323)

SO_2 Emissions

Figure 20: Baseline Scenario SO_2 Emissions

20-Year Estimated SO_2 Emissions (1,000 Tons)				
Project	LI	NYC	NYCA	Regional
ase (Pre-Project)	2	1	10	10,693
T035 - LS Power	2	1	10	10,688
T036 - NextEra Core 1	2	1	10	10,684
T037 - NextEra Core 2	2	1	10	10,685
T038 - NextEra Core 3	2	1	10	10,689
T039 - NextEra Core 4	2	1	10	10,686
T040 - NextEra Core 5	2	1	10	10,683
T041 - NextEra Core 6	2	1	10	10,691
T042 - NextEra Core 7	2	1	10	10,691
T043 - NextEra Enh 1	2	1	10	10,696
T044 - NextEra Enh 2	2	1	10	10,691
T047 - Propel Base 1	2	1	10	10,687
T048 - Propel Base 2	2	1	10	10,690
T049 - Propel Base 3	2	1	10	10,685
T051 - Propel Alt 5	2	1	10	10,688
T052 - Propel Alt 6	2	1	10	10,688
T053 - Propel Alt 7	2	1	10	10,684

Figure 21: Policy Scenario SO_2 Emissions

20-Year Estimated SO_2 Emissions (1,000 Tons)				
Case	LI	NYC	NYCA	Regional
Policy Case (Pre-Project)	1	0	5	10,676
T035 - LS Power	1	0	5	10,659
T036 - NextEra Core 1	1	0	5	10,653
T037 - NextEra Core 2	1	0	5	10,652
T038 - NextEra Core 3	1	0	5	10,654
T039 - NextEra Core 4	1	0	5	10,653
T040 - NextEra Core 5	1	0	5	10,659
T041 - NextEra Core 6	1	0	5	10,652
T042 - NextEra Core 7	1	0	5	10,652
T043 - NextEra Enh 1	1	0	5	10,653
T044 - NextEra Enh 2	1	0	5	10,662
T047 - Propel Base 1	1	0	5	10,648
T048 - Propel Base 2	1	0	5	10,659
T049 - Propel Base 3	1	0	5	10,648
T051 - Propel Alt 5	1	0	5	10,657
T052 - Propel Alt 6	1	0	5	10,655
T053 - Propel Alt 7	1	0	5	10,661

Figure 22: Policy + B-VS Scenario SO_2 Emissions

20-Year Estimated SO_2 Emissions (1,000 Tons)				
Case	LI	NYC	NYCA	Regional
Policy Case: Barrett - VS	1	0	5	10,678
T035 - LS Power	1	0	5	10,659
T036 - NextEra Core 1	1	0	5	10,659
T037 - NextEra Core 2	1	0	5	10,655
T038 - NextEra Core 3	1	0	5	10,660
T039 - NextEra Core 4	1	0	5	10,656
T040 - NextEra Core 5	1	0	5	10,663
T041 - NextEra Core 6	1	0	5	10,652
T042 - NextEra Core 7	1	0	5	10,652
T043 - NextEra Enh 1	1	0	5	10,658
T044 - NextEra Enh 2	1	0	5	10,664
T047 - Propel Base 1	1	0	5	10,647
T048 - Propel Base 2	1	0	5	10,661
T049 - Propel Base 3	1	0	5	10,649
T051 - Propel Alt 5	1	0	5	10,663
T052 - Propel Alt 6	1	0	5	10,660
T053 - Propel Alt 7	1	0	5	10,661

NO_x Emissions

Figure 23: Baseline Scenario NO_x Emissions

20-Year Estimated NO_x Emissions (1,000 Tons)				
Project	LI	NYC	NYCA	Regional
Baseline Case (Pre-Project)	48	42	182	6,741
T035 - LS Power	46	43	183	6,742
T036 - NextEra Core 1	46	43	182	6,741
T037 - NextEra Core 2	46	43	182	6,740
T038 - NextEra Core 3	46	43	182	6,741
T039 - NextEra Core 4	46	46	183	6,741
T040 - NextEra Core 5	46	44	182	6,739
T041 - NextEra Core 6	46	43	182	6,742
T042 - NextEra Core 7	46	43	182	6,742
T043 - NextEra Enh 1	46	44	182	6,743
T044 - NextEra Enh 2	46	45	182	6,742
T047 - Propel Base 1	46	43	182	6,741
T048 - Propel Base 2	46	44	183	6,740
T049 - Propel Base 3	46	44	183	6,740
T051 - Propel Alt 5	46	44	183	6,740
T052 - Propel Alt 6	46	44	182	6,740
T053 - Propel Alt 7	46	44	183	6,740

Figure 24: Policy Scenario NO_x Emissions

20-Year Estimated NO_x Emissions (1,000 Tons)				
Case	LI	NYC	NYCA	Regional
Policy Case (Pre-Project)	22	7	61	6,681
T035 - LS Power	21	7	60	6,680
T036 - NextEra Core 1	21	7	60	6,680
T037 - NextEra Core 2	21	7	60	6,680
T038 - NextEra Core 3	21	7	60	6,681
T039 - NextEra Core 4	21	7	60	6,678
T040 - NextEra Core 5	21	7	60	6,681
T041 - NextEra Core 6	21	7	60	6,680
T042 - NextEra Core 7	21	7	60	6,680
T043 - NextEra Enh 1	21	7	60	6,679
T044 - NextEra Enh 2	21	7	60	6,679
T047 - Propel Base 1	21	7	60	6,675
T048 - Propel Base 2	21	7	60	6,680
T049 - Propel Base 3	21	7	60	6,675
T051 - Propel Alt 5	21	7	60	6,681
T052 - Propel Alt 6	21	7	60	6,680
T053 - Propel Alt 7	21	7	60	6,680

Figure 25: Policy + B-VS Scenario NO_x Emissions

20-Year Estimated NO_x Emissions (1,000 Tons)				
Case	LI	NYC	NYCA	Regional
Policy Case: Barrett - VS	22	7	61	6,684
T035 - LS Power	21	7	60	6,680
T036 - NextEra Core 1	21	7	60	6,684
T037 - NextEra Core 2	21	7	60	6,682
T038 - NextEra Core 3	21	7	60	6,683
T039 - NextEra Core 4	21	7	60	6,680
T040 - NextEra Core 5	21	7	60	6,684
T041 - NextEra Core 6	21	7	60	6,682
T042 - NextEra Core 7	21	7	60	6,682
T043 - NextEra Enh 1	21	7	60	6,680
T044 - NextEra Enh 2	21	7	60	6,681
T047 - Propel Base 1	21	7	60	6,677
T048 - Propel Base 2	21	7	60	6,680
T049 - Propel Base 3	21	7	60	6,676
T051 - Propel Alt 5	21	7	60	6,682
T052 - Propel Alt 6	21	7	60	6,681
T053 - Propel Alt 7	21	7	60	6,682

Transmission Constraint Summary

Figure 26: Baseline Scenario 2040 Long Island Constraints

Contingency Name	Limiting Line	Limiting Hours
PAR,NRTHPT1 -NRTHPT P - 1	NORTHPORT P 138 - NORTHPORT1 138	3,970
P5_EGC_138_M - VLYSTRM	SPRAINBROOK 345 - EAST GARDEN CITY 345 1	2,684
P5_EGC_138_M	DUNWOODIE 345 - SHORE ROAD 345 1	2,401
E.G.C. 138 NEWBRGE 138 1	DUNWOODIE 345 - SHORE ROAD 345 1	1,775
DUNWODIE 345 SHORE_RD 345 1	EAST GARDEN CITY 138 - NEWBRIDGE 138 1	1,172
SB:SPRA345_RN2	VALLEY STREAM 138 - VALLEY STREAM P 138	1,074
2-TRIPS,CARLA PL-E.G.C. - 1	CARLE PLACE 138 - EAST GARDEN CITY 138	1,044
P5_EGC_138_M - NEWBRG 69	JAMAICA 138.00-VALLEY STREAM P 138.00	963
1-TRIPS,CARLA PL-E.G.C. - 1	CARLE PLACE 138 - EAST GARDEN CITY 138	689
2-TRIPS,CARLE PL-E.G.C. - 1	CARLE PLACE 138 - EAST GARDEN CITY 138	645
24 :EGC 1360 - CARLEGC	CARLE PLACE 138 - EAST GARDEN CITY 138	589
SPRNBRK 345 EGRDNCTR 345 1	NEWBRIDGE 138 - NEWBRIDGE2 69	385
3-TRIPS,HOLBROOK-HOLBRK2 - 2	HOLBROOK 138 - HOLBROOK2 69	99

Figure 27: Policy Scenario 2040 Long Island Constraints

Contingency Name	Limiting Line	Limiting Hours
1-TRIPS,CARLA PL-E.G.C. - 1	SPRAINBROOK 345 - EAST GARDEN CITY 345 1	5,034
T-BUS,VLY S-E.G.	CARLE PLACE 138 - EAST GARDEN CITY 138	3,389
SPRNBRK 345 EGRDNCTR 345 1	VALLEY STREAM 138 - EAST GARDEN CITY 138	2,699
3-TRIPS,HOLBAOOK-HOLBRK2 - 2	HOLBROOK 138 - HOLBROOK2 69	2,252
7-TRIPS,KINGS -PILGRIM - 1	NORTHPORT P 138 - NORTHPORT1 138	1,618
3-TRIPS,PT JEFF1-PT JEFF3- 1	PILGRM P 138 - HAUPAGUE 138	1,573
6-TRIPS,RULND RD-STERLING- 1	DUNWOODIE 345 - SHORE ROAD 345 1	1,477
NNC L/O 398	RULAND ROAD 138 - STERLING 138	688
871 L/O T:881&882	PORT JEFFERSON1 138 - PORT JEFFERSON3 138	594
DUNWODIE 345 SHORE_RD 345 1	KINGS 138 - PILGRIM 138	121

Figure 28: Policy + B-VS Scenario 2040 Long Island Constraints

Contingency Name	Limiting Line	Limiting Hours
1-TRIPS,CARLA PL-E.G.C. - 1	BARRETT2 138 - VALLEY STREAM 138	5,223
1-TRIPS,BARRETT2-VLY STRM- 2	SPRAINBROOK 345 - EAST GARDEN CITY 345 1	4,638
T-BUS,VLY S-E.G.	CARLE PLACE 138 - EAST GARDEN CITY 138	2,908
3-TRIPS,HOLBAOOK-HOLBRK2 - 2	VALLEY STREAM 138 - EAST GARDEN CITY-2 138	2,811
SPRNBRK 345 EGRDNCTR 345 1	NORTHPORT1 138 - NORTHPORT2 138	2,219
98 :HOL 1370	HOLBROOK 138 - HOLBROOK2 69	2,194
7-TRIPS,KINGS -PILGRIM - 1	NORTHPORT P 138 - NORTHPORT1 138	1,617
3-TRIPS,PT JEFF1-PT JEFF3- 1	DUNWOODIE 345 - SHORE ROAD 345 1	1,413
NNC L/O 398	LAKE SUCCESS 138 - SHORE ROAD 138	1,367
871 L/O T:881&882	PILGRM P 138 - HAUPAGUE 138	1,290
3-TRIPS,HOLBROOK-HOLBRK2 - 2	DUNWOODIE 345 - SHORE ROAD 345 1	1,128
6-TRIPS,RULND RD-STERLING- 1	RULAND ROAD 138 - STERLING 138	726
1-TRIPS,L SUCS -SHORE RD- 1	PORT JEFFERSON1 138 - PORT JEFFERSON3 138	598
80 :RUL 1410	HOLBROOK 138.00-HOLBRK2 69.00	516
DUNWODIE 345 SHORE_RD 345 1	KINGS 138 - PILGRIM 138	405
SB:SPRA345_RN2	HOLBROOK 138 - HOLBROOK2 69	239
1-TRIPS,NRTHPRT1-NRTHPRT2- 1	KINGS 138 - PILGRIM 138	119

Long Island Net-Load Variability Sensitivity

As offshore wind generation projects are constructed in Long Island, the need to maintain flexible resources to balance minute-to-minute energy variability in the area will increase. Variability can come from several sources such as real-time changes in electrical demand, and output of both behind-the-meter and utility-scale solar photovoltaic resources connected to the Long Island system. In today's system, any unforeseen generation resource availability in Long Island is accommodated through a combination of reserves and a transmission constraint margin. Long Island does not currently have a specific regulation or spinning reserve requirement but shares a multi-zonal requirement with other NYISO zones.

To calculate transmission security margins for use in this sensitivity, the NYISO performed a statistical analysis using the hourly offshore wind, solar, and load patterns from the production cost models. Assuming a normal distribution, the statistical probability of exceedance values of hour-to-hour changes in net load (load minus solar minus wind), which are used to set the Long Island transmission constraint margin, are shown in the table below.

Figure 29: Long Island Constraint Reliability Margin Calculation Results

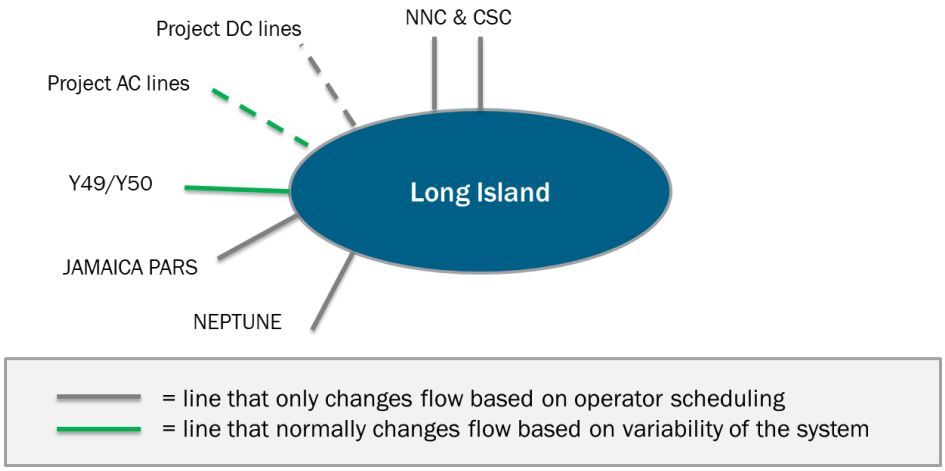
	LI Reliability Margin (MW)		
Year	P90	P95	P99
2030	314	407	614
2035	417	544	788
2040	623	815	1,228
2045	664	864	1,289

To estimate the impact of the reliability margin on the proposed projects, the P95 value was modeled in the Policy + B-VS Scenario in both the pre-project case and for each of the top-tier projects. Its important note that production cost simulations are performed with "all lines in-service" and do not capture pre-contingency outages. If a transmission outage on a Long Island tie line were to be modeled pre-contingency, both offshore wind curtailment and project production cost savings would increase.

The margin value was divided by the number of transmission ties between Long Island and other areas that can support variability. This value is then subtracted from the thermal limit of each line. In the pre-project case, there are only two tie-lines that can support variability in Long Island, which are the Y49 and Y50 transmission lines. Proposed projects add between zero and three new tie lines that can support variable flows. The diagram below conceptually shows current

and proposed tie lines.

Figure 30: Long Island Tie-Line Diagram



Results from the Policy + B-VS Scenario production cost simulations modeling the P95 reliability margins are shows in the tables below.

Figure 31: Long Island Offshore Wind Curtailment in Variability Sensitivity

	LI OSW Curtailment (2040)	
Project	Policy + Barrett-VS	Policy + B-VS P95
Pre-Project	15.8%	18.8%
T035 - LS Power	1.6%	1.8%
T036 - NextEra Core 1	8.0%	8.0%
T040 - NextEra Core 5	7.7%	7.6%
T048 - Propel Base 2	6.3%	8.0%
T049 - Propel Base 3	2.3%	3.7%
T051 - Propel Alt 5	4.5%	4.6%
T052 - Propel Alt 6	4.2%	4.2%

Figure 32: Production Cost Savings in Variability Sensitivity

	20-Year Production Cost Savings (2022 $M)	
Project	Policy + Barrett-VS	Policy + B-VS P95
T035 - LS Power	$906	$1,227
T036 - NextEra Core 1	$291	$634
T040 - NextEra Core 5	$332	$680
T048 - Propel Base 2	$513	$817
T049 - Propel Base 3	$902	$1,225
T051 - Propel Alt 5	$609	$956
T052 - Propel Alt 6	$618	$963