

Appendix N: Avoided Cost Assessment

Long Island Offshore Wind Export Public Policy Transmission Planning Report

**A Report from the New York
Independent System Operator**

DRAFT for May 31, 2023, MC

DRAFT – FOR DISCUSSION PURPOSES ONLY

Appendix N: Avoided Cost Assessment

Overview of Methodology

All of the proposed Long Island PPTN transmission projects increase import and export capability of Long Island that facilitate better utilization of electric supply to meet demand across NYCA. This reduces the expected capacity of new emission-free generation projects needed to meet State policy. To measure the economic impact of this phenomenon, the NYISO has implemented a new assessment in the capacity benefit metric calculations. The avoided capital cost assessment measures the reduction in the capital cost of emission-free generation required to build future resources through 2040. This assessment reflects the benefits from the additional transmission expansion to, among other things, potentially reduce the necessary Renewable Energy Contracts (RECs) procurement by NYSERDA to meet the state energy policy and subsequently decrease the overall cost to New York ratepayers.

The NYISO leveraged a capacity expansion model that is designed to optimize future system buildout while adhering to demand and policy requirements. This analysis was conducted for both the Policy and Policy + B-VS Scenarios for a set of projects that necessitated additional evaluation to distinguish their economic benefits to the transmission system.

Methodology

- Update transfer limits associated with each transmission project
- Offshore wind energy profiles, which are consistent with outputs from production cost simulations, model the “un-curtailed” offshore wind energy associated with the addition of each transmission project
- Increased transfer capability of each transmission project is translated to a reduction in the Zone K capacity reserve requirement
- Perform capacity expansion simulations for both pre- and post-project cases

Evaluation

- Measure the change in generation buildout costs driven by a transmission project’s ability to (1) reduce offshore wind energy curtailment and (2) increase transfer capability to/from Long Island

The results from this assessment can be combined with the production cost metric to develop a holistic comparison of proposed transmission projects economic benefits.

Detailed Assumptions

The proposed transmission projects are represented in the capacity expansion model through: 1) an increase in offshore wind production due to reduced curtailment identified in the production cost models,

2) interzonal transfer limit changes, and 3) Zone K capacity reserve margin decreases driven by increase in transmission security limits. Consistent with production cost simulations, the NYISO used model year 2030 as the estimated in-service date for the proposed transmission projects.

Modeling Offshore Wind Curtailment Reduction in Avoided Cost Assessment

As identified in the **Production Cost** and **Performance** metrics, all proposed projects are effective at reducing offshore wind curtailment levels and unbottling offshore wind resources interconnected to Long Island. To model the impact that the proposed projects have on offshore wind generation, the offshore wind energy outputs from the production cost simulations were used as inputs to the capacity expansion model for the avoided cost assessment starting at the estimated in-service date. Hourly outputs from each offshore wind plant were extracted for both the pre- and post-project cases from the production cost simulations and provided as fixed profiles for the capacity expansion model. Since production cost simulations were run at 5-year intervals (2030, 2035, 2040, and 2045), offshore wind outputs were assumed constant for the in between years for the capacity expansion simulations. For instance, the offshore wind profiles for 2035 were assumed in the capacity expansion model for years 2035-2039. As compared to the pre-project case, each proposed transmission project assumes a higher energy contribution from offshore wind generators due to the reduction in curtailment levels from the production cost simulations.

The figure below summarizes the annual Long Island offshore wind curtailed energy for both the pre-project and post-project scenarios for a set of projects that necessitated additional evaluation to distinguish their economic benefits to the transmission system. Both the Policy and Policy + B-VS Scenarios were evaluated with the Policy + B-VS Scenario having higher offshore wind energy curtailment due to the inclusion of the Barrett – Valley Stream transmission constraints.

Figure 1: Annual Long Island Offshore Wind Curtailment Energy (MWh)

Project	Policy Scenario Annual OSW Curtailment (MWh)			Policy +B-VS Scenario Annual OSW Curtailment (MWh)		
	2030	2035	2040	2030	2035	2040
Pre-Project	173	538	3,131	2,440	2,358	3,823
T035 - LS Power	48	9	383	47	10	387
T036 - NextEra Core 1	103	20	206	2,057	1,910	2,001
T040 - NextEra Core 5	103	22	85	2,031	1,857	1,854
T048 - Propel Base 2	95	18	651	1,389	1,252	1,530
T049 - Propel Base 3	95	16	209	104	26	551
T051 - Propel Alt 5	76	14	52	1,134	1,002	1,079
T052 - Propel Alt 6	84	14	53	1,245	1,092	1,001

Modeling Interzonal Transfer Limits

For each analyzed project, new connections between zones are modeled as new “pipes” in the pipe-and-bubble capacity expansion model. Consequently, the Long Island export interface limit was also upgraded after conducting linear N-1 thermal transfer limit analysis, which accounted for the new pipes between zones.

Figure 2: Long Island “Pipe” Limits Under N-1 Conditions (MW)

Project	Interface Limit		Interface Limit Increase	
	Export (MW)	Import (MW)	Export (MW)	Import (MW)
Pre-Project	1,081	1,644	-	-
T035 - LSPower	3,910	3,505	2,829	1,861
T036 - NextEra Core 1	2,904	3,510	1,823	1,866
T040 - NextEra Core 5	3,238	4,410	2,157	2,766
T048 - Propel Base 2	2,609	2,478	1,528	834
T049 - Propel Base 3	2,595	2,484	1,514	840
T051 - Propel Alt 5	3,309	2,825	2,228	1,181
T052 - Propel Alt 6	3,685	3,164	2,604	1,520

Calculation of LCRs for Avoided Cost Assessment

The purpose of considering capacity reserve margin changes for Zone K in the avoided cost analysis is to estimate potential benefits from improved import capabilities into Zone K. In NYISO’s Locational Minimum Installed Capacity Requirements (LCR) determination process, Transmission Security Limit Floors (TSL Floors), representing the low bound for LCRs, are implemented for all Localities. For purposes of the avoided costs analysis, the NYISO leveraged the methodology of the TSL Floors to approximate the reduction in the Zone K LCR for each of the projects analyzed due to increased import capability. The TSL Floor methodology used for the LCR process would produce the TSL Floors in the ICAP terms. However, since the Avoided Cost Assessment models LCRs in terms of UCAP requirement, the TSL Floor methodology is modified in this assessment to produce the UCAP requirement floors. The Bulk Power Transmission Limit for Long Island as part of this modified TSL Floor calculation was assumed to increase by the incremental import capability for each proposed project under the most limiting N-1-1 contingency conditions as compared to the pre-project case.

The LCRs utilized in NYISO markets are presently determined by the LCR optimizer, based on assumptions and inputs that reflect future system and market conditions. As noted in the **Capacity Benefits** metric, the LCR results are very sensitive to these assumptions and making these assumptions for the 20-year study timeframe would be speculative. Additionally, the actual Zone K LCR can be

impacted by the LCRs of the other Localities. Therefore, for the purpose of the avoided cost analysis in this comparative evaluation, the NYISO considers that it is reasonable to assume that changes in the Zone K LCRs are based on the changes in the modified TSL Floor for Zone K. Figures 3 and 4 show the inputs used in calculating the Zone K LCRs in the avoided costs analysis for purposes of this evaluation. Figure 5 shows the modified TSL Floors calculation used to determine changes in the Zone K LCR assumed in this evaluation for model year 2030. This modified TSL Floor calculation methodology is consistent with the one used for the LCRs for the 2023-2024 Capability Year.

Figure 3: Import Transfer Limit Under N-1-1 Conditions (MW)

Project	Policy Scenario	Policy + B-VS Scenario
Pre-Project	1,005	1,005
T035 - LSPower	2,740	2,080
T036 - NextEra Core 1	3,055	2,950
T040 - NextEra Core 5	3,105	3,075
T048 - Propel Base 2	2,455	2,180
T049 - Propel Base 3	2,325	2,325
T051 - Propel Alt 5	3,145	3,145
T052 - Propel Alt 6	3,255	3,255

Figure 4: Pre-Project Modified TSL Floor Calculation¹

Modified Transmission Security Limit Floor Calculation	Formula	Long Island (Zone K)
Load Forecast (MW)	[A] = Given	5,133 ²
Bulk Power Transmission Limit (MW)	[B] = Studied	325 ³
UCAP Requirement (MW)	[C] = [A]-[B]	4,808
SCR UCAP (MW)	[D]	33.7
UCAP Requirement Floor (%)	[E] = [C+D]/[A]	94.3%

¹ <https://www.nyiso.com/documents/20142/35886565/2023-LCR-Report.pdf/>

² Forecasted load values consistent with Policy Case Scenario 2 from 2021-2040 System and Resource Outlook

³ Bulk power transmission limits are calculated using N-1-1 import capability minus Neptune's import capability. Post-project limits were assumed to increase by the incremental import capability for each project under the most limiting N-1-1 contingency conditions as compared to the pre-project case.

Figure 5: Model Year 2030 LCR (%UCAP Equivalent) Assumed In Assessment

Project	Policy Scenario	Policy + B-VS Scenario
Pre-Project	94%	94%
T035 - LSPower	58%	72%
T036 - NextEra Core 1	51%	54%
T040 - NextEra Core 5	50%	50%
T048 - Propel Base 2	64%	70%
T049 - Propel Base 3	67%	67%
T051 - Propel Alt 5	49%	49%
T052 - Propel Alt 6	47%	47%

*Assumed LCRs are representative based on model assumptions described above and cannot be relied upon for future estimation of LCRs.

Summary of Assumptions

The offshore wind energy curtailment reduction (TWh), Transmission Security Limit increase (MW), and Zone K export capability increase assumptions used for the projects analyzed are included below for the Policy and Policy + B-VS Scenarios.

Figure 6: Avoided Cost Assessment Project Assumption Summary – Policy Scenario

Project	Approximated 20-Year Offshore Wind Curtailment Reduction (TWh)	Zone K Export Capability Increase (MW)	Zone K Bulk Power Transmission Limit Increase (MW)
T035 - LSPower	6.0	2,829	2,015
T036 - NextEra Core 1	5.8	1,823	2,330
T040 - NextEra Core 5	6.0	2,157	2,380
T048 - Propel Base 2	5.5	1,528	1,730
T049 - Propel Base 3	5.9	1,514	1,600
T051 - Propel Alt 5	6.2	2,228	2,420
T052 - Propel Alt 6	6.1	2,604	2,530

Figure 7: Avoided Cost Assessment Project Assumption Summary – Policy + B-VS Scenario

Project	Approximated 20-Year Offshore Wind Curtailment Reduction (TWh)	Zone K Export Capability Increase (MW)	Zone K Bulk Power Transmission Limit Increase (MW)
T035 - LSPower	27.1	2,829	1,355
T036 - NextEra Core 1	6.0	1,823	2,225
T040 - NextEra Core 5	6.5	2,157	2,380
T048 - Propel Base 2	13.1	1,528	1,455
T049 - Propel Base 3	26.6	1,514	1,600
T051 - Propel Alt 5	16.0	2,228	2,420
T052 - Propel Alt 6	15.1	2,604	2,530

Simulation Results

With the proper representation of each transmission project in place, the capacity expansion model simulation was performed up to 2040, and results were compiled. The analysis identified a few common trends that describe the impact of the evaluated transmission projects' impact on future generation buildout to meet system needs.

- All projects reduce the amount of upstate solar capacity needed due to the reduction in Long Island offshore wind energy curtailment. The increased energy associated with reduced curtailment allowed energy demand and renewable policy targets to be met with less renewable generation projects.
- All projects improved the transmission connections between Upstate and Downstate New York areas and increased the power transfer capability between the regions. With increased transmission limits to Long Island, the Zone K capacity reserve margin requirement is reduced and the capacity needed to meet statewide reliability requirements can then be relocated to more cost-effective geographic areas.

Each evaluated transmission project provided different magnitudes of benefits but were generally produced by the same system impacts as described. The analysis revealed that the specific designs of the transmission project affect how much savings can be achieved.

Offshore Wind Curtailment Reduction Impacts

As each proposed transmission project increases the electrical connectivity between Long Island and other areas in New York, more offshore wind energy can be injected into the NYCA. Increased offshore wind energy production due to the addition of a transmission project displaced the need for as much solar generation capacity and its production in several upstate zones as compared to the pre-project case. The figures below highlight the reduction in solar capacity due to the addition of each project evaluated in the Policy and Policy + B-VS Scenarios.

Figure 8: Policy Scenario: 2040 Solar (UPV) Installed Capacity Delta to Pre-Project

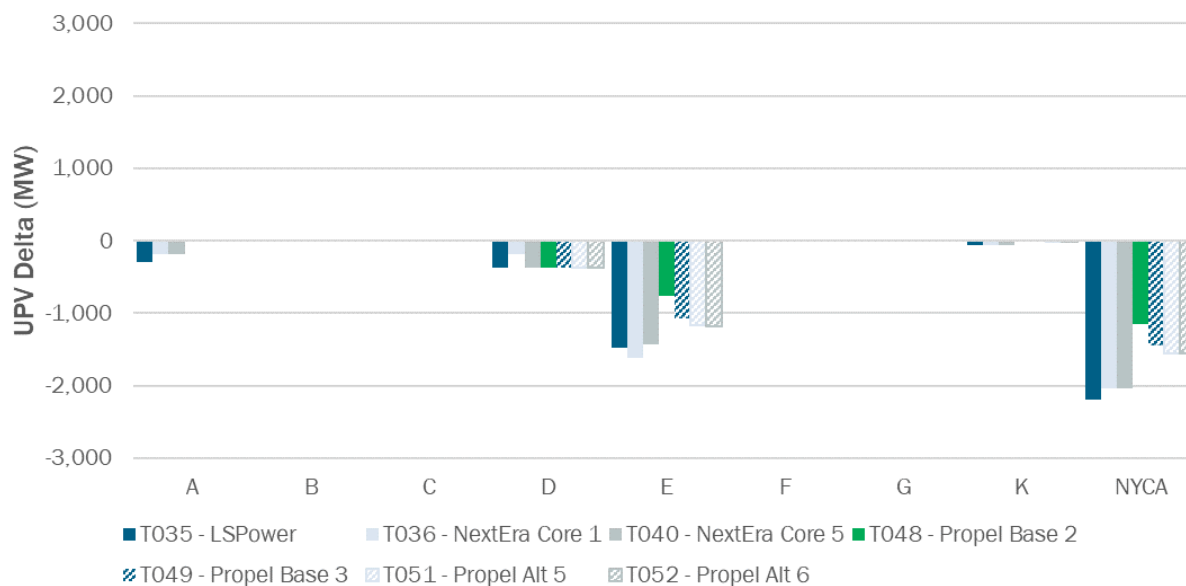


Figure 9: Policy + B-VS Scenario: 2040 Solar (UPV) Installed Capacity Delta to Pre-Project

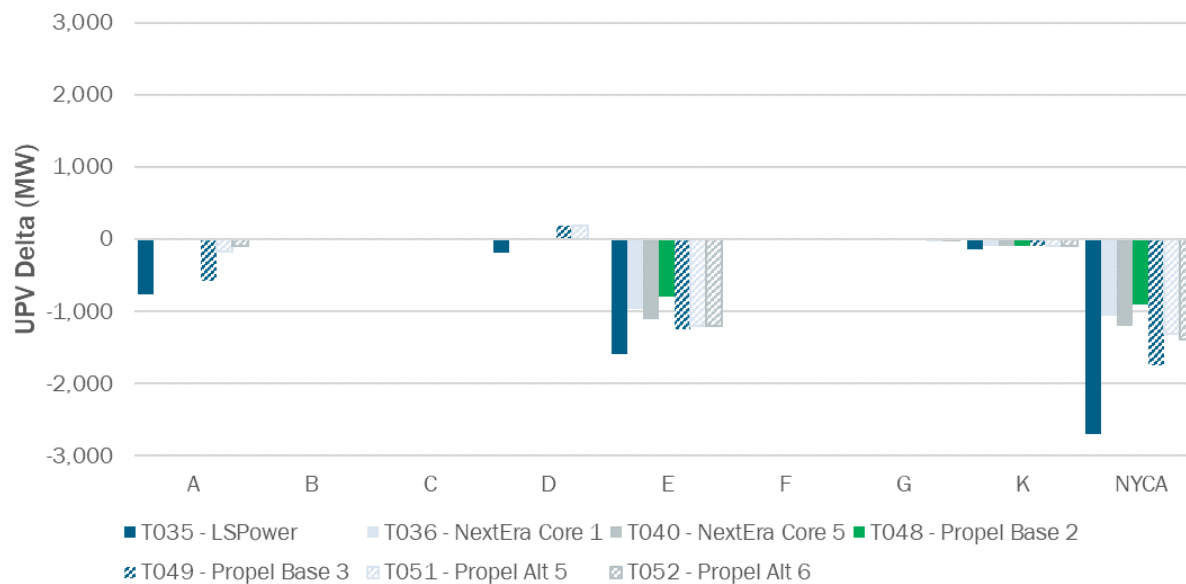


Figure 10: Policy Scenario: 2040 UPV Installed Capacity Delta to Pre-Project (MW)

Project	A	B	C	D	E	F	G	K	NYCA
T035 - LSPower	-292	0	0	-373	-1,471	0	0	-54	-2,190
T036 - NextEra Core 1	-183	0	0	-186	-1,609	0	0	-54	-2,031
T040 - NextEra Core 5	-182	0	0	-373	-1,422	0	0	-54	-2,030
T048 - Propel Base 2	0	0	0	-373	-763	0	0	-7	-1,142
T049 - Propel Base 3	0	0	0	-373	-1,069	0	0	-7	-1,448
T051 - Propel Alt 5	0	0	0	-373	-1,171	0	0	-7	-1,551
T052 - Propel Alt 6	0	0	0	-373	-1,177	0	0	-7	-1,556

Figure 11: Policy + B-VS Scenario: 2040 UPV Installed Capacity Delta to Pre-Project (MW)

Project	A	B	C	D	E	F	G	K	NYCA
T035 - LSPower	-773	0	0	-186	-1,592	0	-10	-141	-2,702
T036 - NextEra Core 1	0	0	0	0	-964	0	0	-94	-1,058
T040 - NextEra Core 5	0	0	0	0	-1,102	0	0	-94	-1,196
T048 - Propel Base 2	0	0	0	0	-804	0	-10	-94	-907
T049 - Propel Base 3	-578	0	0	186	-1,256	0	-10	-94	-1,751
T051 - Propel Alt 5	-181	0	0	186	-1,208	0	-10	-94	-1,306
T052 - Propel Alt 6	-89	0	0	0	-1,198	0	-10	-94	-1,390

Several of the proposed projects reduce annual offshore wind curtailment in 2040 by over 3 TWh. Assuming a 40% annual capacity factor for offshore wind and 20% for solar, this equates to approximately a 1,700 MW equivalent reduction in solar capacity. The charts above show results from the fully optimized capacity expansion model where the proposed projects displace between 0.9 – 2.7 GW UPV capacity NYCA wide by 2040. Generally, the results from the model align with the simple calculation provided given the reduced curtailment provided by each project. For each project, the majority of solar capacity displaced is in Zones A, D, and E.

Long Island Import Capability Increase Impact

Complementary to the reduction of curtailment benefits, the increased import transfer limits from the proposed projects also increase the free exchange of energy to Long Island from other NYCA zones. This allows for a reduction in the amount of generation capacity needed to be geographically located on Long Island to meet reliability requirements. As a result, emission-free generation capacity (e.g., Dispatchable Emission Free Resources) can be more cost-effectively constructed in New York areas outside of Long Island, and this produces a capital cost savings.

The figures below show the magnitude of Dispatchable Emission Free Resource (DEFER) capacity movement from Long Island to upstate zones produced by the set of proposed projects evaluated in the

avoided cost assessment.

Figure 12: Policy Scenario: 2040 DEFR Installed Capacity Delta to Pre-Project

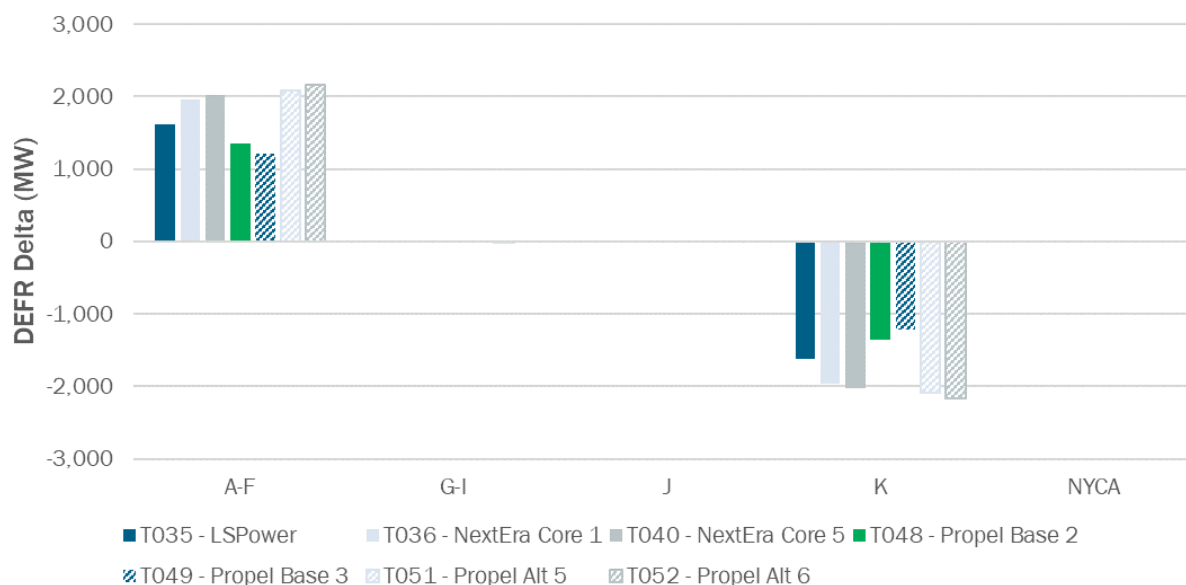


Figure 13: Policy + B-VS Scenario: 2040 DEFR Installed Capacity Delta to Pre-Project

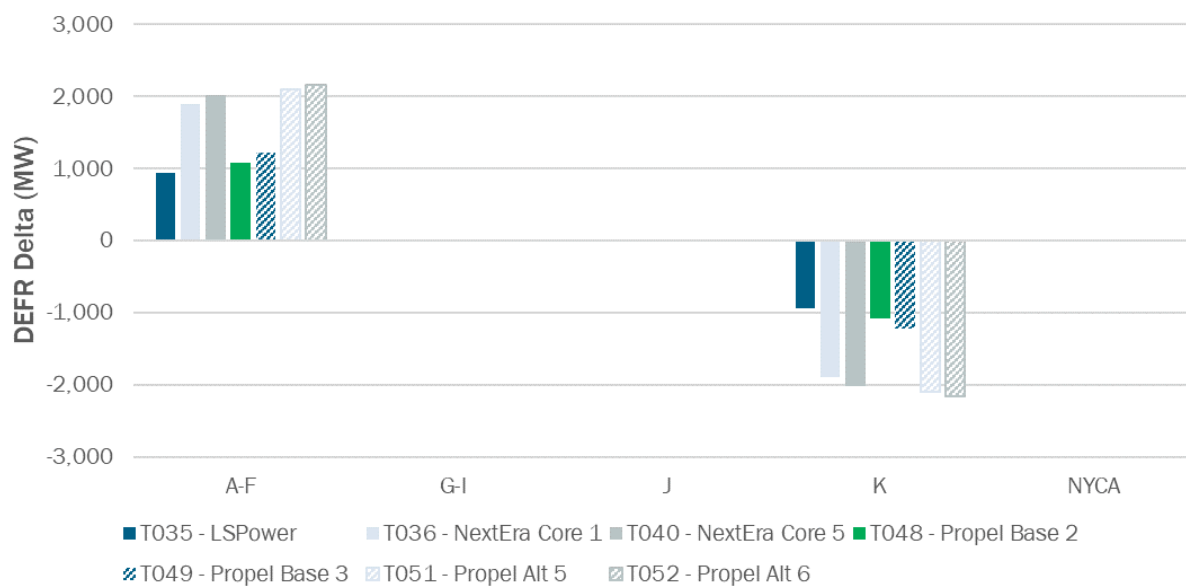


Figure 14: Policy Scenario: 2040 DEFR Installed Capacity Delta to Pre-Project (MW)

Project	A-F	G-I	J	K	NYCA
T035 - LSPower	1,618	0	0	-1,618	0
T036 - NextEra Core 1	1,955	0	0	-1,955	0
T040 - NextEra Core 5	2,023	0	0	-2,023	0
T048 - Propel Base 2	1,349	0	0	-1,349	0
T049 - Propel Base 3	1,214	0	0	-1,214	0
T051 - Propel Alt 5	2,090	0	0	-2,090	0
T052 - Propel Alt 6	2,158	0	0	-2,158	0

Figure 15: Policy + B-VS Scenario: 2040 DEFR Installed Capacity Delta to Pre-Project (MW)

Project	A-F	G-I	J	K	NYCA
T035 - LSPower	944	0	0	-944	0
T036 - NextEra Core 1	1,888	0	0	-1,888	0
T040 - NextEra Core 5	2,023	0	0	-2,023	0
T048 - Propel Base 2	1,079	0	0	-1,079	0
T049 - Propel Base 3	1,214	0	0	-1,214	0
T051 - Propel Alt 5	2,090	0	0	-2,090	0
T052 - Propel Alt 6	2,158	0	0	-2,158	0

The proposed projects displace between 0.9 – 2.2 GW of DEFR capacity in Zone K and shift that capacity to upstate zones (A-F) to satisfy the NYCA capacity reserve margin. The DEFR capacity is shifted to upstate zones where it is more cost-effective to build generation.

Avoided Capital Cost Results

The two primary factors driving the magnitude of avoided generation capacity are reduced offshore wind energy curtailments and the increased Zone K import transmission limits. Unbottled offshore wind energy reduces the need to build as much solar capacity in upstate zones and, in turn, provides avoided capital cost savings. Increased import transfer limits into Long Island lower the zone's effective capacity margin requirement and enable the movement of DEFR capacity from Zone K to upstate zones where capital costs are lower.

The magnitude of the capital cost savings for each proposed project is generally correlated with the amount of increase in Zone K import capability and reduction in offshore wind energy curtailment. Some secondary factors, such as which zone a project's new lines are connected and the project's increase in Zone K export limit, impact the capital cost savings and could also be used to differentiate the projects.

The figures below show the results of the avoided cost⁴ analysis with disaggregated impacts of

⁴ Generator capital costs align with assumptions for Policy Case Scenario 2 from the *2021-2040 System and Resource Outlook*
<https://www.nyiso.com/documents/20142/33395392/2021-2040-Outlook-Appendix-D.pdf>

reduced solar capacity buildout and relocated DEFR capacity for the two scenarios modeled.

Figure 16: Policy Scenario Total Capital Cost Savings

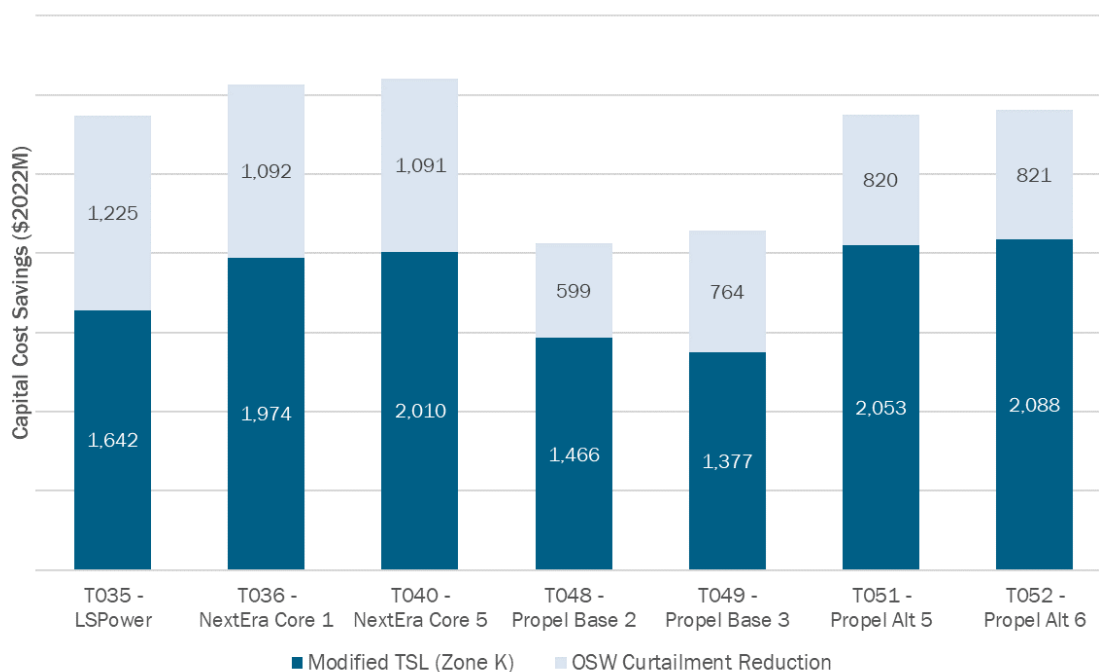
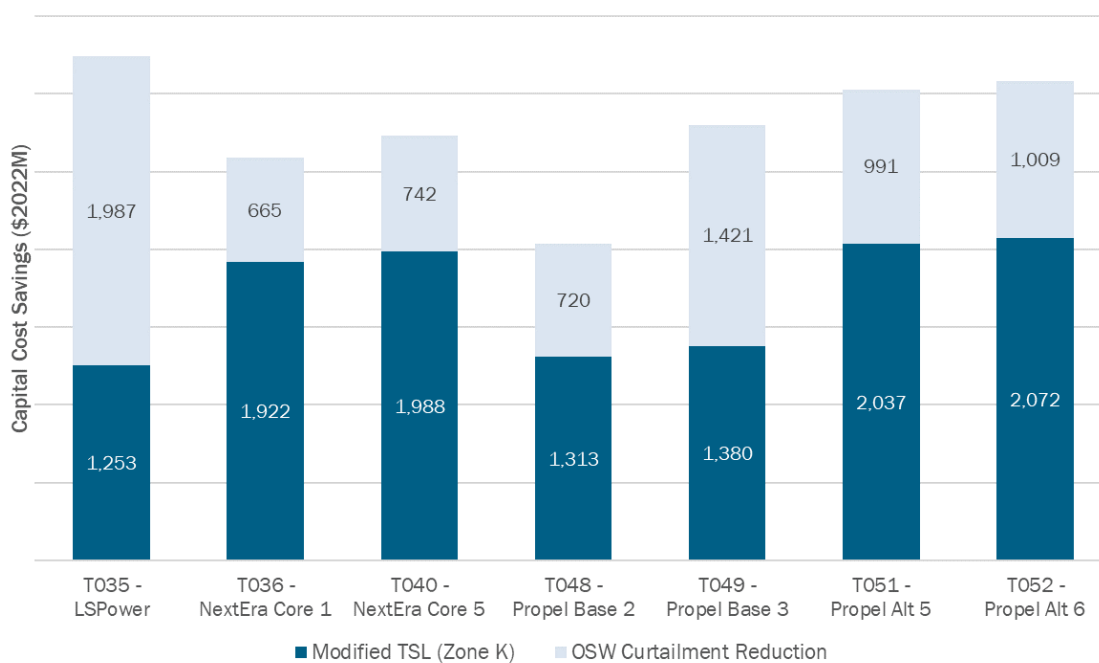


Figure 17: Policy + B-VS Scenario Total Capital Cost Savings



All projects analyzed create capital cost savings through the reduction in upstate solar capacity

additions. The avoided solar capacity represented less than half of the total capital cost savings calculated. Additionally, all projects analyzed in this assessment helped to increase the Long Island transmission security limit and reduced the capacity reserve margin for Long Island (per methodology described above). With a reduced capacity reserve margin in Zone K, DEFR capacity was able to be sited in less costly upstate areas, which constituted over half of the total avoided capital cost savings.

The figure below summarizes the total avoided cost savings for each project analyzed.

Figure 18: Total Capital Cost Savings (\$2022 M)

Project	Total Capital Cost Savings (\$2022 M)	
	Policy Scenario	Policy + B-VS Scenario
T035 - LSPower	2,866	3,240
T036 - NextEra Core 1	3,066	2,586
T040 - NextEra Core 5	3,101	2,731
T048 - Propel Base 2	2,065	2,033
T049 - Propel Base 3	2,141	2,801
T051 - Propel Alt 5	2,873	3,028
T052 - Propel Alt 6	2,909	3,081

In total, the proposed projects evaluated enable between \$2.0-3.2B of avoided capital cost savings through 2040 under this analysis. Projects that enable higher reductions in Long Island offshore wind energy curtailment and increase import capability to Long Island produce the highest savings.