POWERGEM

Final Report

Ability of Energy Storage to Address Transmission Reliability Needs in New York City

PREPARED FOR

New York Battery and Energy Storage Technology (NY-BEST™) Consortium

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Executive Summary

New York Battery and Energy Storage Technology Consortium ("NY-BEST™" or "Client") engaged PowerGEM to evaluate the ability of battery energy storage system(s) ("BESS") to address transmission reliability needs in the Consolidated Edison ("ConEd") service territory (or "Zone J"). The analysis sought to evaluate the technical feasibility and quantify on an economic basis the capabilities of BESS to address system demand supply shortfalls identified in the ConEd January 2026 Reliability Needs Report, issued 20 January, 2026 (Case: 25-E-0764), and to meet the stated requirements of the following Request for Information (RFI): Clean & Non-Emitting Reliability Solutions to Manage Zone J Reliability Needs RFI from ConEd.

PowerGEM performed a combination of power flow analysis and forward market analysis of NYISO Zone J for the evaluation. Forward analysis is completed using production cost modeling ("PCM") software to simulate the NYISO market to predict future congestion, curtailment, and location-based marginal price ("LMP"). The benefit of performing forward PCM analysis is that it includes forecasted impact of system changes (incorporating known transmission upgrades, generator additions and retirements, fuel prices, etc.).

Following the process in the ConEd January 2026 Reliability Needs Report, PowerGEM identified and resolved the shortfall via BESS additions. Subsequently, a candidate set of thirty-two (32) buses at fourteen (14) substations were identified as capable of addressing the reliability need based on their proximity to the BESS additions and their qualifications of being downstream of the reliability constraint. These sites were then screened on an economic basis to finalize BESS site selection. The full list of candidate sites is given in Appendix A.

Following an iterative economic-reliability simulation process, PowerGEM identified the following sites for which BESS both satisfied the stated ConEd reliability needs and provided substantive economic benefits:

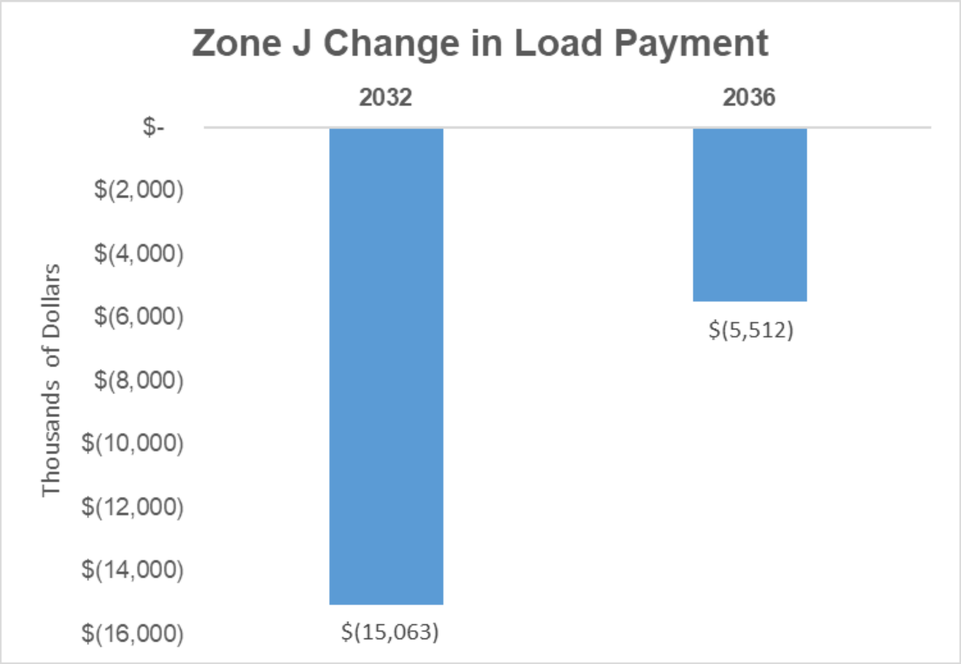
BESS Site	BESS Size – 2032*	BESS Size – 2036*
Farragut 345 kV West	50 MW / 200 MWh	75 MW / 300 MWh
Farragut 345 kV East	50 MW / 200 MWh	75 MW / 300 MWh
Water Street 138 kV	50 MW / 200 MWh	75 MW / 300 MWh
Gowanus 138 kV	15 MW / 60 MWh	150 MW / 600 MWh
Farragut Y7 138 kV [Downstream of Farragut 345 kV East]	0 MW	127.5 MW / 510 MWh
Farragut Y8 138 kV [Downstream of Farragut 345 kV West]	0 MW	75 MW / 300 MWh
Farragut X 138 kV	0 MW	150 MW / 600 MWh
TOTALS:	**165 MW / 660 MWh**	**727.5 MW / 2910 MWh**

* Note: BESS sizes reflect 4-hour durations as studied in the economic evaluation

In addition to addressing the reliability shortfall, an acute analysis with the Champlain Hudson Power Express (CHPE) HVDC line and Ravenswood 3 unit off-line showed that appropriately scaled BESS of 4-hour and longer durations at these locations would have sufficient capacity and energy to sufficiently charge to meet the need without causing constraints. The BESS project sites were evaluated at the bulk system level, but they can be interpreted as an aggregation of multiple downstream projects, including as distributed energy storage.

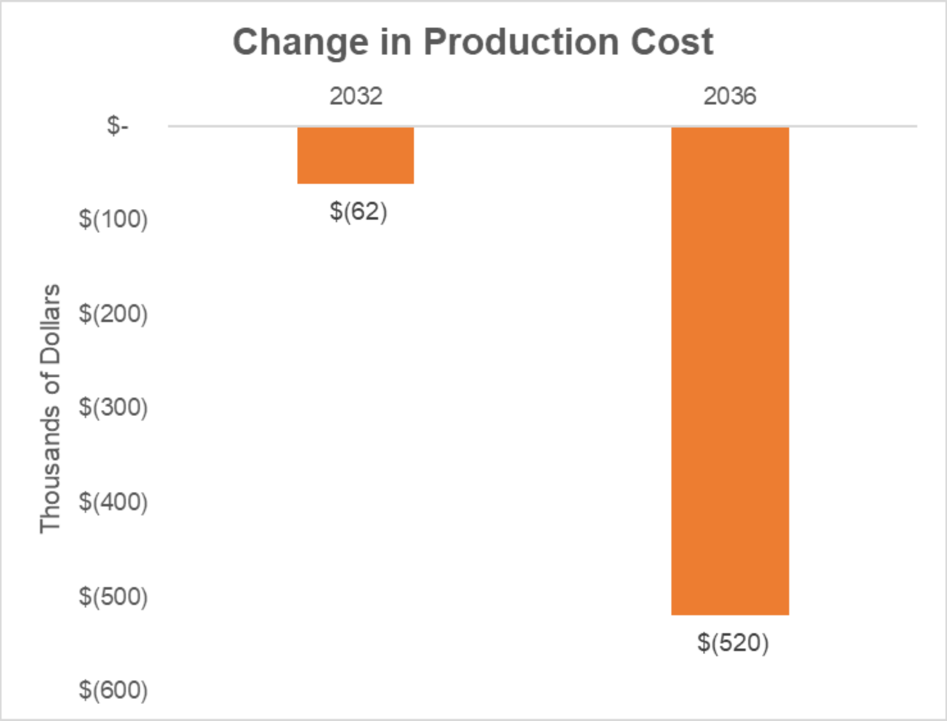
Siting batteries at these locations lowered load payments, production costs, and emissions in 2032 and 2036. Annual load payments are the total energy costs paid by Zone J customers over a year, and annual production cost is the total system-wide cost of generating electricity in the NYISO, including fuel, variable O&M, emissions, and energy imports. Energy storage deployed in Zone J will have additional economic benefits that were not addressed in the study, including potential deferral value for distribution infrastructure and capacity contributions within the New York City locational minimum installed capacity requirement (LCR).

The addition of battery storage within ConEd reduces annual load payments primarily by suppressing LMPs during the highest-demand hours, which are precisely the hours when the largest volumes of load are being served and when congestion-driven price premiums are most acute.



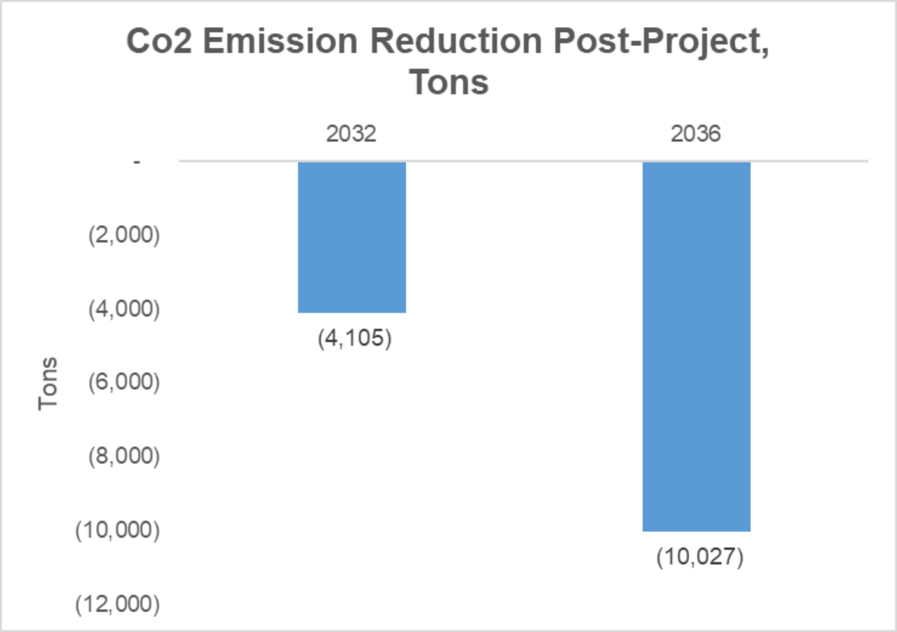
Zone J change in load payment with 4-hour duration batteries

Battery storage reduces system production costs by displacing higher-cost marginal generation during peak periods, including gas-fired peakers with elevated heat rates and emissions costs, and shifting energy consumption to off-peak hours when lower-cost baseload and renewable resources are available.



NYISO change in production cost with 4-hour duration batteries

With the BESS, CO_2 emissions are reduced by 4.1 ktons and 10 ktons in 2032 and 2036, respectively; NOx emissions are reduced by approximately 3 tons and 8 tons in 2032 and 2036, respectively.



NYISO change in CO_2 emissions with 4-hour duration batteries

Introduction

New York Battery and Energy Storage Technology Consortium (“NY-BEST™” or “Client”) engaged PowerGEM to evaluate the ability of battery energy storage system(s) (“BESS”) to address transmission reliability needs in the Con Edison (“ConEd”) service territory (or “Zone J”). The analysis sought to evaluate the technical feasibility and quantify on an economic basis the capabilities of BESS to address system shortfalls identified in the ConEd January 2026 Reliability Needs Report[1] (“ConEd Report”), issued 20 January, 2026 (Case: 25-E-0764), and to meet the stated requirements of the following Request for Information (RFI): Clean & Non-Emitting Reliability Solutions to Manage Zone J Reliability Needs RFI from ConEd.[2] PowerGEM performed a combination of power flow analysis and forward market analysis of NYISO Zone J for the evaluation.

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[1] https://www.coned.com/en/business-partners/business-opportunities/-/media/952c149c53a3409094fae2303cb5992e.ashx

[2] https://www.coned.com/en/business-partners/business-opportunities/-/media/e0114aec48144025a19a5eadf9ce7e9a.ashx

Overview of ConEd’s Reliability Needs

In January 2026, ConEd published its January 2026 Reliability Needs Report (Case 25-E-0764), identifying a transmission security deficiency within the New York City 345/138 kV Transmission Load Area (TLA) emerging in 2032 and growing through 2036. This need is driven in part by the changing resource mix and transmission topology in New York City, including the addition of the Champlain Hudson Power Express (CHPE) high-voltage direct current (HVDC) transmission line from Quebec, the addition of new offshore wind resources such as Empire Wind, and the retirement of gas- and oil-fired peaking generation within the city. Under summer peak conditions, ConEd performed N-1-1-0 contingency analysis and identified thermal overloads on multiple 345 kV and 138 kV feeders following the sequential and independent loss of the CHPE HVDC link at Astoria (1,250 MW) and Ravenswood Unit 3 (986.8 MW) — the two most severe contingencies for the NYC 345/138 kV TLA.

To quantify the magnitude of the reliability need, ConEd reduced load until all thermal violations were resolved. This process identified a peak MW shortfall of 125 MW in 2032, growing to 750 MW by 2036, with the duration of the need expanding from 3 hours to 9 hours per peak day over the same period. The need is projected to continue growing beyond the study horizon, reaching approximately 2350 MW by 2045.

Based on these findings, and pursuant to the New York Public Service Commission's December 2025 Order (Case 25-E-0764), ConEd issued a Request for Information (RFI) seeking clean and non-emitting reliability solutions to address the identified transmission security deficiency during summer capability periods. The RFI solicits a broad portfolio of solutions, including demand response, energy efficiency, and battery energy storage, located within NYISO Zone J, excluding Staten Island and certain upper Manhattan and Bronx networks where local transmission constraints limit their effectiveness.

Upon reviewing the ConEd Reliability Needs Report and the accompanying RFI, NY-BEST and PowerGEM determined that battery energy storage systems, if sited at strategic locations on the ConEd transmission grid, would mitigate the identified reliability shortfall while simultaneously providing broader bulk power system benefits. These benefits include reduced system production costs, lower load payments for Zone J consumers, and reductions in greenhouse gas emissions.

The objective of this study was to:

- Replicate ConEd's transmission planning methodology and confirm the identified reliability needs for the NYC 345/138 kV TLA in the 2032 and 2036 study years.
- Identify areas within Zone J where additional generation injection would mitigate the reliability needs, while avoiding areas excluded by ConEd's RFI (Staten Island, Washington Heights, Riverdale, Fordham, Southeastern Bronx, and Northeastern Bronx).
- Identify specific, economically preferred transmission interconnection points within those eligible areas that satisfy transmission reliability requirements while maximizing ratepayer and developer benefits.

- Establish that BESS can resolve the reliability shortfall and that the BESS can charge sufficiently to continue to resolve the need in an acute situation.
- Quantify the broader bulk power system benefits of the proposed battery storage additions beyond resolving transmission violations, including avoided production costs, reduced Zone J load payments, and greenhouse gas emissions reductions.

Methodology, Input Development, and Assumptions

PowerGEM utilized its TARA power flow simulation software and PROBE LT market simulation software to site and size BESS and complete a comparative 8760-hour nodal market analysis to evaluate BESS as a solution to the identified reliability shortfalls. The study was organized across four modeling steps, comprising an iterative power flow and production cost modeling process. The stages of the modeling process are given in Figure 1 below.

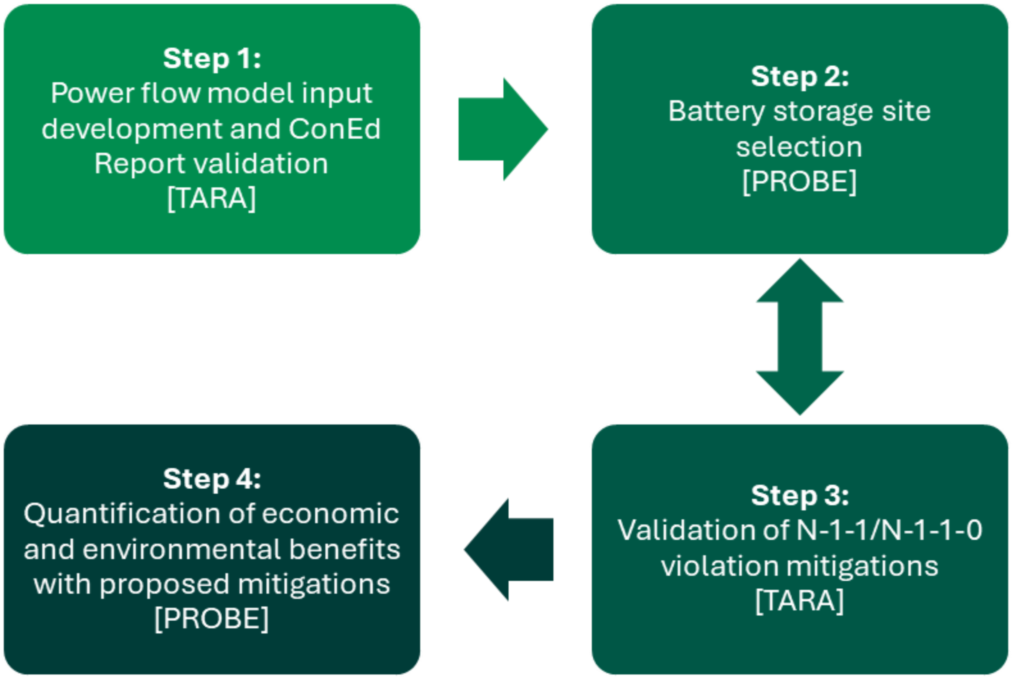

Figure 1: Diagram of process steps and interfaces of software tools

Software Modeling Tools

TARA is a steady-state AC power flow modeling tool that evaluates transmission security under potential contingency events, including the loss of generation, loss of load, or loss of transmission facilities. TARA replicates NYISO, ConEd, and NERC reliability requirements to ensure reliable power flows consistent with physical system constraints. The software is developed by PowerGEM and licensed extensively by developers, utilities, ISOs, and other reliability organizations, including both the NYISO and ConEd.

PROBE is a chronological production cost simulation platform that combines both the physics of the transmission system and economic unit commitment and dispatch by performing an 8760-hour security-constrained unit commitment and economic dispatch (SCUC/SCED). This process replicates the methodology used by the NYISO to clear the wholesale energy market. PROBE is developed by PowerGEM and utilized by developers, utilities, and ISOs across the industry.

Inputs and Assumptions

The **transmission model** uses a full, detailed base representation with approved transmission projects as modeled in future planning load flow cases. The 2025 NYISO FERC Form No. 715 50/50 power flow models were used as the starting basis. PowerGEM monitors thousands of transmission facilities and N-1 contingencies for overload during simulation, consistent with typical market operations. Single contingencies were modeled and supplemented as needed to match the ConEd assumptions.

For **generation capacity**, all future generators were modeled at each unit's appropriate in-service date, provided the project has an executed interconnection agreement. All announced generation retirements were modeled as retired at their appropriate retirement dates. Representative generator outages were applied to the model.

Hourly demand was modeled at the zonal level for all 8760 hours based on the NYISO Gold Book demand forecast.

Hourly wind and solar profiles were utilized during simulation for all 8760 hours, with PowerGEM sourcing wind and solar profiles from NREL. Renewable plants were bid as "price-takers" with a typical cost of $0 or -$15, depending on production tax credit and investment tax credits.

Natural gas prices were sourced from published CME Group pricing at the time the project commenced and kept consistent through remaining simulations. The natural gas price was varied monthly and by pipeline.

Battery storage durations:

In each stage of the analysis, battery storage durations were assumed based on the determined MWh values of the projects to meet the stated need requirements as described in the ConEd Report. The most constrained cases between 4- and 6-hour duration BESS with the same MWh ratings were evaluated. The BESS projects are modeled at the bulk system level and can be interpreted as an aggregation of multiple downstream projects. As the report indicates, systems could have varied capacity and duration combinations to meet the same MWh energy need.

BESS ability to meet the reliability need is dependent on the total energy storage amount (MWh) of the BESS system and the total power injection and charging ability (MW) of the BESS system. The relationship between the energy content and the power delivery ability of battery systems is frequently described as a duration of the BESS system, i.e. a 4-hour or 6-hour duration BESS where the ratio of energy to power is 4 or 6, respectively. This report utilized this commonly used nomenclature; however, it is important to recognize that the term duration is only indicative of this ratio and the amount of time a BESS can inject energy at maximum power. A 4-hour duration BESS system with the same energy content (i.e., amount of batteries) as a 6-hour system can act in exactly the same manner as the 6-hour system, the only difference between the two is that the 4-hour system can inject power and charge at a higher rate.

For this analysis, the energy content of the BESS were assumed based on the MWh values of the projects to meet the stated need requirements as described in the ConEd report. To evaluate the ability of both 4- and 6-hour BESS ability to meet the need with BESS systems with that MWh, reliability analysis was performed with the power level limited to the six-hour system. Similarly, to evaluate the ability for the BESS to charge, the charging power was also limited to the 6-hour system level. In both cases, validating the ability of the lower power 6-hour system in turn validates the performance of the higher power four-hour system.

Since most of the BESS being installed in ConEd territory are 4-hour systems, the economic analysis was performed on the four-hour BESS.

Analytical Results

Step 1: Power flow model input development and ConEd Report validation

PowerGEM followed the modeling process per the ConEd Report to identify and confirm the generation shortalls in 2032 and 2036. TARA was utilized consistent with modeling tools and practice used by NYISO and ConEd, and NYISO's 2025 FERC Form No. 715 50/50 power flow models were utilized in all analysis. The models for 2030 and 2035 were adjusted to meet expected load in 2032 and 2036, respectively, per the RFI as models for these study years are not published explicitly by the NYISO. System load levels were inspected, and the ConEd system was scaled as necessary to the peak load levels as described in the ConEd Report. To obtain the 2032 model, load was scaled to 12.049 GW per the ConEd report; to obtain the 2036 model, load was scaled to 12.70 GW. A new 345/138 kV Sunset Park substation tapping both Goethals to Gowanus 345 kV lines was added to the 2036 model based on the ConEd 2025 Local Transmission Plan (LTP)[3]. This substation was not included in the FERC 715 models but was assumed for this analysis given its proximity to facilities driving the identified reliability need.

With the power flow models updated, N-1-1-0 Security Constrained Dispatch (SCD) was performed following the sequential and independent loss of CHPE HVDC at Astoria (at 1,250 MW) followed by loss of the Ravenswood 3 generation unit (at 986.8 MW) as identified in the ConEd Report. SCD enables automatic system adjustments of generation and system elements (e.g., PARs) per NYISO guidelines and criteria to secure the system, i.e., to resolve reliability violations including thermal and voltage criteria violations.

The N-1-1-0 results for the 2032 and 2036 models showed violations along the 345 kV corridor from Goethals to Gowanus substations. This thermal overloading reflects a generation shortfall in the ConEd 345/138 kV transmission system, because if sufficient generation were available, it would have been appropriately dispatched via the SCD approach to address these overloads.

ConEd assumed load reduction downstream of Gowanus to mitigate these violations, and while it should be noted that distributed BESS can be considered a load modifier, BESS was modeled as generation-only for the purposes of this analysis. A generation-only solution reflected this same degree of shortfall, with additional downstream, proximate generation bringing the 345 kV lines to within 100% of their normal ratings.

Per the RFI, generation was sited downstream of the feeders showing overloads except within Staten Island or the following networks: Washington Heights, Riverdale, Fordham, Southeastern Bronx and Northeastern Bronx. High voltage transmission buses were identified that meet these criteria, including Farragut 138 kV and 345 kV, FDR 345 kV, Gowanus 138 kV and 345 kV, Greenwood 138 kV, Water Street 138 kV, and Sunset Park 138 kV transmission buses. The identified area downstream of Gowanus is shown in Figure 2 and extends north and south. Twenty-nine (29) candidate buses representing eleven (11) substations were selected via review using TARA for the

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[3] https://www.nyiso.com/documents/20142/55462035/03b_CECONY_2025_LTP.pdf/f21ff9a3-02f3-eab1-310c-4a6c15521365

site screening evaluation in PROBE. Additionally, three (3) substations indicated in ConEd's Standardized Interconnection Requirements (SIR) queue were also considered for the screening. These are summarized in Appendix A. These buses effectively represent fourteen (14) total substations, as discussed in the next section.

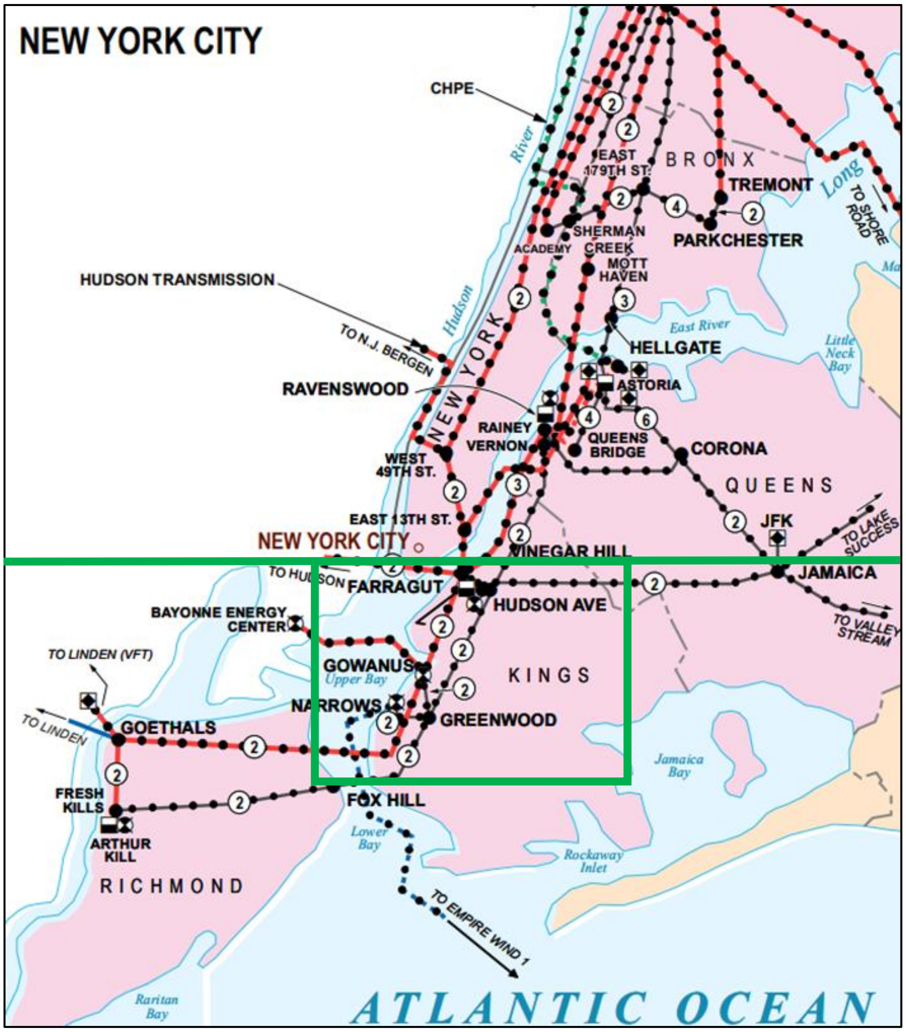

Figure 2: Transmission network downstream of Gowanus for which generation insertion would address the identified need per the ConEd Report

Step 2: Battery storage economic site screening

To identify the highest-value sites and sizes from the thirty-two (32) technically eligible transmission bus locations, all of which are capable of accommodating storage interconnection to meet the identified need, an economics-driven screening analysis was performed using the PROBE generator screening module. In order to perform the analysis, a set of specific BESS sites were needed. Using prospective project sites and generator parameters specified by the user, the module evaluates a limited set of production cost model simulations in a user-specified study year and returns summary-level metrics for candidate projects considering their location, size, and, for BESS, duration. Unlike the single "snapshot" power flow cases evaluated in Step 1, this screening assessment included a chronological assessment of the NYISO system, including hourly fluctuations in demand, generation, imports and exports, and storage charge and discharge, as well as other economic properties like fuel prices and emissions. To simplify the iterative analysis, the full annual 8760-hourly chronology was reduced to 14 representative days per quarter, or 1344 hours per year.

The eleven substation candidates determined via TARA in Step 1 and three substations indicated in ConEd's SIR queue were utilized for the screening. The SIR queue-selected sites were identified as downstream of Gowanus 345 kV. Twelve (12) total sites were evaluated for 2032 and fourteen (14) sites were evaluated for 2036. The interconnection points considered for the screening analysis and their applicable screening outputs are provided in Table 1 below. Note that the results presented are outputs of the partial simulation results and not a full 8760 analysis. Further, the table shows that multiple sites with fairly similar economics can meet the stated need.

Table 1: Screening analysis buses and applicable partial screening-level simulation results

Bus Name	Bus kV	Selected	Partial Year BESS Revenue (k$)		Partial Year Zone J Load Payments (k$)	
			2032	2036	2032	2036
Bensonhurst No. 1 [SIR]	27	No	$33.99	$45.18	$333,230	$377,860
Bensonhurst No. 2 [SIR]	27	No	$33.78	$45.89	$333,184	$377,726
Farragut 138 X	138	**Yes**	$39.29	$65.93	$333,103	$377,478
Farragut 138 Y	138	**Yes**	$39.17	$68.48	$332,986	$377,692
Farragut 345 East	345	**Yes**	$37.04	$66.12	$332,632	$377,498
Farragut 345 West	345	**Yes**	$41.23	$72.79	$332,762	$377,433
FDR 345	345	No	$27.84	$45.55	$332,843	$377,856
Gowanus 138	138	**Yes**	$32.01	$45.30	$332,948	$377,263
Gowanus 345	345	No	$27.59	$45.51	$332,894	$377,850
Greenwood [SIR]	27	No	--	$46.08	--	$377,685
Greenwood North	138	No	$31.74	$45.88	$333,098	$377,682
Greenwood South	138	No	$31.77	$45.70	$333,102	$377,659
Sunset Park 138	138	No	--	$50.22	--	$377,936
Water Street 138	138	**Yes**	$39.10	$65.31	$331,927	$377,757

These points were considered at 50 MW / 300 MWh in 2032 and 100 MW / 600 MWh in 2036 to determine which sites were economically the most beneficial.

Final sites were chosen based on the following simulation output metrics: the ability of the BESS to reduce load payments within ConEd (i.e., NYISO Zone J) and the highest total revenue generated by the BESS. Load payments reflect the cost of electricity paid by consumers in a specified region or regions of a power system, i.e., the sum of LMP multiplied by the quantity of electricity consumed over all simulated hours. Generator revenues provide an understanding of generator operational dispatch and economic performance. Together, these metrics provide insight into potential benefit to both the energy consumers and the generation owners.

While BESS sites were selected economically, the most important site selection criterion was the mitigation of the overloads representing the shortfall as presented in the ConEd report.

Step 3: Validation of N-1-1/N-1-1-0 violations mitigation

Using the power flow models developed in the ConEd Report results validation, the N-1-1-0 SCD reliability evaluation was repeated with the projects modeled at the final sites selected via the generator screening to validate that shortfalls were mitigated in the 2032 and 2036 study year scenarios. If the project sizes from the screening were insufficient to address the shortfalls, additional MW were added, and the reliability simulation was again repeated until the mitigations were successful in addressing the identified thermal loading violations.

The final set of project sites are given in Table 2 below. These represent the outcome of the iterative reliability and economic evaluation performed in validating the ConEd Report results, performing the site screening in PROBE, and determining the required MW additions and associated durations of BESS to address the reliability need. The stated needs requirement in 2032 was 3 hours, and the stated need requirement in 2036 was 9 hours. However, the full MW output to address the shortfall is not needed over this full period, and the MWh numbers given reflect the minimum energy (i.e., MWh) requirement based on the required power (i.e., MW) additions. It is worth noting that these final mitigations are less than the stated MW needs per the ConEd report, because the shortfalls were addressed with generation additions – while ConEd addressed the MW need via load reduction. Further, the full MW outputs and such variation can occur based on the solution type, e.g., generation additions, load reduction, new transmission lines, etc.

Table 2: Project sites and sizes determined following PROBE screening

BESS Site	BESS Size – 2032	BESS Size – 2036
Farragut 345 kV West	50 MW / 150 MWh	50 MW / 300 MWh
Farragut 345 kV East	50 MW / 150 MWh	50 MW / 300 MWh
Water Street 138 kV	50 MW / 150 MWh	50 MW / 300 MWh
Gowanus 138 kV	15 MW / 45 MWh	100 MW / 600 MWh
Farragut Y7 138 kV [Downstream of Farragut 345 kV East]	0 MW	85 MW / 510 MWh
Farragut Y8 138 kV [Downstream of Farragut 345 kV West]	0 MW	50 MW / 300 MWh
Farragut X 138 kV	0 MW	100 MW / 600 MWh
TOTAL REQUIREMENT:	**165 MW / 495 MWh**	**485 MW / 2910 MWh**

Final project selections were modeled as bulk power system-connected (i.e., modeled at transmission-level, high voltage substations), which could be interpreted as an aggregate representation of multiple projects downstream of their locations. Disaggregated generator representation was not simulated in this analysis, and it is possible that the total needed MW addition downstream of bulk power system substations, such as at the distribution level, would increase or decrease due to system losses and other network characteristics.

Table 2 reflects minimum energy requirements (i.e., MWh) based on the duration needs per the ConEd report, i.e., 3 hours in 2032 and 9 hours in 2036. Further, the identified MW in Table 2 also reflects the minimum MW requirement at these sites to address the reliability needs based on power flow analysis. Battery durations with correspondingly scaled capacity to match or exceed this energy content requirement could also be used to mitigate the shortfall during the identified risk hours without needing to recharge, as specified in the RFI. For purposes of analysis, 4-hour duration batteries with appropriate capacities increased as needed to maintain the same MWh capability were assumed in the economic evaluation in the next section of this report. Table 3 summarizes the final assumed BESS sizes at the selected sites in the economic evaluation considering 4-hour durations.

Table 3: Final 4-hour duration project sites and sizes assumed for 8760 economic evaluation

BESS Site	BESS Size – 2032	BESS Size – 2036
Farragut 345 kV West	50 MW / 200 MWh	75 MW / 300 MWh
Farragut 345 kV East	50 MW / 200 MWh	75 MW / 300 MWh
Water Street 138 kV	50 MW / 200 MWh	75 MW / 300 MWh
Gowanus 138 kV	15 MW / 60 MWh	150 MW / 600 MWh
Farragut Y7 138 kV [Downstream of Farragut 345 kV East]	0 MW	127.5 MW / 510 MWh
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Farragut X 138 kV	0 MW	150 MW / 600 MWh
TOTALS:	**165 MW / 660 MWh**	**727.5 MW / 2910 MWh**

Acute Analysis: Loss of CHPE and Ravenswood 3

For the purposes of power flow analysis, discharging of BESS served as direct counterpart to ConEd's selection of load reduction to address the stated reliability need. Charging of BESS was not considered in the power flow portion of the analysis but necessary charge and discharge capability was studied.

Additional analysis was conducted where CHPE and Ravenswood 3 were assumed on outage and not able to serve load during the two weeks surrounding the summer peak load. These conditions were evaluated for study years 2032 and 2036 under both a pre- and post-project scenario to quantify the impacts of the batteries under this contingency condition and to further validate the capability of the systems to address system reliability concerns. The purpose of this analysis is to ensure that the energy storage units could successfully charge in the double contingency situation.

This analysis is meant to be illustrative of the batteries' capability to perform as needed and add value under an extreme scenario. A 6-hour duration was assumed for all BESS to illustrate that the minimum MW capacity identified could address the shortfall assuming sufficient energy content. Further, 6-hour durations were assumed because the abilities of the BESS to charge would be more limited with a longer duration – a 4-hour battery would imitate charging of 6-hour, for example. It should be noted that systems could have varied capacity and durations to meet the same MWh energy need, e.g., a higher MW capacity fleet of batteries with shorter durations.

In 2032, without the newly sited batteries on the system, other generators compensate to avoid load shed (i.e., unserved load). However, in 2036, Zone J experiences approximately 1040 MWh of unserved load with a maximum hourly loss of 370 MW in the pre-project scenario. There is no unserved load in either of the post-project scenarios. Compared to the same two-week period without these outages, the pre-project cases in both 2032 and 2036 make up for the loss of CHPE and Ravenswood 3 almost entirely with fossil generation. Both baseload combined cycle units and simple cycle combustion turbines, operated as peakers, increased their generation to replace the load previously served by CHPE and Ravenswood 3. This is true for the entirety of NYISO, as well as Zone J.

Figure 3 shows the battery charge and discharge schedules on June 23 through June 25 in 2032, which encompasses the summer peak load for Zone J and NYISO. In 2032, the ConEd report shows a need from hours 15 to 18, with a maximum need of 125 MW. The results show that the batteries added in 2032 have sufficient capacity and energy to resolve the stated need and that the batteries can sufficiently charge overnight to meet the need without causing constraints.

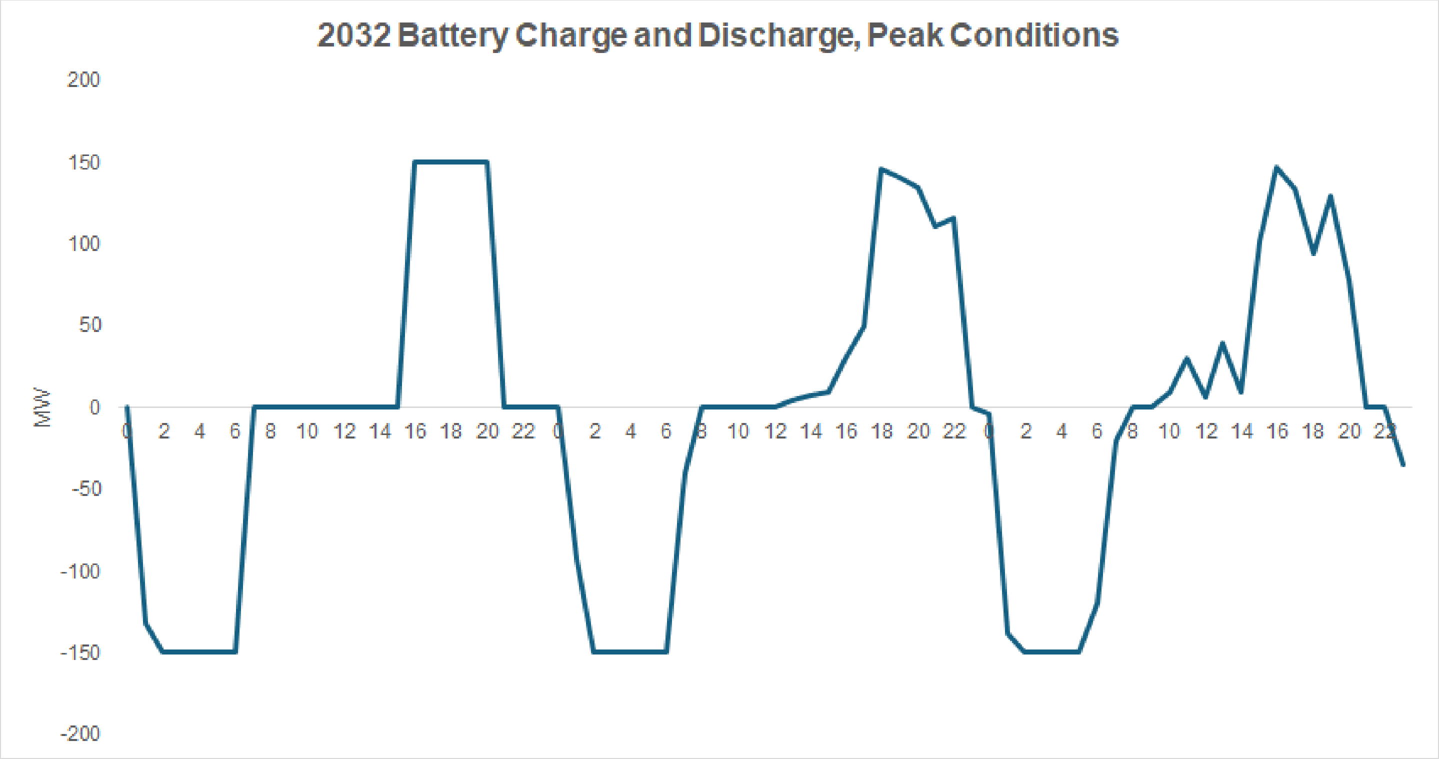

Figure 3: Battery Charge and Discharge Schedule, 2032 Peak Conditions

Figure 4 shows the same 3-day period surrounding the peak load condition in 2036.Unserved energy for Zone J was observed on June 25 in the pre-project scenario. With batteries added in the post-project case, all unserved energy was resolved.

Negative values on this chart indicate charging conditions for the batteries, while positive values indicate discharging. The ConEd report shows need starting in hour 12 through the end of hour 20, and any proposed solution must adequately dispatch to meet the need over these hours without adding to demand (i.e., charging during this time period). As this chart shows, the batteries added subject to Tasks 1-3 of the analysis can adequately charge before the need begins and discharge to meet the need between hours 12 and 21 over the course of multiple days. The PROBE model optimizes battery charge and discharge economically. This analysis shows that adequate charge and discharge is possible on an economic basis, but uneconomic operations could also be implemented if needed.

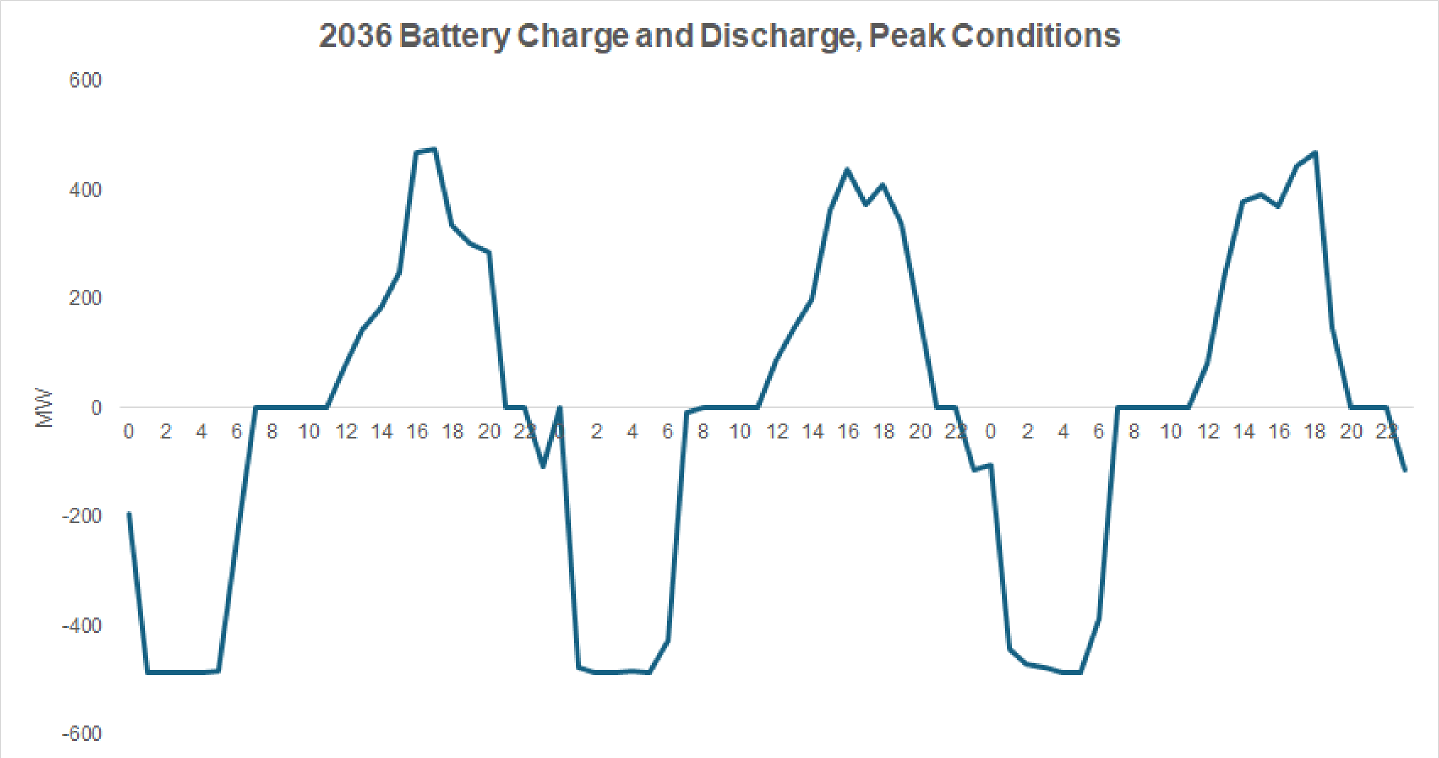

Figure 4: Battery Charge and Discharge Schedule, 2036 Peak Conditions

Additionally, the analysis shows that Zone J and NYISO can serve load more efficiently and cost-effectively with the addition of the newly sited batteries in both 2032 and 2036 when compared to the pre-project results. This is reflected in the difference between pre- and post-project LMPs, load payments, and production costs.

The stabilization of LMPs as shown in Figure 5 directly influences the total financial burden on the grid. By mitigating the price spikes, the additional batteries facilitate a substantial reduction in the total cost required to serve local load. This correlation is most evident when viewing the aggregate savings in load payments across both study years.

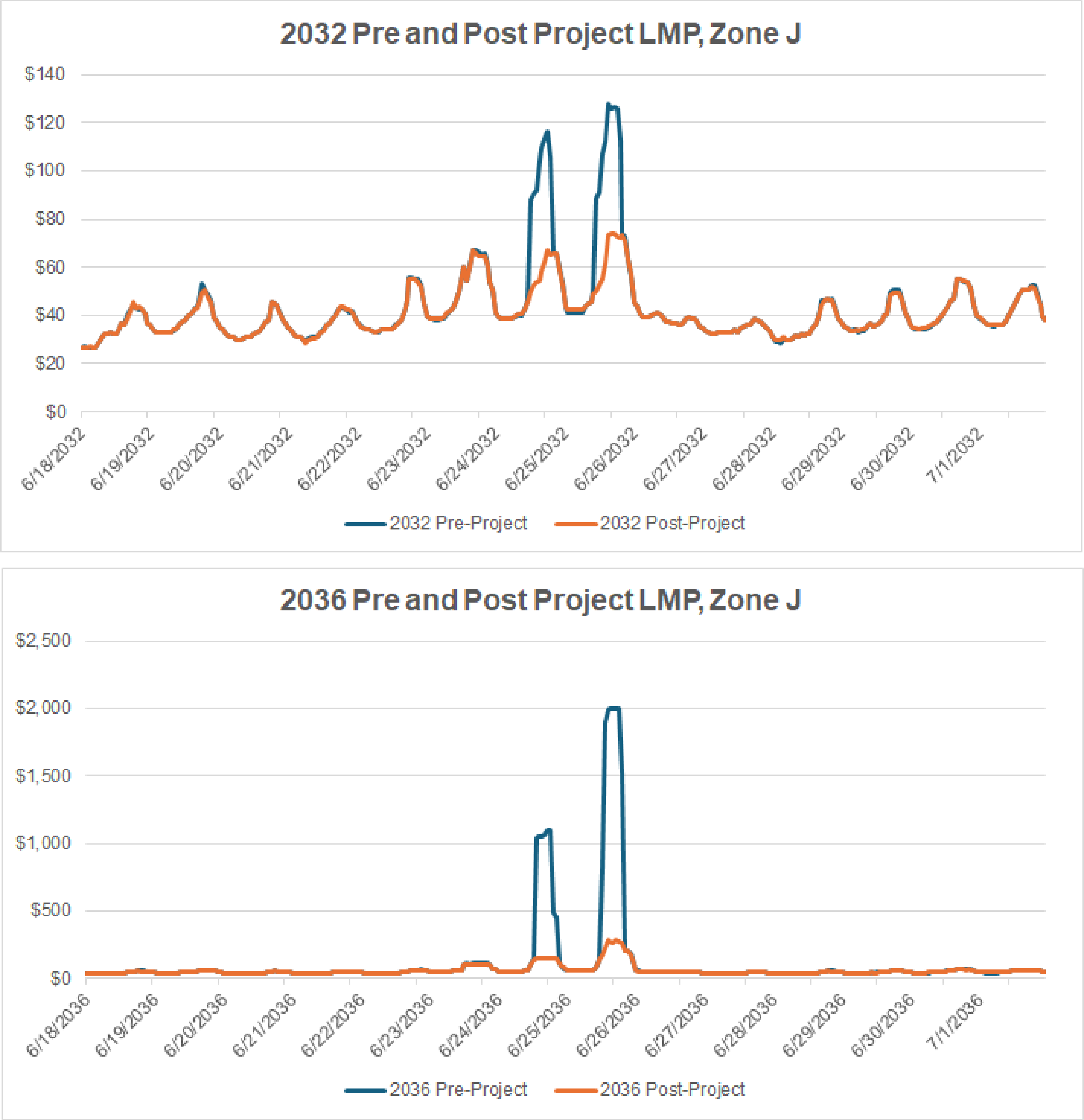

Figure 5: Zone J Pre- and Post-Project LMPs, 2032 and 2036

While load payment reductions reflect savings passed to consumers, reductions in the total production cost represents the impact on the system-wide cost profile. See Figure 6 and Figure 7. These reduced production costs and load payments are due to the batteries shifting generation during high demand time periods away from less-efficient units. In 2036, the batteries reduce the usage of peaker plants in the attempt to meet high demand when compared to the pre-project case. That, along with the resolution of the unserved energy, accounts for the large economic impacts seen in the post-project 2036 case over a relatively short period of time.

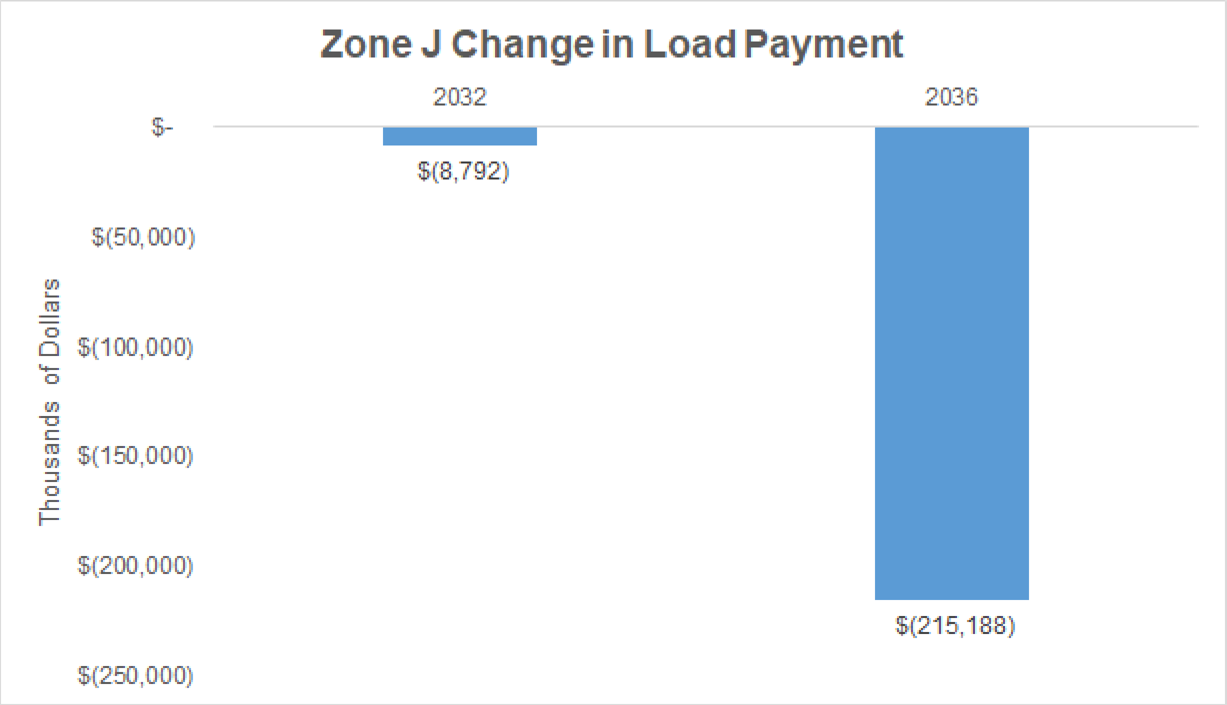

Figure 6: Zone J Change in Load Payment Pre-and Post-Project with CHPE and Ravenswood 3 Outage, June 18 – July 1, 2032 and 2036

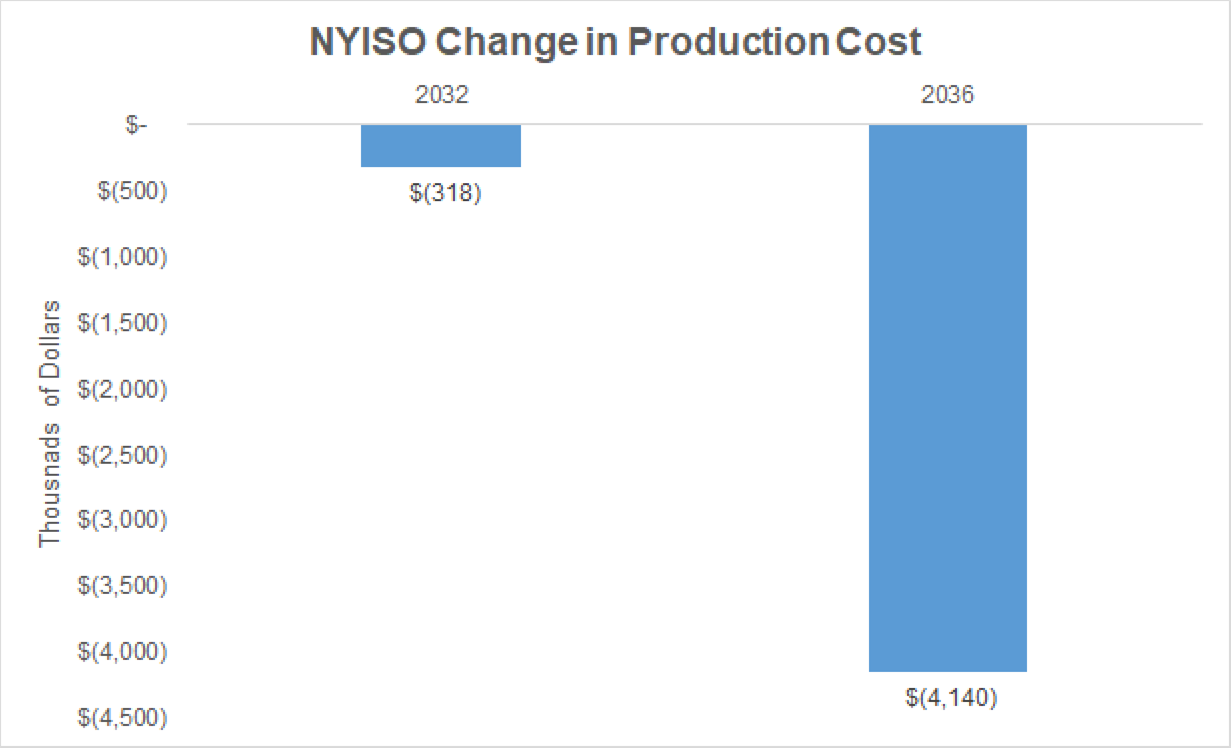

Figure 7: Change in NYISO Production Costs Pre-and Post-Project with CHPE and Ravenswood 3 Outage, June 18 – July 1, 2032 and 2036

Step 4: Quantification of economic and environmental benefits with proposed mitigations

With the set of project locations, sizes, and durations finalized, annual production cost model simulations were performed for the 2032 and 2036 study years to provide a pre- and post-project production cost modeling and comparative analysis. Pre-project simulations considered the system without the added storage assets; post-project simulations considered the system with the added storage assets. A post-simulation comparative evaluation of pre- vs. post-project results was also performed to quantify the impact of the projects on overall system economics.

Energy storage deployed in Zone J will have additional economic benefits that were not addressed in the study, including potential deferral value for distribution infrastructure and capacity contributions within the New York City locational minimum installed capacity requirement (LCR).

Changes to Annual Location-Based Marginal Price (LMP)

The annual location-based marginal price (LMP) represents the average marginal cost of serving load at a given location and reflects the combined effects of energy supply costs, transmission losses, and transmission congestion. LMPs are calculated at each node in the NYISO system for every hour of the 8760-hour simulation and incorporate both temporal variation (hour-to-hour changes in demand and supply) and location-specific transmission constraints. In areas like ConEd's Zone J, where transmission congestion frequently limits the flow of lower-cost power into the load pocket, LMPs tend to be elevated relative to the broader NYISO system.

The addition of battery storage within Zone J serves to mitigate transmission congestion by injecting power locally during peak demand periods when constraints are most binding, thereby reducing LMPs during high-price hours. Simultaneously, the storage charges during lower-demand, lower-price periods, which modestly increases prices during those hours. The net effect is a flattening of the LMP profile and an overall reduction in the average annual LMP within the ConEd service territory. This metric is important because LMPs directly determine the cost of electricity borne by Zone J ratepayers, i.e., a reduction in average LMP translates to lower wholesale energy costs for New York City consumers.

Although LMP impacts are limited given the size of the batteries added to the system in the scope of the overall generation portfolio in the 2032 and 2036 study years, the results show that the proposed battery storage portfolio reduce LMPs, on average, within Zone J. In addition, the battery additions reduce the maximum LMPs seen in Zone J, particularly in 2032. This can be attributed to significant battery, solar, and wind additions in 2036 compared to what is present on the system in 2032, which collectively have a stabilizing effect on LMPs. Figure 8 shows the changes in average and maximum monthly LMP after the batteries are added to the system.

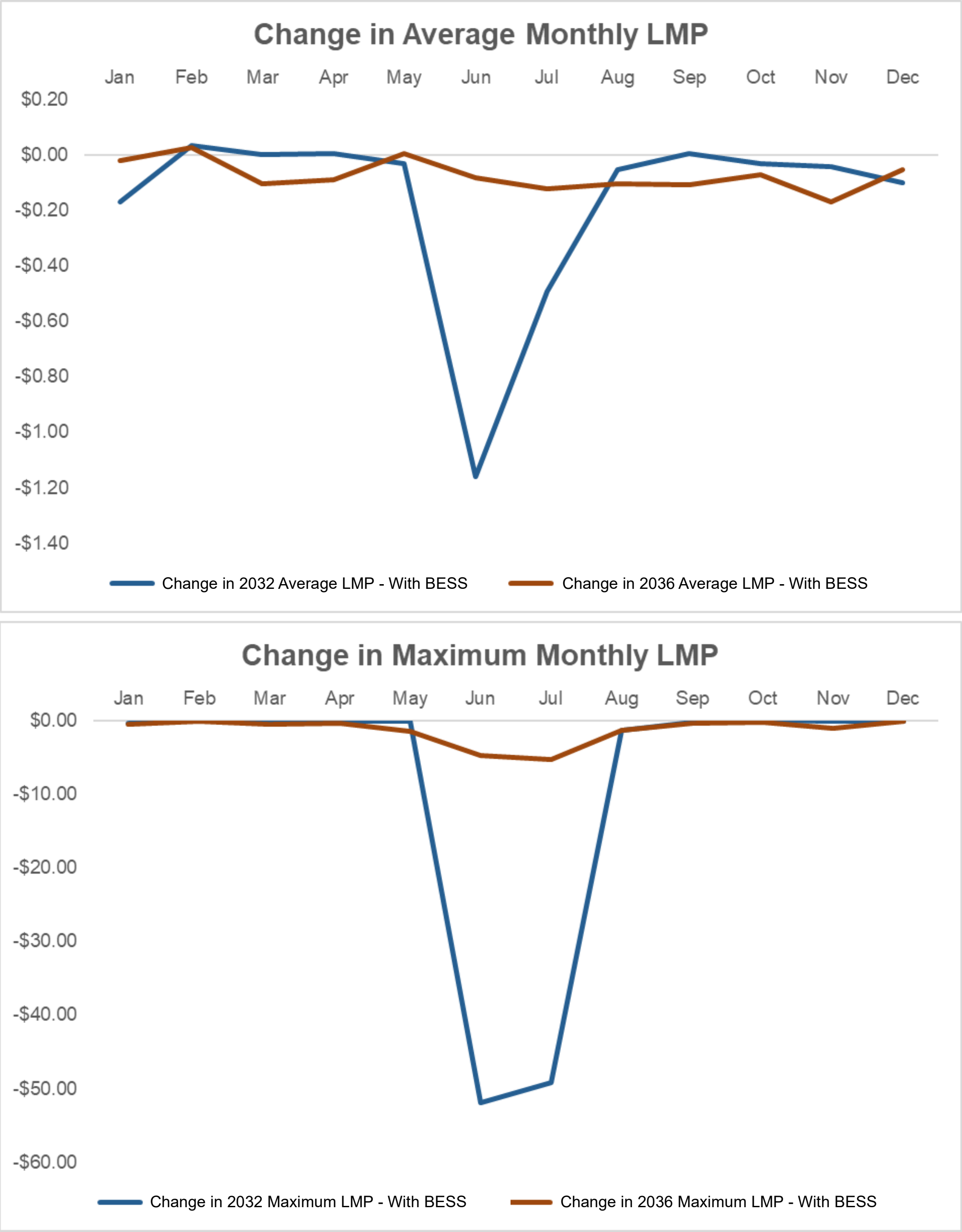

Figure 8: Change Average and Maximum Zone J Monthly LMP Post-Project, 2032 and 2036

Annual Load Payments

Annual load payments represent the total energy cost paid by Zone J customers over the course of a year. Load payments are calculated by multiplying the LMP at each node by the corresponding hourly load at that node, then aggregating across all nodes and all 8760 hours within Zone J. While LMP reflects the marginal cost of energy at a given location and time, load payments capture the total dollar impact on ratepayers by weighting those prices against actual consumption patterns, making load payments the more direct measure of what customers ultimately pay for electricity.

The addition of battery storage within Zone J reduces annual load payments primarily by suppressing LMPs during the highest-demand hours when the largest volumes of load are being served and when congestion-driven price premiums are most acute. Because load payments are the product of both price and quantity, even modest LMP reductions during peak hours, i.e., when load volumes are at their greatest, can produce meaningful savings for Zone J ratepayers. This metric is particularly relevant for evaluating the consumer benefit of BESS deployment, as it translates the locational price effects observed in the LMP analysis into aggregate dollar savings for New York City electricity customers. With the BESS added, load payments in Zone J are reduced by $15.06M and $5.5M in 2032 and 2036, respectively (see Figure 9). NYISO-wide load payments are reduced by $19.7M and $15.2M in 2032 and 2036, respectively (see Figure 10).

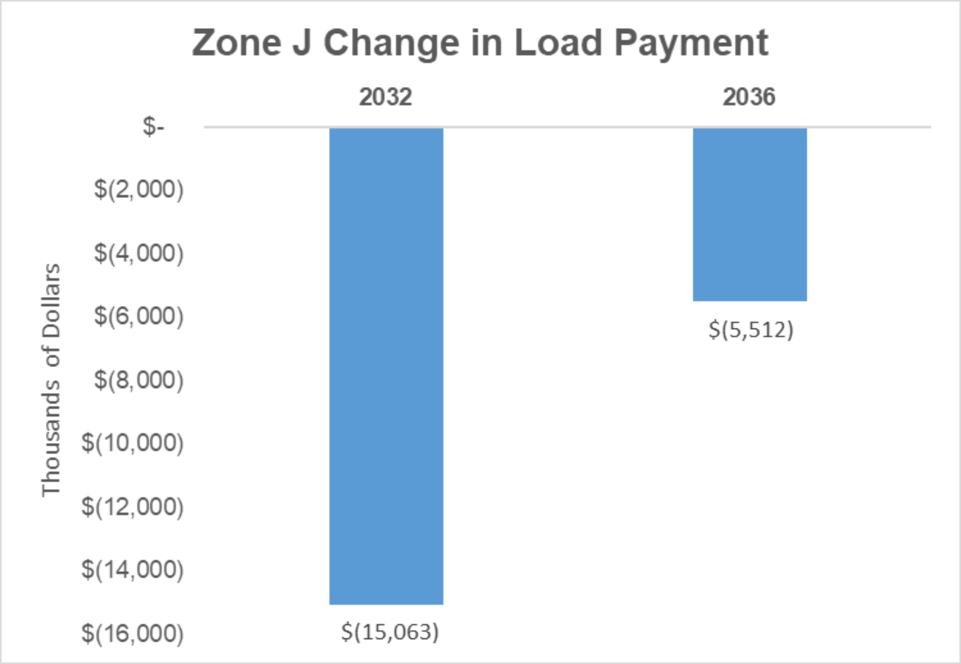

Figure 9: Zone J Annual Change in Load Payment, 2032 and 2036

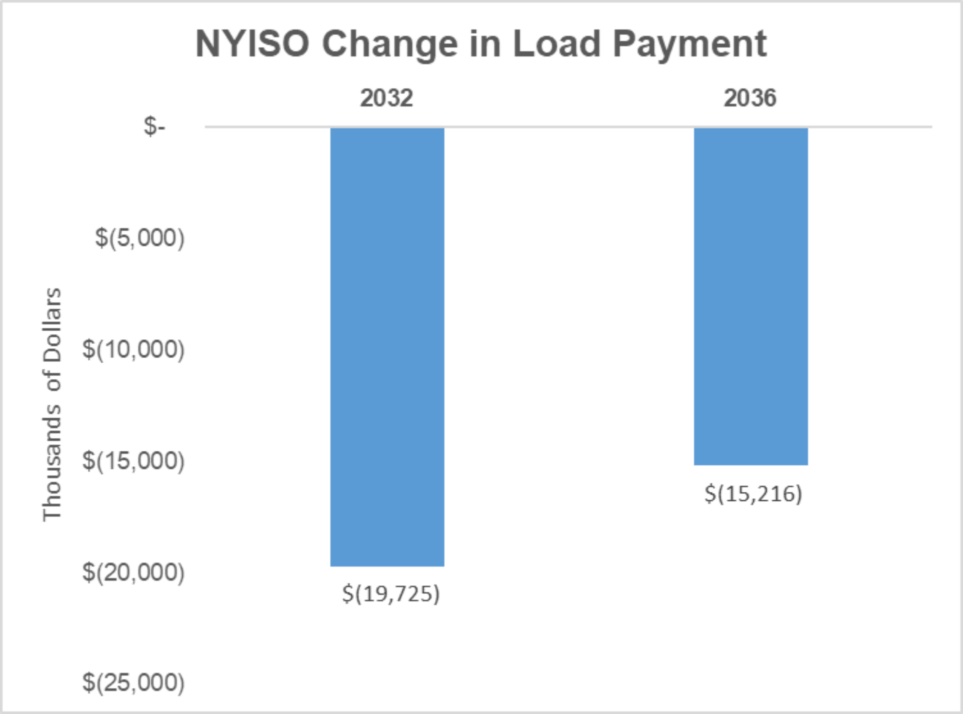

Figure 10: NYISO Annual Change in Load Payment, 2032 and 2036

Annual Production Cost

Annual production cost represents the total cost incurred to produce electricity across the NYISO system, encompassing fuel costs, variable operations and maintenance (O&M) costs, emissions costs, and the cost of energy imports from neighboring systems. This is the objective function that the NYISO wholesale energy market is designed to minimize through its SCUC/SCED process – generators submit offers, and the market clearing algorithm selects the least-cost combination of resources to serve load while respecting transmission constraints. While production cost is not a metric specific to ConEd or its ratepayers, it is a fundamental measure of overall system efficiency and is widely used to evaluate the system-wide economic impact of resource additions or retirements.

By comparing annual production costs with and without the proposed battery storage additions, the analysis quantifies the net avoided production cost attributable to the BESS projects. Battery storage reduces system production costs by displacing higher-cost marginal generation during peak periods, such as gas-fired peakers with elevated heat rates and emissions costs, and shifting energy consumption to off-peak hours when lower-cost baseload and renewable resources are available. The resulting avoided production costs reflect net savings in fuel expenditures, O&M costs, emissions compliance costs, and import costs across the full NYISO footprint. This metric provides a system-level perspective on the economic value of the proposed BESS additions, complementing the Zone J-specific ratepayer benefits captured in the LMP and load payment analyses.

Avoided production costs were found to be $62k in 2032 and $520k in 2036. These increases demonstrate that the BESS projects are capturing systemic efficiencies, effectively displacing more expensive marginal units across the NYISO footprint. See Figure 11.

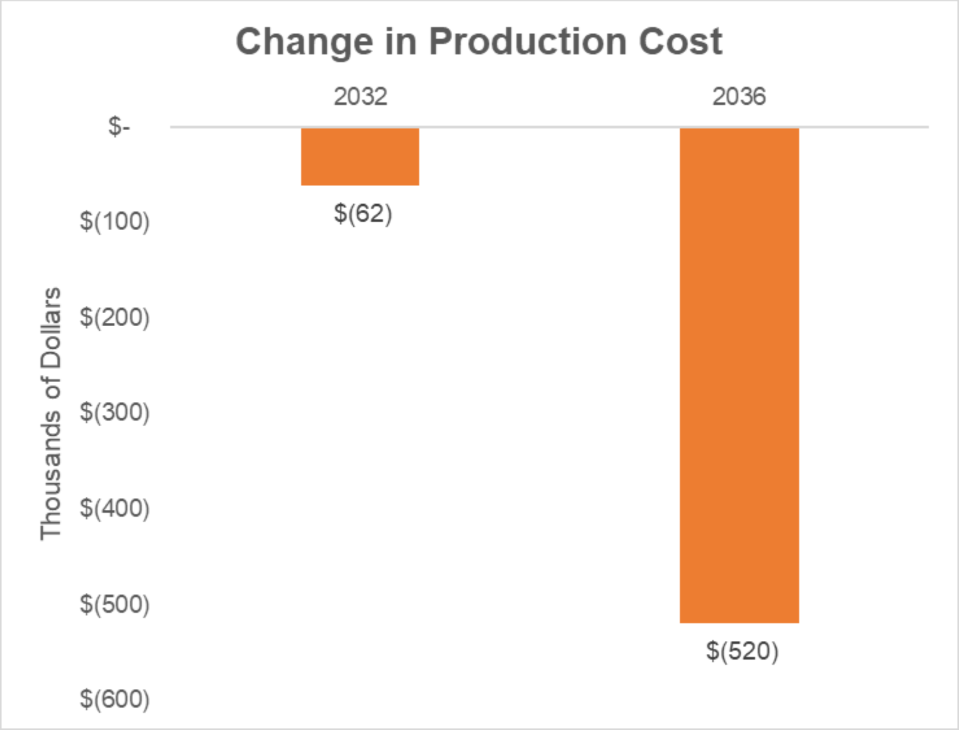

Figure 11: Change in NYISO Production Costs, 2032 and 2036

Annual Emissions

Annual CO_2 emissions represent the total carbon dioxide produced by the generating fleet across the NYISO system over the course of a year, calculated based on each unit's hourly generation output and its corresponding emissions rate. A central objective of the ConEd RFI is to address transmission reliability needs exclusively through clean and non-emitting resources, consistent with the goals of New York's Climate Leadership and Community Protection Act (CLCPA) and the broader imperative to reduce local criteria pollutants in New York City.

With the BESS, CO_2 emissions are reduced by 4.1 ktons and 10 ktons in 2032 and 2036, respectively. See Figure 12. BESS reduces system-wide CO_2 emissions through two complementary mechanisms. First, storage charges predominantly during off-peak periods when lower-emitting resources, e.g., nuclear, hydroelectric, and renewable generation, are more frequently on the margin, and then discharges during peak periods to displace less efficient, higher-emitting thermal generation that would otherwise be dispatched to serve load. Second, by providing local capacity within Zone J, battery storage directly offsets the need to run aging gas- and oil-fired peaking plants in New York City, which are among the least efficient and highest-emitting units on the system. The net effect is a measurable reduction in annual CO_2 emissions, demonstrating that BESS can simultaneously address transmission reliability needs and advance the state's decarbonization objectives.

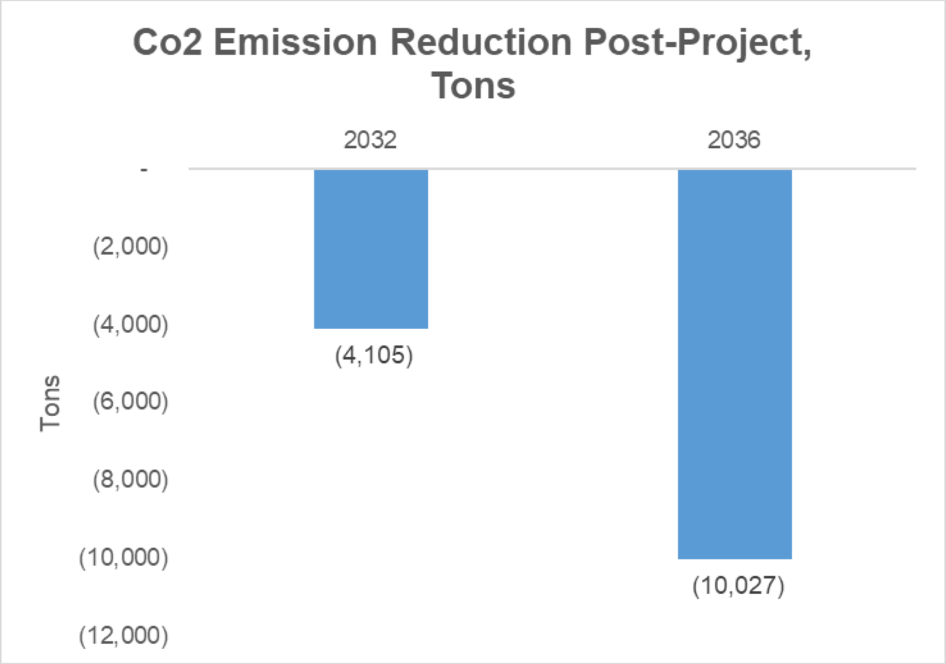

Figure 12: CO_2 Emission Reduction Post-Project, Tons, 2032 and 2036

NOx emissions decreased in the post- project scenario by approximately 3 tons and 8 tons in 2032 and 2036, respectively. These emissions reductions occur due to the batteries offsetting output from fossil generating units, including some peaker units which can burn higher emitting fuels or at high heat rates. NOx emissions and unit run hours are of particular concern in New York City, where air quality impacts are concentrated in the immediate vicinity of the plants.

Conclusions

In summary, the analysis showed that energy storage solutions can meet the reliability needs identified for New York City while simultaneously providing additional grid benefits. Power flow modeling showed that 165 MW / 660 MWh of energy storage systems in 2032 and 727.5 MW / 2910 MWh of energy storage systems in 2036, in the form of either four-hour or six-hour duration batteries, fully addressed the identified reliability needs. Acute analysis demonstrated that the BESS could sufficiently charge even when the two main contingencies were applied. The energy storage systems interconnected to the seven (7) network nodes in ConEd that were evaluated also provided additional benefits including:

1. Zone J load payment reductions:
    a. $15.06M and $5.5M reduction in Zone J load payments in 2032 and 2036, respectively.
2. NYISO-wide system production cost reductions:
    a. $62k and $520k reduction in NYISO-wide system production costs in 2032 and 2036, respectively.
3. NYISO-wide emissions reductions:
    a. 4.1 ktons and 10 ktons reduction in NYISO-wide of CO_2 emissions in 2032 and 2036, respectively.
    b. 3 tons and 8 tons of NOx emissions reductions in 2032 and 2036, respectively.

While these and other sites were screened and selected based on an iterative reliability and economic evaluation process, it is noted that additional site options were identified which, with sufficient BESS installation, would also adequately address the minimum identified reliability need in the 2032 and 2036 study years, i.e., 165 MW / 495 MWh in 2032, and 485 MW / 2910 MWh in 2036.

Further, the analysis showed that storage can meet the needs of the identified shortfall subject to the associated N-1-1 contingency over a two week period, and that the batteries have sufficient capacity and energy to resolve the stated need and that the batteries can sufficiently charge overnight to meet the need without causing constraints.

Appendix A – Summary of evaluated BESS sites

Table A.1 – Sites utilized in TARA in Step 1 of the analysis

Substation Name	kV	Remarks
Gowanus South	345	
Greenwood	138	
Greenwood South	138	
Hudson (#3)	138	
Farragut/Seaport (For Feeder #38M12)	138	
Farragut/Seaport (For Feeder #38M14)	138	
Sunset Park	138	New Sunset Park station (2036 only)

Table A.2 – Candidate sites considered for PROBE screening in Step 2 of the analysis, selected via review using TARA

Power Flow Model Bus Name	Substation Name	kV	Remarks
FARRAGUT EAS	Farragut East	345	
FARRAGUT WES	Farragut West	345	
FGT_Y3	Farragut/Brownsville (Bank #1 Bus) / Farragut Y	138	
FGT_Y1	Farragut/Brownsville (Bank #3 Bus) / Farragut Y	138	
FGT_X1	Farragut/Hudson Ave (Bank #1 Bus) / Farragut X	138	
FGT_X3	Farragut/Hudson Ave (Bank #3 Bus) / Farragut X	138	
FGT_X5	Farragut/Hudson Ave (Bank #5 Bus) / Farragut X	138	
FGT_X7	Farragut/Hudson Ave (Bank #7 Bus) / Farragut X	138	
FGT_Y5	Farragut/Seaport (For Feeder #38M11) / Farragut Y	138	
FGT_Y7	Farragut/Seaport (For Feeder #38M12) / Farragut Y	138	
FGT_Y10	Farragut/Seaport (For Feeder #38M13) / Farragut Y	138	
FDR_B24	FDR	345	
GOWANUS	Gowanus	345	
GOWNUST10	Gowanus	138	
GOW 1&3	Gowanus	138	
GOWBARG3	Gowanus	138	
GOWNUST14	Gowanus (Bank #1 Bus)	138	
GOWNUST2	Gowanus (Bank #2 Bus)	138	
GOWNUSR14	Gowanus (Phase Angle Regulator #1 Bus)	138	
GOWNUSR2	Gowanus (Phase Angle Regulator #2 Bus)	138	
GOWBARG1	Gowanus Barge G1	138	
GOWNUSR20	Gowanus R3 bus	138	
GOWNUST20	Gowanus Transformer 3 bus	138	
GRENWOOD N	Greenwood North	138	
GRENWOOD S	Greenwood South	138	
SUNPARK138	Sunset Park	138	New Sunset Park station (2036 only)
SUNPARK27	Sunset Park	27	New Sunset Park station (2036 only)
WATER TX1	Water Street	138	
WATER ST	Water Street	27	

Table A.3 – Candidate sites considered for PROBE screening in Step 2 of the analysis, selected via review of ConEd’s Standardized Interconnection Requirements (SIR) queue

Substation Name	kV
Bensonhurst No. 1	27
Bensonhurst No. 2	27
Greenwood	27