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VIA ELECTRONIC DELIVERY

Honorable Michelle L. Phillips
Secretary
New York State Public Service Commission
Three Empire State Plaza, 19th Floor
Albany, New York 12223-1350

RE: Case 18-E-0130 – In the Matter of Energy Storage Deployment Program

JOINT UTILITIES' STUDY OF NON-MARKET TRANSMISSION AND DISTRIBUTION ENERGY STORAGE USE CASES AND RELATED PROCESS PROPOSALS

Dear Secretary Phillips:

In accordance with Ordering Clause No. 20 in the Commission's June 20, 2024 *Order Establishing Updated Energy Storage Goal and Deployment Policy* in the subject proceeding,[1] enclosed please find for filing the Joint Utilities'[2] Study of Non-Market Transmission and Distribution Energy Storage Use Cases and Related Process Proposals.[3]

Respectfully submitted on behalf of
the Joint Utilities,

/s/ Janet M. Audunson

Janet M. Audunson
Assistant General Counsel

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[1] Case 18-E-0130, *In the Matter of Energy Storage Deployment Program*, Order Establishing Updated Energy Storage Goal and Deployment Policy (issued June 20, 2024).

[2] The Joint Utilities are Central Hudson Gas & Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, Orange and Rockland Utilities, Inc., and Rochester Gas and Electric Corporation.

[3] The Secretary granted the Joint Utilities an extension for filing this study to October 29, 2024.

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STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

In the Matter of Energy Storage Deployment Program	))	Case 18-E-0130

JOINT UTILITIES' STUDY OF NON-MARKET TRANSMISSION AND DISTRIBUTION ENERGY STORAGE USE CASES AND RELATED PROCESS PROPOSALS

I. INTRODUCTION AND BACKGROUND

The New York Public Service Commission (Commission) issued a recent order[1] addressing the energy storage roadmap[2] developed by the New York State Department of Public Service (DPS) and the New York State Energy Research and Development Authority (NYSERDA). The 2024 Storage Order, among other directives, (1) expands the statewide energy storage deployment goal to 6 GW by 2030; (2) provides additional incentive programs for market-based bulk, retail, and residential energy storage deployments; and (3) directs the Joint Utilities[3] to conduct a study of the non-market transmission and distribution (T&D) services that energy storage can provide.[4] The Joint Utilities address the study requirement of the 2024 Storage Order in this filing (this Study).

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[1] Case 18-E-0130, *In the Matter of Energy Storage Deployment Program* (Storage Proceeding), Order Establishing Updated Energy Storage Goal and Deployment Policy (issued June 20, 2024) (2024 Storage Order).

[2] Storage Proceeding, New York State Department of Public Service and New York State Energy Research and Development Authority New York's 6 GW Energy Storage Roadmap: Policy Options for Continued Growth in Energy Storage (filed March 15, 2024), *available at* https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Energy-Storage/Energy-Storage-Roadmap.pdf

[3] The Joint Utilities are Central Hudson Gas & Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, Orange and Rockland Utilities, Inc., and Rochester Gas and Electric Corporation.

[4] Storage Proceeding, 2024 Storage Order, pp. 66-67 and Ordering Clause No. 20, pp. 96-97.

In the 2024 Storage Order, the Commission stated that this Study should include (1) an engineering and economic review of the types of energy storage applications the utilities can deploy as part of their obligations to provide safe and reliable service in the most efficient and effective manner; (2) a description of how utilities will modify system planning and operations to accommodate energy storage as a new tool; and (3) a proposed process for the review and approval of energy storage projects as well as "a cost recovery mechanism, if the process does not align with the normal rate case schedules."[5] This Study addresses each of these directives.

The Joint Utilities support the Commission's determination of energy storage as another T&D asset to be deployed alongside traditional assets and affirm that non-market energy storage use cases should be another tool in the utility toolbox and treated in a manner similar to traditional utility investments. Energy storage allows for the reliable, efficient, and affordable movement of electric power across time, much like the development of electric substations and AC transmission lines, which allow for the reliable, efficient, and affordable movement of electric power across distance.

Throughout this Study, the Joint Utilities will utilize two terms to help explain how energy storage can address non-market T&D needs. The first term, *utility wired infrastructure (UWI),* includes, but is not limited to, utility-owned and operated T&D conductors, cables, and related structures and components, substations and related equipment, and various communications, protection, and control technologies. UWI will continue to play a leading role

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[5] *Id.*, pp. 66-67.

in expanding the electric system to accommodate electrification and the siting of renewable resources.[6]

The second term, *utility integrated storage (UIS)*, refers to energy storage owned and operated by a utility for non-market purposes to provide equivalent non-market T&D services to UWI. UIS serves a similar purpose as other utility-owned and operated critical infrastructure — such as capacitors, conductors, transformers, or switchgear – which utilities are obligated to plan, deploy, and operate to maintain network performance, provide customers with reliable service, and comply with regulations and mandates. In addition, UIS is a key grid-enhancing technology that can increase T&D utilization. Operation of UIS will be controlled, dispatched, and coordinated with other utility infrastructure, including UWI, to deliver the intended use case outcome. UIS offers utility planners another "tool in the toolbox" to meet customers' evolving needs.

II. EXECUTIVE SUMMARY

Although some of the Joint Utilities have deployed utility-owned energy storage projects with approved use cases, the ability and frequency to use UIS as a T&D resource alongside UWI has been limited. Unlocking the Joint Utilities' ability to employ UIS as a tool to provide non-market T&D services will support an efficient energy transition and provide benefits. Modern T&D systems are increasingly dynamic and will become more so as supply becomes more intermittent with renewable penetration, and load becomes more complex as electrification

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[6] The U.S. Department of Energy defines renewable energy as "energy that comes from unlimited, naturally replenished resources, such as the sun, tides, and wind. Renewable energy can be used for electricity generation, space and water heating and cooling, and transportation." *Available at* https://www.energy.gov/eere/renewable-energy

increases.[7] The New York Independent System Operator's (NYISO) most recent System & Resource Outlook aptly describes the situation, noting that "[a]long with other state economic and clean energy policies, New York's energy landscape will continue to change rapidly. The evolving system requires continuous re-examining of how to efficiently and cost-effectively balance resources and demands."[8] Energy storage can be dispatched to absorb and inject power relatively quickly, bringing unique attributes to the T&D system. At various times, energy storage can be a T&D asset, a market-based asset, or a combination of both. However, this Study focuses on UIS, which provides non-market T&D services. UIS is well suited as a tool in the toolbox for utilities to enhance safe and reliable service, especially against this backdrop. Moreover, utility T&D systems offer the delivery and integration infrastructure necessary to maximize the benefits of UIS. This is particularly true in ensuring customers receive the benefits from clean energy resources they have paid for. Thus, the ability to integrate UIS as part of the T&D system when opportunities arise advances the public interest.

Having UIS as a tool in the toolbox will enhance utility planning options to provide more effective and efficient outcomes. For example, in more densely populated areas, UIS may help meet customer needs, especially to meet EV demand and other beneficial electrification (i.e., Bridge-to-Wires (BTW) programs and distribution hosting capacity). In some instances, UIS can deliver faster solutions to enhance customer service reliability and resiliency while minimizing environmental disturbances associated with building new or upgraded T&D lines. New

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[7] Electrification as used herein includes beneficial electrification, which refers to electrification necessary to address increasing demand from building decarbonization via heat pumps, clean heating and cooling measures, transportation electrification (i.e., customers increasingly choosing electric vehicles (EVs)) and electric heating for homes and businesses.

[8] *2023-2042 System & Resource Outlook (The Outlook)*, A Report from the New York Independent System Operator (July 23, 2024), p. 4.

operational processes will need to be introduced to manage UIS once UIS has been established as a tool in the planning process.

This Study addresses these matters and describes priority UIS applications to meet utility obligations to serve, support grid operations, and advance the State's clean energy policies. The UIS applications developed by the Joint Utilities are presented in Part III of this Study in more detail, with examples of UIS provided in Appendices A and B hereto.[9] Part IV of this Study presents a multi-step planning and evaluation framework for UIS while Part V addresses operational and future considerations for energy storage today and the need to update the framework as new needs, applications, and technologies emerge through the clean energy transition. Part VI of this Study explains why the unique nature of storage applications from both a timing and cost perspective requires a flexible regulatory approach that encourages the timely deployment of UIS. Lastly, Part VII presents the Joint Utilities' conclusions on UIS.

For all the reasons set forth herein, the Joint Utilities respectfully request that the Commission: (i) accept this Study in satisfaction of the 2024 Storage Order;[10] (ii) authorize UIS for non-market T&D applications; (iii) approve the UIS planning and evaluation framework proposed in Part IV of this Study for the purpose of identifying programs and projects to be presented to the Commission for its review and approval; (iv) adopt the proposed utility approach for requests for approval of UIS programs, projects, and corresponding budgets that do not align with normal rate case schedules, as discussed in Part VI of this Study; and (v) direct

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[9] Niagara Mohawk Power Corporation d/b/a National Grid (in Appendix A) and Consolidated Edison Company of New York, Inc. and Orange and Rockland Utilities, Inc. (in Appendix B) provide UIS examples. There are some differences in applications that represent the specific perspectives of the utilities providing the appendices.

[10] *Supra* note 4.

each of the Joint Utilities to file tariff revisions as needed to implement the surcharge mechanism proposed herein.

III. T&D ENERGY STORAGE APPLICATIONS

In 2022, the Joint Utilities developed five utility-owned, grid-connected energy storage use cases for non-market T&D needs and presented them as part of comments filed in the Commission's Climate Leadership and Community Protection Act (CLCPA) Proceeding.[11] The five use cases were: (1) co-locating energy storage at utility infrastructure; (2) operationally complex reliability/resilience projects; (3) real-time operation/controls integration; (4) energy storage for transmission applications/system integration; and (5) mobile energy storage systems. Work on developing energy storage applications continued in 2023 and was refined by the Energy Storage Task Force (ESTF) established by the Joint Utilities' Advanced Technology Working Group (ATWG). To further advance the discussion of potential energy storage use cases, including their attributes and applicability, the ESTF engaged in studies to support storage deployment across the state, and intends to continue advancing technology and feasibility work necessary to support the clean energy transition.

In its review of utility ownership of energy storage, the Commission directed the Joint Utilities to "conduct a study of the non-market T&D services that energy storage projects can provide."[12] To comply with this requirement, the Joint Utilities have identified targeted, real-world applications that would enable the Joint Utilities to address planning violations, maintain

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[11] Case 22-M-0149, *Proceeding on Motion of the Commission Assessing Implementation of and Compliance with the Requirements and Targets of the Climate Leadership and Community Protection Act* (CLCPA Proceeding), Joint Utilities' Comments on Utility Ownership of Distributed Energy Resources and Large-Scale Renewable Energy Projects (filed August 10, 2022), pp. 14-18.

[12] *Supra* note 4.

system reliability and resiliency, provide operational flexibility, maximize renewable energy generation output, and meet customers' electrification requirements through deploying energy storage integrated into utility infrastructure and operations via UIS. Given these considerations, the Joint Utilities have identified six applications (A through F) where UIS could support or provide T&D services.

A. Flexible Transmission Capacity: Energy storage is integrated with utility substations or lines to provide flexible capacity to areas of the transmission grid sensitive to acute forecast increases due to electrification or other loads; provide contingency, resilience, or stability support; and help manage grid congestion. This also offers the ability to strategically use UIS in specific locations to reduce local emissions.

B. Flexible Distribution Area Capacity: Energy storage is integrated with utility distribution lines to provide flexible capacity to areas of the grid sensitive to acute forecast increases due to EV charging or other beneficial electrification or customer loads, and provide contingency, resilience, and reliability support.

C. Distribution Resiliency and Reliability: Energy storage is integrated with utility distribution lines or networks to increase the reliability and resiliency of the local grid and temporarily restore electricity delivery or reduce demand for grid operations in areas of the system susceptible to interruption and weather events.

D. Bridge-to-Wires (BTW): Energy storage is integrated and sited with utility distribution lines or networks to proactively support infrastructure in areas of the grid subject to a greater rate of change related to accelerated and large customer load growth due to electrification, EV concentration, or economic development.

E. Large-Scale Renewable Enablement: Energy storage is integrated with utility substations or transmission lines to increase the deliverability of renewable energy resource(s) by managing variable transmission system capability and voltage, in addition to mitigating curtailment of renewable resource(s).

F. DER Integration and Hosting Capacity on Distribution Network: Energy storage is integrated with utility distribution infrastructure to increase the capacity of system areas or load pockets to host additional renewable and distributed energy.

The T&D priorities and applications discussed above are prioritized differently by each of the Joint Utilities based on grid topology, utility system configurations, and the customer needs of each region. Additional T&D UIS priorities and applications specific to certain utilities are discussed in Appendices A and B to this Study. As the electric power system evolves, these applications will become increasingly important tools for addressing emergent needs and challenges. The complexity of the grid will require more sophisticated planning, solutions, and operational procedures. A periodic re-evaluation is needed to assess, change, and/or incorporate new priorities to manage evolving grid needs as customer electricity demand changes and sources of electricity supply change.

The T&D energy storage applications are described in more detail below, and the discussion of each application is structured in a consistent manner that addresses the following considerations:

- Challenge: A customer need, grid need, or policy objective supported by a system modification or upgrade.
- Potential UIS Solution: A description of the UIS solution, alone or in combination with UWI. The description focuses on how UIS functionality helps address the challenge.
- Evaluation: The benefits (customer and technical performance) of the UIS solution from a quantitative and qualitative perspective.
- Implementation Steps: How the UIS solution is built and operated to serve customers, address the challenge, and support the broader New York energy system.

A. **Flexible Transmission Capacity**

This application integrates energy storage with utility transmission system infrastructure to provide flexible capacity for balancing variable power flow, supporting system stability, and helping to manage grid congestion, which are core reliability functions. For this application, utilities would operate the UIS to prioritize support of the local electric grid based on system design requirements, conditions, and emergencies rather than market signals. The utility would maintain full operational control and flexibility to manage the reliability of local transmission systems.

i. Challenge

The challenge is similar to that addressed in subpart E, the Large-Scale Renewable Enablement application. Certain hours of the day see more significant transmission line capacity constraints than others. With the transformation of New York's energy system, this problem will worsen as electrification increases load, and intermittent renewable resources are not always timed to match those load increases. Increased transmission capacity will be required to meet rising demand in specific regions. Alternatively, areas with high energy demand and a scarcity of supply are more susceptible to system instability; however, expanding the transmission network can be challenging, as described in the Large-Scale Renewable Enablement application in subpart E.

ii. Potential UIS Solution

UIS can help solve this problem by taking advantage of low-load, non-congested periods to prepare for and relieve future capacity constraints. For instance, a battery close to a load can charge during off-peak hours and release power into the local load when upstream transmission system capacity is limited.

A UIS solution can be designed to address the constraint as the load and supply change. The capacity and energy specifications of the UIS would be designed to prevent criteria violations – and not to optimize for market signals – while meeting customer needs. For example, the UIS must have capacity (i.e., megawatts (MW)) and/or energy (i.e., megawatt-hours (MWh)) to provide sufficient power to a substation to prevent a local transmission line overload. The UIS has reactive power capability to help regulate local system voltage throughout the day with the prevailing load shape.

UIS can be dispatched according to a predetermined schedule with its operation adjusted in response to local conditions and needs, including power flow and voltage support. The dispatch schedule would be determined by the utility grid needs such as these and not by market-based indicators. Operations and control capabilities will comply with reliability criteria and protocols.

iii. Evaluation

This UIS solution offers multiple benefits:

PRIMARY:
- Provides capital cost savings by deferring a traditional transmission upgrade.

SECONDARY:
- Enhances reliability while minimizing need to operate fossil fuel generators.
- Aids resiliency and reliability during winter peak periods.
- Is visible and dispatchable by the NYISO to assist in transmission system operations and resource management during system contingencies.
- Is environmentally benign.
- Provides siting flexibility as an alternative to deploying additional transmission line infrastructure.

iv. Implementation Steps

The UIS solution can be connected to an existing or new substation. A schedule will be developed based on anticipated local transmission system needs so that when events occur, the utility can make the asset available for the NYISO to address system conditions that may arise. The NYISO provides direction for the operation of the UIS based on a proposed schedule from the utility and may coordinate to redispatch operations of the UIS based on emergent system needs.

Similar to the implementation recommendation for the Large-Scale Renewable Enablement application discussed in subpart E below, a UIS solution is most optimally operated as a cost-based resource integrated into a utility's transmission system. A merchant resource that does not have cost-based recovery would depend on energy arbitrage profits to cover its costs. Although this profit maximization operational goal will alleviate some congestion, merchant operators may not consider local reliability needs and may not be economically incentivized to fully relieve congestion. In some circumstances, a merchant battery may not be incentivized to discharge during a peak congestion hour if a larger price spread is expected in a subsequent period.[13] However, the behavior of a cost-based asset on a utility transmission system would not need to focus on price spreads or forecasts. Grid needs would solely determine such an asset's operations, and the asset would be charged and discharged as necessary to optimize for efficient system operations.

B. Flexible Distribution Area Capacity

This application integrates energy storage with utility distribution system infrastructure to provide flexible capacity to support grid areas sensitive to acute forecast increases due to EV charging and other beneficial electrification. Flexible capacity can be coordinated to manage UWI limitations. UIS flexibility could also support different operational scenarios, such as when planned outages are necessary to perform infrastructure upgrades. Flexible capacity also

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[13] *See 2023 State of the Market Report,* Potomac Economics (May 2024), p. 19, *available at* https://www.potomaceconomics.com/wp-content/uploads/2024/05/NYISO-2023-SOM-Full-Report__5-13-2024-Final.pdf and *Energy Storage Resources: Opportunity Costs and Mitigation Measures,* NYISO (December 17, 2019), slide 4, available at https://www.nyiso.com/documents/20142/9802057/ESR%20-%20MIWG%20-%2012_17_19.pdf/1dfbbd94-d9fe-0cad-bbf0-775950f723bd

increases contingency, resilience, and reliability support for local distribution customer needs. Providing such distribution capacity to support reliable customer service represents a primary utility responsibility.

i. Challenge

Load growth increases distribution system demand, causing voltage and thermal capacity violations. In some areas, traditional solutions may not be optimal due to siting and space constraints. This application may also be addressed in tandem with those applications in subparts A and F.

ii. Potential UIS Solution

To address distribution capacity issues, UIS can charge during off-peak hours and discharge to reduce power flow through a constrained distribution system element such as a feeder or transformer. Specifically, charge and/or discharge durations are sized to offset the magnitude and duration of peak demand fluctuations, and energy storage can be dispatched or automated to inject or absorb power to balance local network capacity. UIS can operate in coordination with a utility's advanced distribution management system (ADMS) and future distributed energy resource management system (DERMS) to coordinate UIS dispatch with distribution feeder optimization plans. Similarly, UIS dispatch profiles can match daily or seasonal load profiles to limit peak demand on the system.

This UIS solution has a modular and scalable design, which includes multiple switching options with onboard protection and controls to enable connection and power to different distribution feeder locations in various configurations. This UIS solution, which should have applications throughout New York State, is expected to be a device utilizing standardized designs—to leverage efficiency gains—and a footprint that is easy to site and permit when it is located on utility property. Such installations can also support voltage regulation with advanced volt-ampere reactive (VAR) injection or absorption to support distribution system voltage and power factor for variable demand. Further, the UIS solution could include oversized inverters for higher reactive output to reduce the need for some traditional voltage control equipment, such as voltage regulators and capacitors.

iii. Evaluation

This UIS solution offers multiple benefits:

PRIMARY:
- Provides capital cost savings by moderating the need for deployment of traditional distribution upgrades and allowing for enhanced planning of such upgrades.
- Releases capacity or increases electrification hosting capacity on existing grid infrastructure.

SECONDARY:
- Results in avoided costs and provides time savings for manual operations and other grid services.
- Provides increased hosting capacity for small or aggregated (non-utility owned) distributed energy resources (DERs).

iv. Implementation Steps

The UIS solution can be configured and integrated into utility infrastructure through (1) distribution feeders with multiple three-phase primary voltages (i.e., front-of-the-meter (FTM)) using pad-mounted, pole-mounted, or other right-of-way configurations; (2) distribution substations; (3) sub-transmission lines; and (4) priority electrification circuits.

C. Distribution Resiliency and Reliability

This application integrates energy storage within a utility distribution system infrastructure to provide additional or temporary backup power during a constraint or interruption of the primary power source. It can temporarily restore supply or reduce demand for grid operations and increase reliability in an area of the system with constraints caused by a system contingency. This may include servicing an area where system expansion is limited due to physical and environmental constraints. Providing such distribution capacity to support reliable customer service is a primary utility responsibility.

i. Challenge

Power interruptions and constraints—such as outages, thermal overloads, or loss of distribution or sub-transmission—can affect customers' service. The operational flexibility of UIS can benefit the operations of distribution networks and substations by temporarily supporting feeder ties, controlling voltage, and managing power factor. In some applications, UIS, as part of a microgrid, can enhance safety, resiliency, and reliability for critical connected customers (e.g., healthcare, public safety, or other societal services).

Adding redundant supplies to distribution substations may be impractical, prohibitively expensive, or time-consuming due to distance, lack of space, phase synchronization, or other constraints. A feeder upgrade might also be difficult due to siting and permitting challenges. Finally, a wires solution might work during some system conditions (e.g., lighter load periods) but not others (e.g., peak load periods).

ii. Potential UIS Solution

This UIS solution is designed to provide power to the local distribution system, with an emphasis on supporting customers during distribution outages or constraints, as well as providing capabilities to mitigate sub-transmission or transmission outages. Discharge duration is sized to match the magnitude and duration of local customer and system needs. Further, smart inverters can help regulate distribution circuit voltage if desired. UIS provides equivalent services to a wired solution (e.g., decreased risk, load relief, and redundancy for N-1 contingency scenarios). In addition, energy storage can operate in coordination with the distribution control center and distribution automation schemes such as fault location, isolation, and service restoration (FLISR) to increase resiliency. Utilities can integrate UIS into existing utility systems and operate with distribution control centers. UIS can feature multiple switching options with onboard protection and control to enable connection and power to different distribution feeder locations in various configurations. Such installations can also support voltage regulation with advanced VAR injection or absorption to support distribution system voltage and power factor for variable demand. Further, the UIS solution could include oversized inverters for higher reactive output to reduce or eliminate some traditional voltage control equipment, such as voltage regulators and capacitors.

UIS can support islanding and grid-forming capabilities, where feasible. When emergencies or power interruptions occur, distribution islanding can temporarily restore some power or reduce the need to deploy mobile diesel generation to some customers or critical infrastructure. The UIS can also include microgrid controllers and comply with standards such as the Institute of Electrical and Electronics Engineers (IEEE) 2030.5 and 2030.7 to support seamless integration and operation within the Common Information Model (CIM) framework. The UIS are small devices with small modular footprints and well-established paths for siting and permitting. They can also be pole-mounted or installed where utilities have site control. UIS can also meet both upstate and downstate requirements. Given that these are systems that are rapidly deployable, modular, and scalable, UIS allows the connection of multiple utility-owned and operated devices to increase total capacity or stored energy. UIS solutions incorporate robust cybersecurity measures compliant with industry standards, including North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection (CIP) standards.

iii. Evaluation

This UIS solution offers multiple benefits:

PRIMARY:
- Improves reliability and resilience for connected customers.
- Mitigates the risks associated with contingencies by providing flexible capacity during peak demand or unexpected contingency events.
- Improves near-term resiliency and reliability, with value from deferring a UWI solution in the longer term.
- Provides an option to build a near-term solution to match load growth and a longer-term solution using UWI.

SECONDARY:
- Avoids costs and provides time savings as a result of less manual switching of capacitor banks for voltage regulation.
- Provides demand reduction for the local distribution system.
- Creates incidental electricity cost savings for customers.

iv. Implementation Steps

UIS is configured and interconnected to the grid via distribution feeders with multiple three-phase primary voltages (i.e., FTM) using pad-mounted or pole-mounted configurations via distribution substations, utility rights-of-way, or utility microgrids. UIS provides:

- grid services to utilities that have control and dispatch authority; and
- resource monitoring, control, and coordination.

D. Bridge-to-Wires (BTW)

i. Challenge

Many customer load pockets will experience significant load increases due to electrification and other load growth. The speed and magnitude can vary as large sectors of the state economy transition away from fossil fuel to electric power as envisioned by the CLCPA.

Current customer energy service processes require that customers submit service requests before new service infrastructure is designed and built. Due to the complex nature of electric design, including underground construction, right-of-way limitations, space, and reliability requirements, utilities design and build systems at larger scales. It may not be possible or efficient to meet customer needs in a timely fashion, or avoid system violations, if designs are limited to wires and construction must wait for customer load letters to be received by the utilities. Further, building UWI solutions alone could limit the ability to combine the long-term value and benefits, such as enhanced operational flexibility and resiliency, that energy storage can provide. The available tools and permissible practices set the pace at which utilities plan and build to meet customer needs and support reliability. As the pace of the transition accelerates and customer needs to expand in many areas simultaneously, the UWI-only approach can encounter logistical and resource constraints that could hinder the energy transition and limit the speed of customer adoption of electrification technologies. Improvements in planning flexibility, more tools in the toolbox, and a wider array of construction approaches are needed to support the clean energy transition. UIS in the form of BTW is another unique application intended to address this challenge.

ii. Potential UIS Solution

BTW can efficiently address emerging customer needs by using UIS to complement UWI as customer load grows. For example, rather than waiting for a fleet electrification customer's service request and triggering a subsequent response to meet customer timelines, utilities can proactively deploy UIS in combination with UWI to provide flexible capacity in targeted areas of the distribution grid. Utilities would continue to plan and build additional UWI as adoption rates accelerate but with the flexibility to use UIS for expanded support or transition the UIS to fulfill other grid needs such as supporting local emergencies, resiliency, local grid optimization, or increasing hosting capacity for DERs. In targeted areas with clustered large individual loads, utilizing the new BTW application can optimize system expansion by coordinating and sharing utility distribution feeders, customer services, and batteries to support initial customer loads and provide resiliency. UIS would be integrated at the optimal utility infrastructure location (i.e., at the substation, along the right-of-way, or at the point of service) to maximize the full benefit of energy storage. By addressing emerging needs proactively with BTW, it is possible to enable initial service capacity and provide a "bridge" to support accelerating demand while additional UWI is built. In this way, the BTW solution offers optionality and efficiency. When UIS is available to help manage load growth in BTW areas, more UWI resources could be available for deployment in areas where UWI is the immediate required solution.

BTW solutions are suited to support grid needs that emerge quickly and may grow. A BTW solution can be located near a single large new load or a cluster of large transportation hubs installing EV chargers. While a large UWI solution could take years to plan, permit, and build, a proactive BTW solution could be built in phases as close to the speed of electrification adoption as possible.

BTW solutions offer flexibility and can be used in multiple ways. A BTW solution could be designed to meet capacity needs in the near term and repurposed to meet other grid needs as they emerge. Such needs could include grid management, local reliability and resilience, and system emergencies. This can be done by keeping the BTW resource where it was installed or moving it to a location where it can provide enhanced value.

BTW has the flexibility to support customer loads and reliability needs simultaneously and over time while supporting local grid management needs such as feeder balancing, power quality, and resiliency for distribution circuits Additionally, BTW can be coordinated with the NYISO to help share capacity to support system emergencies and broader energy transition goals, this ensures that the investment remains used and useful over the life of the project.

iii. Evaluation

In many cases, UWI solutions alone are not the best option, as they cannot meet planning requirements prior to deployment when new loads and customer demand is subject to varying adoption schedules. In contrast, deployment time differences can be spelled out when proposing BTW projects. The benefits that BTW can provide, but not UWI alone, can be valued quantitatively and qualitatively as part of utility planning processes.

Each utility will evaluate the relative costs and long-term value of energy storage as a standalone solution or in combination with UWI solutions to arrive at the best-fit solution when considering deployment options. Utilities must also consider the attributes only UIS can provide when addressing best-fit criteria. UIS operational flexibility and other benefits that BTW brings should be considered beyond simply meeting the load provision requirements of an identified grid need.

iv. Implementation Steps

BTW solutions are configured and integrated with the grid by deploying energy storage coupled with distribution feeders and utility services. They should be optimally sited to support interconnecting loads and enable the interconnection of future loads at locations where the utility has full site control.

BTW solutions provide grid services by optimizing system expansions based on the timing and contours of future load and via grid management applications (e.g., feeder balancing, power transfer, reactive power control, hosting capacity). In this application, UIS would become fully eligible to support broader system needs once local grid needs are fully addressed and UWI is fully built out. Some utilities may be able to redeploy UIS initially designed for mobile applications.

E. Large-Scale Renewable Enablement

This application uses UIS with a utility's transmission system infrastructure to increase the deliverability of renewable energy by managing variable system capacity and voltage. For this application, utilities would operate the UIS to prioritize a dispatch schedule to maximize renewable energy deliverability based on system conditions rather than market signals and maintain full operational control and flexibility to manage reliability on local transmission systems.

i. Challenge

Large-scale renewable energy resources are often located where land is available but the load is minimal. High output from renewable energy in such areas can cause planning criteria violations such as thermal overloads or voltage violations on transmission lines. Congestion on transmission lines can prevent the delivery of renewable energy to areas with greater loads, necessitating the use of resources that may be more expensive and not renewable. Curtailing renewable energy output to avoid transmission violations and congestion is a waste of clean energy that customers have already paid for and is needed to meet CLCPA goals.

A new transmission solution or upgrade to perform these functions may pose environmental challenges to build, be time-consuming to permit, be further complicated by factors such as distance and phase synchronization requiring right of way expansions, and present other challenges, all adding to project costs. Moreover, siting, permitting, constructing, and commissioning a traditional transmission solution could take much longer than siting energy storage while some violations or inefficiencies continue to exist. These challenges also apply to the Flexible Transmission Capacity application as outlined above in subpart A.

ii. Potential UIS Solution

Due to the intermittent nature of renewable resources, transmission capacity may need to be increased only at specific hours of the day when there is significant "excess" generation. Energy storage can increase the capacity of a transmission line utilization by integrating storage within transmission networks serving these generation pockets and charging at these hours – when available generation exceeds the available capacity – and discharging when system capacity is available. UIS allows transmission owners and operators to flexibly address rapid changes in system conditions due to the intermittent nature of renewables to meet customers' needs and enable delivery of clean energy.

The UIS can inject or absorb power to balance the variable output of a large renewable energy resource. The capacity and energy specifications of the UIS are designed to prevent criteria violations. For example, the UIS must have a charging capacity (i.e., MW) to absorb surplus power from the renewable resource to prevent a local transmission line overload. Likewise, the UIS must be appropriately sized and have sufficient duration to absorb power during the period (e.g., hours) for which the renewable resource output could cause a transmission overload. The UIS would inject power into the network when sufficient transmission capacity is available (e.g., during low renewable generation periods). The utility would operate the UIS on a fixed seasonal schedule based on system conditions such as local peak renewable generation rather than market signals.

The UIS has reactive power capability to help regulate local system voltage as renewable power fluctuates. The UIS can be dispatched according to a predetermined schedule and adjust its operation in response to local conditions, including power flow and voltage. Operations and control capabilities will comply with prevailing reliability criteria and protocols.[14]

iii. Evaluation

This UIS solution offers multiple benefits:

PRIMARY:
- Provides capital cost savings from optimization of UIS with, or avoidance of, UWI.
- Reduces renewable resource curtailment and congestion.

SECONDARY:
- Aids resiliency and reliability during winter peak periods.
- Accommodates visibility and dispatchability at the request of NYISO to assist in transmission system operations and resource management.
- Is environmentally benign.

iv. Implementation Steps

The UIS solution is interconnected to the local transmission system at an optimal location relative to the renewable resources to balance renewable output, as discussed above. The UIS

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[14] *E.g.*, NERC, NYISO, and specific utility requirements.

could be connected via an existing or new substation. Like UWI, UIS planned outages and dispatch could be changed to address planned and unplanned contingencies, depending on the needs and policies of individual utilities. The utility would coordinate scheduling with NYISO for regular operations, and NYISO could redispatch or otherwise amend operations in coordination with the utility based on broader system needs.

A UIS solution of this nature is most optimally operated as a cost-based, non-market resource (i.e., a resource where cost is recovered in utility rates) integrated into a utility's transmission system. Although merchant energy storage owners may achieve some of the benefits described here, any resource developed primarily for market participation would need to maximize energy arbitrage profits to cover that asset's cost. This resource type could be economically incentivized against eliminating renewable energy curtailment as at least some transmission line congestion creates the energy arbitrage opportunity on which this type of resource would depend. With its cost recovery guaranteed, however, a non-market resource, such as a utility-owned battery, would seek first to optimize its operations to create the greatest system benefit, minimize congestion, and mitigate as much curtailment of renewable energy as possible.

F. DER Integration and Hosting Capacity on Distribution Network[15]

UIS could be utilized to accommodate increases in DERs, such as solar photovoltaic (PV) projects, on a utility distribution circuit or network. Note that this application differs from the "Large-Scale Renewable Enablement" application discussed above in subpart E in that it intends to target distribution network needs rather than transmission system needs.

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[15] This application is intended to align with current utility practice or proposals on DERs and large generator interconnections on T&D systems and does not imply a change in existing practice or proposals.

i. Challenge

High solar output during off-peak and light load periods can cause voltage problems, thermal overloads, and protective relaying challenges due to variable and reverse power flow on distribution systems. In addition, developer-owned and market-only energy storage assets may cause system constraints during discharge, as described above in subpart B (Flexible Distribution Area Capacity) and subpart E (Large-Scale Renewable Enablement). Contingencies can exacerbate distribution capacity and voltage problems in distribution systems with high penetrations of DERs, while some distribution systems cannot accommodate the interconnection of some types of DERs.

Distribution upgrades, such as substation upgrades, may be prohibitively expensive due to distance, lack of space, permitting, phase synchronization, or other constraints. Similarly, siting, permitting, and construction times for a UWI solution could be extensive. Conversely, a scalable UIS solution could be built to match customer needs as they change.

ii. Potential UIS Solution

UIS discharge duration can be sized to offset the magnitude and duration of peak DER fluctuations. It can be dispatched or automated to inject/absorb power to prevent constraints on utility assets caused by DG output. Further, smart inverters can help regulate distribution circuit voltage if desired.

In this application, UIS systems could leverage standard designs that are modular and scalable. Features could include multiple switching options with onboard protection and control to enable connection and power to different distribution feeder locations in various configurations. These systems could be designed to be easy to site and permit and meet the requirements of upstate and downstate distribution systems. Such UIS systems could support voltage regulation using advanced, four-quadrant smart inverters for voltage/VAR injection to support distribution system voltage and power factor for variable DER output. Engineers can also oversize inverters for higher reactive power output to reduce or eliminate the need for traditional voltage control equipment such as voltage regulators and capacitors.

iii. Evaluation

This UIS solution offers multiple benefits:

PRIMARY:

- Supports higher DER penetration.
- In some circumstances, provides cost savings relative to a traditional distribution upgrade through use of more flexible planning and orderly deployment.

SECONDARY:

- Increases asset utilization and encourages the rightsizing of generation resources.
- Provides avoided losses and potential cost savings resulting from less manual switching of capacitor banks for voltage regulation.
- Provides demand reduction for the local distribution system.

iv. Implementation Steps

UIS is configured and interconnected to the grid through distribution feeders with multiple three-phase primary voltages (i.e., FTM) using pad-mounted or pole-mounted configurations, via distribution substations, or through priority electrification circuits.

UIS provides grid services through utilities maintaining control and dispatch authority. Under some applications, utilities can schedule and bid the UIS. Utilities can also be operators, managing dual participation, and providing resource monitoring, control, and coordination.

IV. PLANNING AND ECONOMIC CONSIDERATIONS

The 2024 Storage Order directs that this Study include "an economic review of the applications that energy storage could provide to the utility as it fulfills its obligations to provide safe and reliable service in the most efficient and effective manner."[16] The following integrates this review of energy storage value as a utility asset into a planning framework that includes stages of evaluation for solutions to identified violations of planning criteria. Specifically, the Joint Utilities explain how they would use UIS as a "tool in the toolbox" by broadly following the same planning process and project evaluation steps for UWI and UIS, while evaluating where UIS attributes could increase benefits.

The New York State power grid serves diverse demands, with the upstate grid facing challenges such as the curtailment of renewable energy in excess of system limitations, expansive geography with overhead electric networks, diverse environmental considerations, and a relative abundance of available land with some areas lacking interconnection capacity to enable additional renewable development. In contrast, the downstate grid contends with high energy demand, spatial limitations, scarcity of energy supplies, and a mostly insular and subterranean network system beset with unique technical challenges. Existing mechanisms, such as Non-Wires Alternatives and Utility Dispatch Rights, allow utilities to procure services from third party-owned energy storage, and these should continue to be utilized, consistent with current practice.

A. <u>UIS as a New Tool in the Toolbox</u>

UIS is a flexible resource that utility planners can use in various applications, as detailed in Part III above, to meet customer and grid needs. Like all solutions, the suitability of UIS depends on the characteristics of the need, the location of the solution, and the total value it can provide. In a time of system expansion, UWI will continue to be selected as the recommended

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[16] *Supra* note 4.

solution for system expansion. Third party-owned energy storage assets would be considered to meet some planning use cases as is done today under Non-Wire Alternatives solicitations and similar Utility Dispatch Rights contracting. However, UIS solutions become increasingly attractive, particularly when siting, engineering, contracting, and construction of UWI and third-party solutions are challenging, impractical, or when a deployed application meets technical requirements while providing grid flexibility and more long-term value.

Energy storage fulfills multiple roles within the energy transition. In addition to providing a means to store intermittent renewable energy for peak demand and providing planned statewide capacity adequacy, utility planners can deploy UIS to solve local grid needs and work as an operational tool with flexibility to help enhance the reliability and resiliency of the local grid. UIS can also support changing customer needs and provide flexible capacity as the speed of electrification changes and load materializes over time.

The subparts i-v immediately below discuss essential elements considered in the energy storage framework to determine the best-fit approach for energy storage deployment. The Joint Utilities identify situations and conditions for UIS deployment when utility planners consider options and solutions. UIS can be incorporated into existing planning and engineering analyses.

UIS solutions offer potential advantages for utility planners in several critical areas. While these advantages do not constitute analysis or selection criteria, they provide a context for how utility planners will consider a UIS tool.

i. Planning Horizon and Scope

- When multiple short- and long-term grid needs can be fulfilled to create flexibility for long-term planning;

- When used as part of a targeted plan for current or projected areas of growth; or
- When a shorter-term or interim solution is necessary and can complement a long-term plan, such as with modular expansion or relocation of assets.

ii. Physical Space

- When practical space constraints such as clearances, congestion, or environmental impacts present barriers to UWI construction and utilities have site control to provide a UIS solution.

iii. Forecast Flexibility

- In areas that may be susceptible to acute forecast increases, such as EVs or heating electrification, that can benefit from flexible capacity.

iv. Operational Requirements

- Where the solution can operate to maintain system, large customer, or renewable energy demand or to address supply volatility.

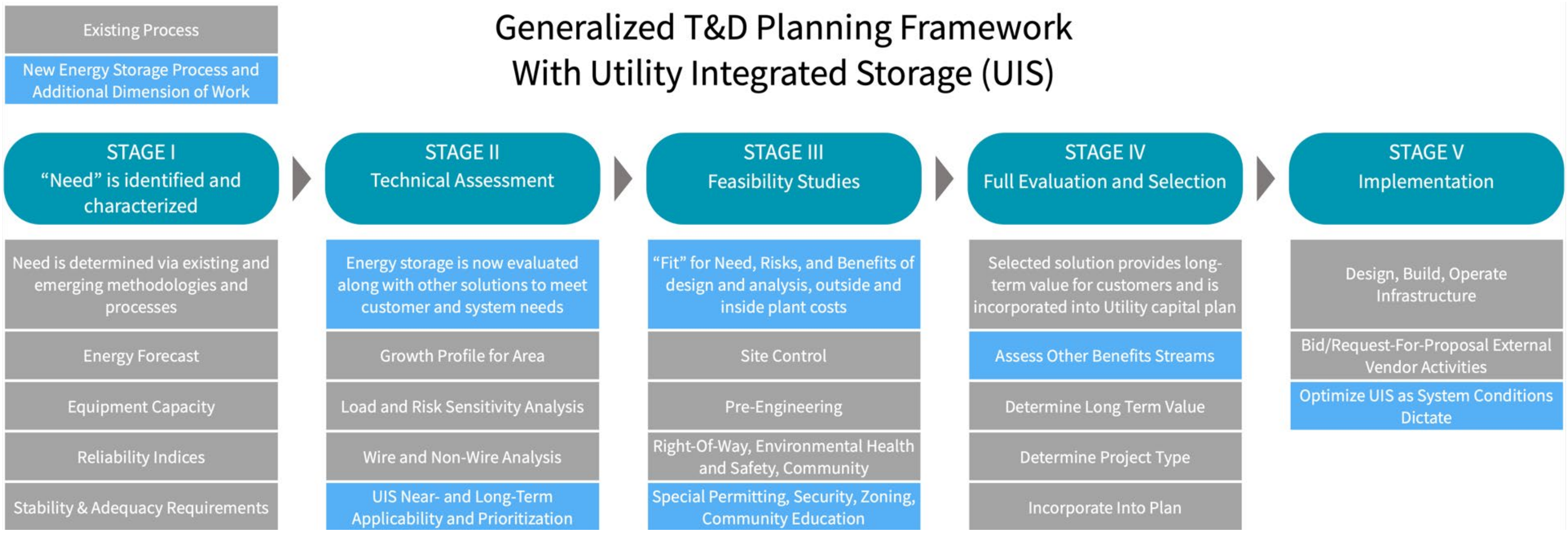
v. UIS Integration Scope

- Where a UIS solution complements a UWI solution.

B. Evaluating UIS as an Appropriate Solution

Utilities will continue to perform T&D system planning as they have in the past. The critical difference will be the new tool of UIS. Figure 1 below illustrates a basic planning framework with UIS. The main differences occur in Stages II, III, and IV, as explained below, where UIS would be evaluated in combination with UWI to meet customer and system planning needs. However, UIS will broadly follow the same processes, including the same economic evaluation approach as UWI, consistent with treating energy storage as a tool in the toolbox, with slight adjustments as described below.

Figure 1: T&D Planning Process with UIS



Existing Process

New Energy Storage Process and Additional Dimension of Work

Generalized T&D Planning Framework
With Utility Integrated Storage (UIS)

STAGE I "Need" is identified and characterized	STAGE II Technical Assessment	STAGE III Feasibility Studies	STAGE IV Full Evaluation and Selection	STAGE V Implementation
Need is determined via existing and emerging methodologies and processes	Energy storage is now evaluated along with other solutions to meet customer and system needs	"Fit" for Need, Risks, and Benefits of design and analysis, outside and inside plant costs	Selected solution provides long-term value for customers and is incorporated into Utility capital plan	Design, Build, Operate Infrastructure
Energy Forecast	Growth Profile for Area	Site Control	Assess Other Benefits Streams	Bid/Request-For-Proposal External Vendor Activities
Equipment Capacity	Load and Risk Sensitivity Analysis	Pre-Engineering	Determine Long Term Value	Optimize UIS as System Conditions Dictate
Reliability Indices	Wire and Non-Wire Analysis	Right-Of-Way, Environmental Health and Safety, Community	Determine Project Type	
Stability & Adequacy Requirements	UIS Near- and Long-Term Applicability and Prioritization	Special Permitting, Security, Zoning, Community Education	Incorporate Into Plan	

The following discusses the details of the process in each stage.

Stage I: "Need" Is Identified and Characterized

Utilities plan according to established methodologies to determine the best way to enhance the grid to support customer needs. As new policies and proceedings establish additional system requirements, the Joint Utilities will look to update the evaluation process to determine where a UIS solution may be a "best fit" for new and emerging needs.

Utilities use planning criteria to provide safe and reliable operation of their T&D systems. Planning criteria include, but are not limited to, electrical loading on lines and equipment, high or low voltage limits, reliability, resilience, stability, and adequacy requirements. Criteria violations are typically revealed by applying customer load and generation forecasts to power system models, and then performing contingency and risk analysis. When evaluating a criteria violation, utility planners may consider several factors, including severity, duration, and frequency. Utility planners will also determine whether violations appear in the near term or farther out in time.

a. Potential Changes with UIS

The Joint Utilities anticipate that efforts identifying and characterizing planning needs will remain the same.

Stage II: Technical Assessment

Utility planners will continue to use technical suitability as a threshold, requiring that all solutions be evaluated for their ability to support customer needs and system performance requirements. Utility planners will also consider a solution's ability to reduce and manage risk and support T&D system capacity needs as part of long-term plans for the clean energy transition. As discussed in Part III above, UIS offers compelling functionality and capabilities in multiple applications.

a. Potential Changes with UIS

Potential UIS applicability is considered at this stage, and potential solutions will be evaluated for technical suitability alongside or in combination with UWI solutions and third party-owned DER solutions identified under existing screening processes and planning criteria. Utility planners will also consider UIS flexibility to support near- and long-term benefits and T&D operations beyond addressing the identified planning violation.

Stage III: Feasibility Studies

In this stage, solutions must consider various project feasibility challenges. These include meeting physical constraints such as siting, zoning, service area characteristics, community acceptance, flooding, fire, and environmental reviews and requirements. Additionally, constructability must be assessed, considering the development timeline, resource availability, and costs to satisfy technical needs. Aligning the solutions with other project schedules and system plans is also essential, along with supporting opportunities for project coordination, project bundling, and economies of scope and scale considerations. Utility planners also need to confirm that the feasibility of interconnection considers the technical requirements identified in the previous stage. Further technical reviews may be necessary after identifying site-specific interconnection options as part of the feasibility assessment. Solutions must clear critical feasibility milestones, including:

- Satisfying all physical constraints, including siting, zoning, community interests, flooding, fire mitigation, and environmental reviews and requirements.

- Constructability assessment, which may consider the development timeline to meet technical requirements.
- Aligning with other project schedules and system plans.
- Supporting opportunities for project coordination, bundling, and economies of scope and scale.

a. Potential Changes with UIS

Utility planners will consider how UIS solutions could reduce lead times and manage implementation risks associated with UWI solutions. Planners must also confirm that the interconnection is feasible and meets the technical requirements in Stage II above. Further technical reviews may need to be assessed after the site-specific interconnection options have been identified as part of the feasibility assessment. At this early adoption phase of battery energy storage, permitting, siting, and community engagement are expected to differ from UWI due to the technical and physical characteristics of battery energy storage. For example, permitting and siting require particular expertise in the knowledge of battery energy storage chemistry, environmental impacts, risk management, and fire regulations at the state and local levels. Additionally, outreach, education, and training are expected to be ongoing with communities on the requirements and concerns regarding the siting of energy storage projects.

Stage IV: Full Evaluation and Selection

In this stage, utility planners will consider the cost and long-term customer value of solutions that have cleared the technical suitability and feasibility requirements. Factors may include how solutions can fulfill multiple short- and long-term needs, offer multiple sources of value, create planning optionality, and offer operational flexibility.

a. Customer Value

The existing planning process prioritizes long-term value as part of solution design and selection. This will continue as utility planners consider UIS solutions as described above in Stage II. The customer value of different solutions will be informed by the benefits that each provides. For example, a solution incorporating UIS may deliver benefits beyond those provided by a UWI or third-party solution, making it more likely that a UIS solution would be the appropriate choice.

Potential benefits are categorized into quantitative, qualitative, and policy support, as shown in the description below. Identification of these benefits can be used where available to inform prioritization among appropriate solutions to solve violations of planning criteria, or to provide additional justification for a project that is incremental to solving the original planning criteria violation. Evaluation of specific benefits would depend on how appropriate and feasible it is to evaluate specific benefits for specific UIS projects. To the extent possible, it should be aligned to meet the requirements of relevant Commission proceedings and other public policy avenues by which the UIS project may be evaluated.

Examples of quantitative benefits that might be converted to monetary values:

- Bridge/deferral value
- Incidental electric cost savings for customers
- A renewable credit reflecting the value energy storage provides in unbottling and balancing renewable generation

Examples of quantitative benefits:

- Enhanced reliability and resilience

- Grid optimization
- Emissions reductions
- Reductions in peak generation
- Avoided curtailment of renewable energy

Examples of qualitative benefits:

- Environmental impact reduction, including air, land, and water
- Hosting capacity increase
- Community impact and outlook
- Reduced reliance on mobile generators
- Operational flexibility
- Economics of scope or scale in solution design, procurement, and/or maintenance

Examples of policy support benefits:

- Supporting CLCPA goals, such as renewable energy and electrification
- Supporting proactive planning objectives
- Supporting Disadvantaged Community (DAC)[17] goals
- Supporting New York State Department of Environmental Conservation regulations

b. Potential Changes with UIS

Planners will consider the near- and longer-term value of solutions that incorporate UIS and identify the solutions that offer the best value for customers, as determined by the long-term

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[17] DACs refer to communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socio-economic criteria, or comprise high concentrations of low- and moderate-income households. *See* New York Environmental Conservation Law (ECL) § 75-0101(5).

value of the solution and its benefits. It is important to note that UIS will broadly follow the same economic evaluation approach as UWI, consistent with treating energy storage as a tool in the toolbox.

In addition, at this stage, each utility would file projects with the Commission utilizing this framework and seeking approval to proceed. These filings would include justifications for UIS in line with justifications provided for UWI in rate cases and other avenues, as discussed in Part VI below. This approval could take the form of project-specific approval or budgetary approval for select project types. With such approval, utilities could begin implementing projects and recovering costs, as detailed below in Part VI.

The following project elements will be submitted to guide the Commission's consideration of each project or group of projects submitted for consideration.

- A full summary of technical and feasibility analysis completed as described in the framework described in subpart IV.B of this Study;
- An estimated cost of the UIS project or a difference in the cost of the project relative to a similar UWI solution; and
- An explanation that includes expected benefits from the project, which may include a breakdown of the quantifiable benefits (and a description of the methodology for calculation), qualitative benefits, and policy support benefits.

Different projects will provide distinct combinations of local and statewide benefits. The utility will only submit projects for consideration that, in its judgment, represent a comparable or better overall value for customers than other possible solutions.

The Joint Utilities ask the Commission to authorize this holistic cost recovery process to evaluate the merits of individual or multiple projects based on the full range of quantitative, qualitative, and policy benefits the utility includes in any submission. Based on the project elements listed above, the Joint Utilities request the Commission to consider individual or multiple projects that satisfy any or all of the conditions below:

- In the instance that the UIS solution could be a lower cost than a UWI solution;
- In the instance the total quantifiable dollar and non-dollar benefits of the individual or multiple UIS project provide substantial or unique value over time; and/or
- In the instance where there is no practical UWI solution that can meet system needs considering project timing, resource availability, technical feasibility, or land availability.

Stage V: Implementation

Solution implementation includes design, construction, operation, integration, and optimization. Utilities will continue to choose execution options that offer customers the most benefit, such as engineering, procurement, and construction (EPC) contracts.

a. Potential Changes with UIS

Utilities will need to monitor and evaluate the performance of UIS systems to optimize and maximize operational benefits as customer needs change.

V. OPERATIONAL AND FUTURE CONSIDERATIONS

Using UIS as a "tool in the toolbox" requires changes to T&D operations and processes. Each UIS system has specific operational guidelines, including battery charging and discharging protocols, maintenance schedules, and performance monitoring. Operating guides and procedures are required to reflect the operational capabilities of UIS under different conditions and scenarios, which will vary in time.

a. Potential Operation Changes May Include:

Real-time forecasting and analysis: UIS will require forecast monitoring for operational alignment and tools to optimize energy storage applications over the long term and in real-time. This includes monitoring performance against established thresholds and adjusting to maximize their use and value. Similarly, operational plans and guidelines are required to support operators when real-time conditions dictate changes in operating mode due to emergencies or other demands.

Resource scheduling: Efficient scheduling of UIS resources is crucial to maximizing the benefits. This involves coordinating UIS operations with other grid resources, such as UWI and DERs, to support performance and reliability.

Switching plans for portions of the system with connected UIS: Switching guides and procedures need to be developed to manage normal and emergency operations of UIS with the existing grid infrastructure. These plans would outline procedures for connecting and disconnecting UIS during maintenance, emergencies, and other operational scenarios, such as when the system is in an abnormal state or when used in emergency or island modes instead of a mobile diesel generator to restore customers temporarily.

Adjustments to capacitor settings and positions: UIS provides reactive power support, which may require adjustments to existing substation and/or field capacitor settings and positions. This will help maintain voltage stability and improve power quality across the local grid.

Field coordination (e.g., switching and tagging, storm restoration): Effective field coordination is essential for the safe and efficient operation of UIS. This includes clear communication protocols, tagging procedures, and coordination with field personnel during switching operations. Existing processes and mapping systems will need to be updated to provide appropriate visibility for operators and field personnel and to reflect any potential new mode(s) of operation and process steps to enable that operation. Enhanced training for responsible personnel will allow for the safe operation of UIS.

Operation and maintenance: The operation and maintenance of UIS in the field will be different from what is required for UWI and will require special expertise that may not currently exist within a given utility. As such, these activities may be completed by qualified personnel within each of the Joint Utilities and/or by experienced vendors operating under long-term contracts.

First responder coordination: First responder coordination includes response plans, establishing protocol and appropriate alarms, providing notification, reinforcing clear communications channels, and establishing regular training and site awareness.

Community engagement and education: Community engagement and education include collaboration on sitting, permitting, and identifying needs, including economic development and concerns.

Energy Storage System Integration with Operational Technologies: UIS must be integrated with utility operational systems to provide reliability and access to the diverse benefits that energy storage can provide.

b. Potential Operating Systems to Integrate and Operate UIS May Include:

Energy Management Systems / Transmission Management Systems: Integration with these systems at the grid operator level will enable real-time monitoring and control of UIS resources, ensuring effective dispatch to meet grid needs.

ADMS/DERMS: UIS will be integrated with ADMS/DERMs to enhance distribution grid operations, including voltage regulation, load balancing, and fault management. Additional equipment is expected to be required at utility host sites to enable the operation of these UIS applications.

Outage Management Systems (OMS): Integration with OMS will allow UIS to support grid restoration efforts during outages, potentially providing temporary backup power and improving overall grid resilience.

Battery Management Systems (BMS) and distributed control systems associated with grid edge and microgrid management: These systems, including direct current (DC) energy storage devices, are necessary to provide the safe and efficient operation of UIS and must be continuously monitored to assess the health of the system and conditions under which it can operate given its state of charge, temperature, and other critical parameters.

Supervisory Control and Data Acquisition (SCADA) systems: SCADA integration will provide real-time data and control capabilities for UIS systems, enabling utility operators in T&D control centers to monitor, dispatch, and manage their performance effectively.

Telecommunications networks: Reliable and secure communication networks are essential for the integration and operation of UIS. These networks will support data exchange between UIS resources and utility control centers.

Cybersecurity plans and systems: Robust cybersecurity measures will be implemented to protect UIS from cyber threats to preserve the integrity and reliability of grid operations.

c. Future Considerations

As discussed throughout this Study, it is impossible to predict all the requirements or needs of utility customers as the state moves through the clean energy transition. While each utility will prioritize applications according to the needs of their customers, new needs, applications, and technologies may emerge. The Joint Utilities support the ability to re-evaluate the energy storage framework periodically to add new applications, assess new technologies, and ask the Commission to consider flexibility in the framework and project proposals in the future, bearing in mind that available technology may have changed since this Study.

VI. PROJECT APPROVAL PROCESS AND COST RECOVERY

In the 2024 Storage Order, the Commission directed the Joint Utilities to propose a process for reviewing and approving UIS projects that function as part of the T&D system and a cost recovery mechanism when such a process does not align with normal rate case schedules. The flexibility to propose UIS projects within and outside the traditional rate case schedule is essential because there is no guarantee that beneficial UIS projects – stemming from rapidly evolving and uncertain supply and demand conditions – will align with rate case schedules[18] and other proceedings.[19] This part addresses the need to focus on providing timely flexibility to support accelerated customer needs that enable the clean energy transition when solutions are needed.

Flexible Approval Process is in the Public Interest

While some UIS opportunities can be forecasted as part of rate cases, others may not. This is attributable to uncertainties in (1) the pace of EV adoption, particularly for fleets; (2) the pace of other electrification activities and technological change, for example, as it relates to the adoption of electrified heating; (3) the pace of development for large-scale renewable generation; (4) the extent to which large, new customers (e.g., data centers or semiconductor fabrication facilities) locate within the state; and (5) increased operational and reliability needs emerging as a result of the process of electrification. DPS Staff and NYSERDA recognized these uncertainties in the Biennial Review through the development of a base-case load forecast and sensitivities.[20] The potential cost of energy storage investments is also an important consideration. Based on a recent National Renewable Energy Laboratory (NREL) report, the system cost of a 60 MW four-hour duration battery would be over $100 million.[21] While many

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[18] Utilities would still be able to propose UIS projects through their respective rate cases.

[19] *See, e.g.,* Coordinated Grid Planning Process (CGPP) in Case 20-E-0197, *Proceeding on Motion of the Commission to Implement Transmission Planning Pursuant to the Accelerated Renewable Energy and the Growth and Community Benefit Act;* Proactive Planning Framework in Case 24-E-0364, *In the Matter of Proactive Planning for Upgraded Electric Grid Infrastructure;* and Grid Flexibility Study in Case 24-E-0165, *Proceeding on Motion of the Commission Regarding the Grid of the Future. See also* https://www.nyiso.com/documents/20142/46037414/2023-2042-System-Resource-Outlook.pdf

[20] *See* Case 15-E-0302, *Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard* (CES Proceeding), Department of Public Service Staff and New York State Energy Research and Development Authority Draft Clean Energy Standard Biennial Review (filed July 1, 2024), pp. 52-54.

[21] NREL, 2023 Annual Technology Baseline – Utility-Scale Battery Storage (July 15, 2023), v8.0, *available at* https://atb.nrel.gov/electricity/2023/utility-scale_battery_storage

UIS applications in New York could be smaller, this information—combined with the uncertainty of load growth discussed above and the potential for energy storage to fit with other proceedings—highlights the need for a flexible evaluation framework for energy storage projects. Such a framework would add to the existing review and approval process and provide utilities with the ability to file proposals for UIS programs and individual UIS projects within this proceeding.

Utilities could elect to request recovery of a "portfolio" of UIS investments, including UIS programs and individual UIS projects. A UIS program investment would support multiple, smaller UIS projects of a similar type and configuration. In contrast, an individual UIS project investment would tend to support a larger project designed to address a specific need. The following illustrative examples characterize UIS programs and projects to aid in comparison only.

UIS Program Example

- *Description:* a group of UIS solutions supporting vehicle electrification growth in multiple distribution system areas.
- *Project Size:* a group of small distribution-size UIS projects.
- *Interconnection location:* utility distribution system.
- *Implementation timeline:* near-term or mid-term, with limited time for development of individual projects.
- *Funding source:* an approved 2-year program budget (reset every two years).

UIS Large Project Example

- *Description:* an individual UIS solution for mitigating the curtailment of a transmission-connected renewable resource.
- *Project Size:* a large UIS project following the NYISO Large Generator Interconnection Process.
- *Interconnection location:* utility transmission or distribution systems.
- *Implementation timeline:* longer-term, with time available for inclusion in a standard rate case.
- *Funding source:* Projects are submitted for Commission approval and funding.

Pathway to File Proposals within this Proceeding

To file within this proceeding, the utility could apply the following approaches or a combination (portfolio). Each utility will have the discretion to decide how to employ the approaches.

Approach 1 (i.e., "Program Approval Process"): For a UIS program, each utility would seek Commission approval for a two-year budget (initial budget) to fund one or more UIS programs that reset every two years. This approach would provide a utility with the flexibility and agility to address emerging grid needs in a timely manner using small UIS projects. Every two years, a utility applying this approach would file a program status report with DPS Staff. The program status report would include a description of the UIS program and information about UIS projects the utility is pursuing as part of the program. The program status report could also indicate if an increase to the program budget is required. In this case, the utility would file a request with the Commission to increase the program budget.

Approach 2 (i.e., "Large Project Approval Process"): For large UIS projects with costs that exceed the program budget described in Approach 1, the utility would make separate filings to request project approval and funding. The request would include information about the project and the results from an evaluation of the project under the planning and evaluation framework described above in Part IV.

Proposed Regulatory Framework for Storage Projects Not Reflected in Rates

The Joint Utilities request that the Commission authorize each utility to fully recover the costs associated with each approved project once placed into service (costs including capital depreciation/amortization, financing costs, appropriate operation and maintenance expense, return on capital, and applicable taxes). Each of the Joint Utilities propose to recover such approved costs through a surcharge mechanism until the time of the next rate plan proceeding, at which time the utility would propose that all remaining costs will be incorporated into base rates when the utility's rates are reset. Each utility would work with DPS Staff to determine the details of the surcharge mechanism for cost recovery. The Joint Utilities request the Commission to direct each of the utilities to file tariff revisions as needed to implement such a surcharge mechanism.

VII. CONCLUSION

Some of the Joint Utilities have deployed utility-owned energy storage projects with approved use cases. However, the ability and frequency to use this resource as a tool in the toolbox has been limited. Modern T&D systems are increasingly dynamic, a trend that will continue as intermittent supply becomes more prevalent with renewable penetration and load becomes more complex as electrification increases. Unlocking the Joint Utilities' ability to use

UIS as a tool to provide non-market T&D services will support an efficient energy transition and provide benefits. Utility T&D systems offer the delivery and integration infrastructure necessary to maximize the benefits of UIS. Thus, the ability to integrate UIS as part of the T&D system when opportunities arise advances the public interest. UIS is well suited as a tool in the toolbox for utilities to enhance safe and reliable service.

For all the foregoing reasons, the Joint Utilities respectfully request that the Commission: (i) accept this Study in satisfaction of the 2024 Storage Order;[22] (ii) authorize UIS for non-market T&D applications; (iii) approve the UIS planning and evaluation framework proposed in Part IV of this Study for the purpose of identifying programs and projects to be presented to the Commission for its review and approval; (iv) adopt the proposed utility approach for requests for approval of UIS programs, projects, and corresponding budgets that do not align with normal rate case schedules, as discussed in Part VI of this document; and (v) direct each of the Joint Utilities to file tariff revisions as needed to implement the surcharge mechanism proposed herein.

Dated: October 29, 2024

Respectfully submitted,

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CORPORATION d/b/a NATIONAL GRID

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[22] *Supra* note 4.

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Appendix A

Niagara Mohawk Power Corporation d/b/a National Grid UIS Examples

Appendix A

Niagara Mohawk Power Corporation d/b/a National Grid

Section 1: Introduction

Niagara Mohawk Power Corporation d/b/a National Grid (National Grid) provides this appendix with supporting details specific to its service territory to illustrate the non-market transmission and distribution (T&D) services that energy storage can provide to utility systems and customers.

National Grid supports New York's efforts to advance energy storage deployment and the role of competitive markets in meeting New York's 6,000 megawatt goal by 2030.[1] In addition to recognizing the role of storage as a market and generation asset, National Grid was particularly encouraged that the Commission's *Order Establishing Updated Energy Storage Goal and Deployment Policy* (Storage Order)[2] recognizes a role for energy storage to address electric system needs as a T&D asset integrated into utility operations.

This appendix provides examples in which energy storage can provide non-market T&D services for targeted areas of National Grid's system, consistent with the Storage Order's directive[3] and aligning with specific applications presented in the Joint Utilities filing[4]. The Joint Utilities filing describes six priority applications that reflect the Joint Utilities interpretation of the types of non-market T&D services energy storage may provide as follows:

A. Flexible Transmission Capacity
B. Flexible Distribution Area Capacity
C. Distribution Resiliency and Reliability
D. Bridge to Wires
E. Large-Scale Renewable Enablement
F. Distributed Energy Resources (DER) Integration and Hosting Capacity on Distribution Network

This appendix will share examples of four of these applications based on system needs and opportunities National Grid evaluated for its service territory.

Section 2: National Grid Context

National Grid owns, operates, and maintains the electric T&D grid across the Upstate New York (UNY) region. This service territory crosses multiple New York Independent System Operator (NYISO) zones spanning the state's western, northern, and eastern borders. For more than one hundred years, this electric grid has been the backbone of UNY's communities and economies. Maintaining a high level of reliability is inherent to how we serve our customers every day. Factors such as equipment age, extreme weather, and tree growth have traditionally been challenges to maintaining reliable electric service. Now, increasing demand from electrification of transportation and heating, the retirement of large-scale

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[1] New York's Climate Leadership and Community Protection Act (CLCPA or Climate Act) has established a goal of achieving 6,000 MW of installed energy storage capacity by 2030.

[2] Case 18-E-0130, *In the Matter of Energy Storage Deployment Program* (Energy Storage Proceeding), Order Establishing Updated Energy Storage Goal and Deployment Policy (issued June 20, 2024) (Order) and Erratum Notice (issued August 29, 2024).

[3] *Id.*, p. 69.

[4] The Joint Utilities consist of National Grid, Consolidated Edison, New York State Electric and Gas, Orange and Rockland Utilities, Rochester Gas and Electric, and Central Hudson Gas and Electric

generation, interconnection of renewable energy resources, and economic development add complexity and urgency to electric system planning.

Certain characteristics of National Grid’s service territory will likely inform the application of energy storage to provide non-market T&D services as well as provide useful context for the example projects shared in this appendix.

- Although a considerable portion of National Grid’s service territory is rural, there are several major urban load centers (e.g., Albany, Buffalo, and Syracuse)
- Certain areas are served by lengthy distribution feeders or radial transmission lines
- Multiple environmental factors (e.g., rugged terrain and extreme weather) can contribute to outages; make maintenance, repairs, and outage restoration difficult and time-intensive; and present serious challenges in constructing new electric infrastructure
- Many T&D assets in National Grid’s service territory are aging and are either currently being replaced or will require replacement in the near future to preserve reliability and meet growing electric demand
- Significant renewable generation has either been built or is forecasted in pockets of UNY, with insufficient transmission infrastructure to deliver this energy to load centers in UNY or in the Downstate New York (DNY) region
- Generator siting decisions are driven by interconnection and physical constraints, with some areas having sufficient land to support generation but not sufficient interconnection capacity (or vice versa)

Community and stakeholder engagement is key to successful siting and deployment of energy storage projects. Community engagement is always a priority for infrastructure projects but is especially critical for energy storage projects in National Grid’s service territory. These utility projects can deliver community benefits including timely improvements to reliability and resiliency of electric service; cleaner energy and cleaner air; limiting land use required for new energy infrastructure; and economic benefits such as job creation, tax revenues, local spending on construction-related services and materials, and increased local workforce training opportunities. National Grid has the institutional memory, local perspective, and project engagement expertise to incorporate lessons learned, anticipate community and customer concerns, and work constructively with localities to ensure utility-owned energy storage projects deliver appropriate benefits and address community requirements.

National Grid filed an electric and gas rate case proposal with the Commission in May 2024 which includes funding for proposed utility-owned energy storage projects that will primarily provide non-market distribution benefits that are comparable to traditional utility infrastructure. The proposed projects are to be located on areas of National Grid’s system that require timely investments to improve reliability, manage loads, and/or reduce outages; are designed to enhance operation of the system or expedited provision of electric service; and could avoid or delay the need for more costly solutions.

Section 3: Illustrative Project Examples of Non-Market T&D Use Cases

Example 1: Energy Storage as Transmission-Level Grid Enhancing Technologies (GETs)

Examples described below fall under the following energy storage applications from the Joint Utilities filing: E) Large-Scale Renewable Enablement and A) Flexible Transmission Capacity

New York requires a significant increase in renewable energy generation to achieve CLCPA goals. Many regions in National Grid's service areas, especially the northern and eastern regions, are experiencing an influx of renewable energy development, which is expected to accelerate in the next decade.

Problem

Though there are large amounts of available land in the northern region of National Grid's service territory, this region does not traditionally experience a huge demand for energy. Simply developing renewable generation is not sufficient to meet the state's goals; that renewable energy must be delivered to load centers when and where the energy is required. For example, solar generation produces power during the day and demand from loads in urban areas peaks in the evenings. This mismatch of load profile and generation profile, coupled with transmission systems constraints in key locations, creates system congestion and results in renewable energy curtailment.

As forecasted in the NYISO's 2023-2042 System & Resource Outlook,[5] renewable energy produced in UNY will continue to face challenges in moving to load centers despite the implementation of necessary CLCPA Phase 1 and Phase 2 transmission upgrades by upstate utilities, as approved by the Commission in 2022 and 2023. Congestion on pockets of the local system and major interfaces (such as Central East), as well as bulk transmission system limitations, not only increase customer costs but also lead to significant curtailment of renewable energy generators which the state has already committed to fund via REC contracts. Moreover, the rapid development of intermittent renewable generation adds another level of complexity to peak load management, which is crucial to the reliable operation of the electric delivery network.

Solution

National Grid, with assistance from Quanta Technology analyzed feasible and fit-for-purpose GETs solutions at specific, unique locations to mitigate curtailment of renewables connected to its local transmission system, ease transmission congestion, reduce customer bills, defer other transmission upgrades, and maintain reliable and resilient electric service to customers. The analysis shows that energy storage integrated into a utility's local transmission system architecture can help provide such benefits in a non-market application, so long as it operates on a deterministic dispatch protocol. Specifically, the battery must operate on predetermined daily charge / discharge schedules that correspond with local renewable generation. This predetermined schedule enables the asset to operate similar to a transmission line to achieve a non-market transmission service. Operating the battery according to this protocol will ensure that it fulfills the stated goals without either compromising its non-market function or creating a new peak.

According to analysis by Quanta Technology, optimally located and sized energy storage systems can perform as GET. They are able to mitigate renewable curtailment by absorbing renewable energy generation in excess of system limitations and releasing it into the network when sufficient transmission capacity is available (e.g., low generation periods). A precise dispatch schedule that adheres to specific transmission system constraints is key to achieving this aim. The analysis performed by National Grid and Quanta Technology showed that, for the specific site and time frame analyzed, the dispatch schedule of this storage transmission asset must be deterministic in nature and optimized to ensure that no new system peak is created. Moreover, the analysis showed that the daily charge / discharge schedule will need to be adjusted seasonally to account for load profile, renewable generation profile, and status of the transmission system. This carefully designed schedule will provide the optimal operational results for this situation by maximizing renewable energy deliverability while eliminating negative system impacts.

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[5] New York ISO, *2023-2042 System & Resource Outlook*, July 23, 2024, p. 57.

Utility integrated storage can help meet this transmission system need. DPS Staff and NYSERDA noted this in its updated 2024 Energy Storage Roadmap, stating that "some use cases and revenue streams are not currently available to energy storage resources through any market" and citing renewable curtailment and congestion reduction as examples of these use cases.[6] National Grid's analysis identified two main reasons utility integrated storage can help: First, co-locating energy storage with renewable facilities may not always be economic. In some specific locations and conditions National Grid has analyzed, narrow market price differentials and curtailment levels or durations could render storage uneconomic if co-located with generation. Therefore, to maximize delivered renewable energy, an energy storage system built at an optimal location that aggregates many sources of renewable power can leverage on an economy of scale. Second, as stated in the Storage Order, contingency support to increase transmission transfer capacity and congestion management to reduce curtailment are services that are not currently procured in wholesale or retail markets. These services are provided by traditional transmission assets and recovered through electricity rates. Hence, energy storage facilities operating independently of renewable generation are not compensated by the market to operate with the specific goal of reducing renewable energy curtailment.

A cost-based, utility-owned storage solution that is agnostic to market prices – but optimizes for transmission system needs – is therefore ideal to address the two problems described above by delivering the most renewable energy to load while maintaining system reliability. Separately from its study with Quanta Technology, National Grid also worked with Energy + Environmental Economics (E3)[7] to assess the value of utility-owned storage in meeting this transmission system need. The two studies assessed different sites and had some differing conclusions, indicating that each potential site has unique characteristics and should be specifically studied accordingly. Despite this, E3's analysis also affirmed a key role for utility-owned storage; E3 found that:

> *"Utility-owned storage devices are well-positioned to provide transmission services by alleviating renewable energy curtailment. By shifting renewable energy throughout the day, a battery can allow more solar and wind power to be delivered to end consumers, even in congested areas. Much like other forms of congestion, market price signals may not be sufficient to incentivize a merchant storage operator to fully alleviate curtailment, and thus excess curtailment may not be solvable by market solutions alone."*

As part of our analysis, National Grid and E3 also conducted interviews with investor-owned utility owners and operators of storage on transmission lines in other jurisdictions in the Western United States, which has large amounts of storage in operation. Multiple, ongoing situations were identified where utility-owned, cost-based assets utilize different control and dispatch logic from third-party merchants operating similar assets, primarily because utility assets were operated with a goal of meeting system needs. These current operations demonstrate not only strong possibilities but also an existing precedent for utility-owned, transmission-level storage facilities operated to address system needs.

Project Operations

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[6] *New York's 6 GW Energy Storage Roadmap: Policy Options for Continued Growth in Energy Storage,* published by NYSERDA on March 15, 2024, page 39

[7] *Utility-Owned Storage in New York State: Applications for Transmission System Services*, Energy and Environmental Economics, Inc. (E3), October 2024, linked at: https://www.nationalgridus.com/Energy-Storage-and-Electricity-Transmission and https://urldefense.com/v3/__https:/www.ethree.com/wp-content/uploads/2024/10/National-Grid-UOS-Filing-Support_20241016.pdf__;!!B3hxM_NYsQ!w9IW4tsc7lh36t1WUfmlMto3yw5zCE-PEFz7bQgnVCBHdN0NGBSAGwmlaWCelo2KODfis7_DhtAnxM8eR1Yy_5mYdHIebixx$)

Although a transmission-level storage asset would operate as part of the transmission owner's overall system as a GETs, a battery asset would present operational complexities. The primary complexity would be the asset's charge and discharge schedules when alleviating renewable energy curtailment. Meanwhile, a utility-owned storage asset's flexibility to address other use cases and the ability of its ownership and operational structure to respond to system needs provide operational benefits.

Under the renewable energy curtailment reduction application, the assets would charge during periods of renewable generation surplus and discharge at times of generation shortfall. To mitigate renewable energy curtailment, National Grid proposes operating energy storage on fixed seasonal schedules that are based on system conditions, not market signals – i.e., operating it as a transmission asset to create predictable capacity on the transmission system, rather than solving for market performance. E3 identified two key advantages to a schedule of this nature: "first, its pre-scheduled nature means the asset operates in a manner that is agnostic to market prices and will minimize adverse impacts on wholesale markets; and second, the simplicity of the fixed schedule would not require significant training or effort on behalf of the utility control room to optimize the operation of the battery."

National Grid anticipates operating the assets to aid in delivering system reliability and efficiency while maximizing renewable energy production, with potential schedule adjustments aimed at achieving these goals made at the discretion of the transmission operator. In anticipation of certain potential contingency situations, such as a forecasted weather event, the asset dispatch schedule could be changed, pre-contingency, to address upcoming contingencies or other events. This would be done in coordination with NYISO and would be performed solely to improve system operations. Additionally, there may be other situations where flexibility provided by a non-market utility-owned storage asset on the transmission system provides value; these include voltage support and addressing thermal constraints, both of which could result from planned and unplanned outages.

E3's analysis also looked at various ownership and operating structures for batteries, based on operational structures used in already-operating, utility-controlled transmission-level batteries. As E3 states in the below quote, utility ownership brought operational benefits in many cases, due to utility familiarity with reliability needs and reduced friction when limiting emergency management to one corporate umbrella:

> *"Utility ownership would allow full operational control and flexibility by the utility. Other utilities with experience operating storage that were interviewed in the development of this report relayed that this type of flexibility for responding in real time to contingency events and grid stability needs have generally experienced challenges under other contractual arrangements with third-party ownership, due to the lag time between a utility requesting dispatch and the third-party responding being too long to deliver maximum value for these use cases."*

Project Economics

A utility-owned storage asset integrated with other transmission assets as a GETs could bring multiple economic benefits that are not necessarily fully valued by purely market-based revenues, including avoided renewable energy curtailment and deferred T&D costs, as well as key qualitative benefits that should also be considered in an economic analysis. A key feature of utility-owned storage is its nature as a cost-based resource, funded through cost recovery in a utility's electricity rates. Given this funding structure, the utility could operate the asset to maximize system utilization and energy production by capturing the otherwise curtailed renewable generation. In this way utilities can advance state renewable energy policy goals and maintain the integrity of competitive markets.

Key qualitative benefits include provision of grid reliability services, increasing system flexibility, and enabling state renewable energy policy targets. Storage could be re-dispatched ahead of time to address contingencies and discharged when available transmission capacity exists. The benefits of additional system flexibility may materialize when storage operated as part of the transmission system limits out-of-market actions taken during contingencies, providing reliability benefits that would not necessarily be present with additional wires infrastructure. Storage assets operated in this fashion would contribute to meeting state decarbonization policy goals and reduce the negative externalities of emissions.

National Grid and its consultants also quantified specific economic benefits of four potential storage projects on the transmission system when the storage is dispatched through utility operations. The potential sites studied by National Grid and its consultants showed annual reductions in curtailed renewable energy ranging from 16% to 48% in the total curtailed renewable energy in the areas studied. Potential for production cost savings ranged based on how the assets were operated: for example, results from the first two sites improved when operations focused on reducing congestion instead of reducing renewables curtailment.

Finally, in some cases, utility-owned storage would defer or eliminate the need for wires upgrades or expansions to deliver renewable energy. This would result in a lower rate base and revenue requirement than would otherwise occur without the storage assets, due to avoided capital costs of deferred wires transmission asset upgrades that would no longer be necessary. In their study of two specific sites, E3 concluded that "a merchant-owned device will generate value through wholesale market streams … but this value is less than the value captured by a utility-owned storage device for which the primary function is to decrease congestion on the grid, provided that new transmission infrastructure can be avoided as a result."

Highway Mobile Energy Storage Sites

Examples described below fall under the following energy storage applications from the Joint Utilities filing: B) Flexible Distribution Area Capacity and D) Bridge-to-Wires

Problem

Demand for electric vehicle (EV) fast charging is forecasted to increase, driven by market adoption, federal incentives and regulations, and state mandates such as the Advanced Clean Cars II[8] and Advanced Clean Truck rules.[9]

Fast charging at highway plazas is critical to ensure New Yorkers can access convenient and reliable charging and to support commerce and the movement of goods. However, there are challenges in providing the necessary electric capacity to enable this charging due to lead times and land use concerns associated with the deployment of electric infrastructure. While electric load related to charging is fast to materialize, the speed at which necessary infrastructure is deployed may not keep up, a trend that was recently recognized by the Commission in its *Order Establishing Proactive Planning Proceeding*.[10]

In the Electric Highways Study,[11] National Grid and expert consultants at RMI, CALSTART, Stable Auto, and Geotab evaluated the future fast charging needs of highway sites in New York in the context of the state regulations such as the Advanced Clean Truck rule, which establishes the goal that 100% of medium and heavy-duty vehicles (MHDVs) sold in New York are zero-emission by 2045. The

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[8] *Adopted Part 218 Advanced Clean Cars II (ACC II),* effective September 4, 2023 and available at https://dec.ny.gov/docs/air_pdf/218acc2.pdf

[9] *Adopted Part 218 Advanced Clean Trucks (ACT),* effective January 29, 2022 and available at https://dec.ny.gov/sites/default/files/2024-01/218act.pdf

[10] Case 24-E-0364, *In the Matter of Proactive Planning for Upgraded Electric Grid Infrastructure* (Proactive Planning Proceeding), Order Establishing Proactive Planning Proceeding (issued August 15, 2024), p. 7.

[11] *A Roadmap for Meeting Future EV Charging Demands*, available at https://www.nationalgrid.com/document/148616/download

whitepaper concluded that charging demand from EVs may require 5 megawatts of charging capacity by 2030 at individual thruway plazas and truck stops, with some sites requiring 40 megawatts of charging capacity in the long-term. These sites may have to connect to high-voltage transmission lines to meet their need for energy, while other locations may require upgrades and non-wire mitigations to enable delivery of power through the distribution system.

The electric grid will be critical to the deployment of fast charging, as will infrastructure used by commuters today, such as travel plazas on highways. The longer lead times for traditional wired solutions mean there is a gap between capacity needed to enable EV fast charging and grid capacity available today. At the same time, to avoid duplicative investment, utilities must ensure that solutions deployed to meet short-term needs are still useful once larger-scale solutions (such as a substation) are finally built.

Solution

National Grid analyzed the short- and long-term charging demand at each travel plaza and identified near term (less than 5 years) need at certain travel plazas. Charging demand profiles were constructed at each site, and then compared to an analysis of the distribution system assets serving each site to understand how a solution would increase load-serving capacity.

Mobile energy storage (MES) units, deployed as a bridge-to-wire solution, are proposed at costly and time-dependent travel plazas with an immediate need for additional electric capacity along the NY State Thruway. Some of these sites are also paired with traditional wired upgrades to help swiftly address the longer-term total system load.

Project Operations

Charging curtailment is expected to occur when the distribution system cannot supply the full demand of the EV chargers. This can be implemented by restricting EVs from connecting to and/or reducing the maximum power of certain chargers.

Energy storage would be integrated into National Grid's distribution system architecture to mitigate charging curtailment of the EV fast chargers at the travel plazas. The units would discharge during peak loading conditions where charging curtailment would otherwise be expected and charge during periods of lower demand when system capacity exists. Traffic patterns and demand for charging are expected to influence the charge and discharge cycle, which may be planned based on National Grid's day-ahead forecast for load-serving capacity at the travel plaza and adjusted according to real-time needs.

National Grid expects this initial use case to create near-term capacity to enable fast charging and expects to eventually redeploy MES for additional use cases. National Grid anticipates the units to be moveable with limited demobilization, site preparation, and interconnection activities required. Additional locations or use cases will be determined based on interconnection and planning requirements which will be evaluated over the life-span of the MES asset. While National Grid expects that redeployment will further extend customer savings and enhance utility operation, it is important to note that utility ownership will also provide a valuable learning experience for the MES use case and how it can be deployed to meet other system needs or conditions.

Project Economics

MES units will bring value to customers by providing near-term capacity to enable fast-charging, while avoiding curtailment or temporary capital costs, prior to the construction of long-term capital solutions. Where successfully integrated into utility operations, MES units could be deployed to meet peak capacity for charging at these locations more quickly than traditional solutions and allow for more efficient investments. This avoids interim upgrades that do not meet the long-term need, providing cost savings and benefits to customers.

MES units may provide other economic benefits in addition to cost-effectively enable EV charging. Some of these MES units will provide charging capacity in or adjacent to disadvantaged communities, delivering access and emissions reductions benefits. Furthermore, National Grid intends to redeploy the MES units to other locations and possibly for additional use cases on its system once the original need is addressed with permanent solutions, allowing the units to provide additional economic value to customers by solving other emergent needs and enhancing system efficiency.

Microgrid

Examples described below fall under the following energy storage applications from the Joint Utilities filing: C) Distribution Resiliency and Reliability

Problem

National Grid has considered energy storage as a component of microgrids to mitigate or eliminate electric power outages. Microgrid opportunities have been and continue to be evaluated to address outages for customers in northeastern New York. Communities in the areas evaluated generally experience more frequent electric service interruptions than the system average. In many cases, these outages do more than inconvenience homeowners, businesses, and schools—these disruptions compromise already insufficient services in the area, such as cell phone and internet service. Further, disruption of electric service is an even greater concern for residents who rely on critical medical apparatuses or heat their homes with electricity.

In locations of poor reliability, customers typically lose power at a frequency and duration that is vastly greater than the system average. Within these high-risk areas, restoration is challenging because troubleshooting and repairs can take up to a full day. Circuit outages can be caused by a multitude of reasons, including extreme weather, trees, motor vehicle accidents, and wildlife. In such areas, reliability is often lower because traditional solutions are challenging to construct due to environmental and geographical constraints, permitting, and cost (e.g., where communities are served by radial transmission lines crossing rugged and protected terrain).

Solution

Storage-enabled microgrids can be viable solutions to transform electric service reliability and resiliency. In one such example, an independent analysis of costs, reliability benefits, and feasibility showed that an energy storage-enabled microgrid integrated into the distribution system and located near load to be a feasible and an appropriate approach to address reliability issues. The analysis suggested that energy storage integrated into the distribution system can deliver significant reliability benefits to affected communities and mitigate not only transmission-related outages but also distribution-related outages.

Microgrid projects with energy storage would be proposed with adaptive protection technologies, advanced monitoring, and advanced controls integrated into National Grid's T&D control centers to enhance system resilience during disruptive events and increase the reliability of service for the community. Storage and microgrids could be integrated at different locations, including at distribution substations and along the distribution feeders to improve reliability and resiliency of electric service.

Project Operations

Operation of energy storage-enabled microgrid projects integrated into the distribution system would be developed to address upstream outages. Project operations would be automated but monitored, directed, and executed by National Grid's Control Center. Each microgrid would have a local microgrid controller to enable operation. The local microgrid controller would manage black start at the local level, resynchronization and reconnection to the upstream grid, mode settings, and protection coordination. Each microgrid would feed locally, allowing for quicker service restoration for local loads and minimizing any customer impacts to only momentary interruptions. Local controllers would communicate upstream with National Grid's Supervisory Control and Data Acquisition (SCADA) system, allowing National Grid operators to monitor and control the microgrid. Operational technology enhancements and some additional training for operators and personnel responsible for maintaining microgrid components may be necessary to effectively integrate energy storage-enabled microgrids to the distribution system while maintaining the safe, reliable, and resilient operation.

Project Economics

A microgrid project can reduce reliance on residential backup generators and related costs, provide equitable access to reliable electricity for customers without the means to buy such generators, and cut associated emissions and noise pollution. Beyond reliability and resiliency benefits, deploying microgrids delivers secondary benefits related to electrification. During non-contingency events, the energy storage unit may be used for load relief to increase capacity for electrification of transportation and residential heating. Utility-owned microgrids can also efficiently deliver value to all customers in a given area, consistent with the utility's obligation to serve, and in contrast to microgrids operated by a single customer or behind-the-meter.

Potential alternatives to address the type of reliability issues discussed in this section include new T&D infrastructure such as transmission or sub-transmission lines. It is National Grid's experience that utility-operated microgrids may present a beneficial option in areas where it is significantly challenging to build traditional T&D infrastructure, such as where new transmission supply lines require construction through environmentally sensitive areas, where undergrounding is not feasible, or where permitting and constructing a traditional solution is prohibitively expensive or not viable.

Distribution Integrated Storage

Examples described below fall under the following energy storage applications from the Joint Utilities filing: B) Flexible Distribution Area Capacity

Problem

National Grid looks to deploy energy storage to provide load relief to infrastructure in either normal or contingency operations. National Grid has identified one such area where load relief is required to a set of cable groups that face thermal limitations in contingency operations, based on current and forecasted loading. If such a contingency operation were to take place, thermal limits of the cable groups would be reached, causing further cable failures, and resulting in outages to distribution stations and their customers.

A long-term solution is being developed to offload the cable group in question; however, this long-term solution is dependent on a separate project intended to reinforce the larger area. No long-term solution to the overloaded cable groups can be determined until the larger area plan is first completed. Based on forecasts, contingency violations are expected prior to the construction of solutions designed to address needs identified in the larger area plan. Therefore, load relief is required as an interim solution.

Solution

An energy storage system can offer load relief for such situations. The system would be operated pre-contingency to address predicted overloads based upon a short-term forecasting schedule. Due to geographical, siting, and spatial interconnection constraints, the energy storage system would be sited at the end of the radial cable group within one of National Grid's substations. The storage system would provide load relief to both the substation and cable group and be interconnected to the substation's low-side bus.

Project Operations

The energy storage asset would be operated pre-contingency, based upon a short-term forecasting schedule, that will be used to develop a day-ahead charge / discharge schedule with a load-following signal in real-time dispatch. This would provide load relief to all upstream assets, including the substation and cable groups. Based on siting and interconnection, upstream system constraints may affect charge / discharge schedule and will be managed by system operators. This storage asset would communicate upstream with National Grid's SCADA, allowing operators to monitor and control the asset and manage the operational schedule. As with the previous example, operational technology enhancements and some additional training for operators and personnel responsible for maintaining the assets may be necessary.

Project Economics

This distribution-integrated storage project would efficiently address the need for additional distribution capacity and provide additional reliability to customers. The alternative solution to this project would be the construction of a new cable in the existing cable group to offer the same incremental redundancy as the energy storage solution. This cable would need to be extended from the terminal station up to the first distribution station, which is an estimated at 15,000 feet. Such a project could not be built in time to meet the forecasted constraint, unless the construction and project schedule was accelerated, which would further exacerbate costs. This alternative solution is currently estimated to cost $6.9M for the cable only; additional substation work would be required to feed and interconnect this cable to the electric system.

Section 4: Considerations for Approval Processes and Cost Recovery Pathways

In the Storage Order, the Commission instructed the Joint Utilities to propose a process for the review and approval for utility-owned projects, as well as a cost recovery mechanism, if such a process does not align with the normal rate case schedules.[12] National Grid also refers to the Joint Utilities' filing for additional comments on intra-cycle cost recovery.

National Grid's rate case proposal, filed in May 2024, included funding to support the development of utility-owned storage and non-wire alternatives projects. These projects are to meet system planning requirements, adding reliability and resiliency, and are consistent with Commission guidance on appropriate use cases for utility-owned energy storage. Where the Commission approves additional use cases for utility-owned storage, such as storage fulfilling the Integrated Large Renewable Enablement application or MES acting as a Bridge to Wires application, future rate cases or the JU's proposed intra-cycle cost recovery mechanism may be appropriate cost recovery channels. The Proactive Planning Proceeding,[13] still in its early stages, is anticipated to provide a further pathway for approval and cost recovery for certain projects that meet the defined criteria once established.

This appendix presents examples that illustrate the non-market T&D applications for energy storage. A project application may produce varying outcomes for customers. In response to CLCPA Phase 2 Order[14], the Coordinated Grid Planning Process (CGPP) was established[15] to act as a long-term planning framework to achieve the objectives of the CLCPA. National Grid supports the effort of the Advanced Technology Working Group (ATWG)[16] to ensure that GETs, including energy storage, are evaluated as

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[12] *Supra* note 2, p. 67.

[13] *Supra* note 5.

[14] Case 20-E-0197, Order on Local Transmission and Distribution Planning Process and Phase 2 Project Proposals (issued September 9, 2021)

[15] Case 20-E-0197, Order Approving a Coordinated Grid Planning Process (issued August 17, 2023).

[16] The Commission create the ATWG to evaluate, test, and establish pathways to support deployment of cost-effective advanced T&D technologies through utility capital planning. The ATWG will ensure advanced technologies are appropriately identified and considered during the different stages of the CGPP and to advance state energy policy.

solutions during the CGPP. Consistent with the CGPP order which views energy storage as Grid Enhancing Technologies, National Grid views CGPP as a potential emerging pathway for the approval and recovery for storage projects selected to meet needs identified through this process. National Grid posits that approval and recovery may vary by project and that existing models be considered when projects are filed with or otherwise evaluated by the Commission.

Section 5: Procurement and Other Economic Considerations

A variety of procurement options could be used to implement the energy storage use cases described above. Analysis performed by National Grid of a variety of procurement models suggests multiple procurement options can be competitive means of delivering storage projects. Competitiveness depends on multiple variables specific to individual projects, including:

- Project location and constructability
- Total project cost
- Cost and structure of capital
- Ability to finance construction
- Stakeholder concerns
- Local energy prices
- Energy dispatch schedule
- Project soft cost payment structure

National Grid's analysis concluded that utility-owned storage procurement options can effectively minimize incremental costs to customers in certain situations. For one specific potential project, National Grid's analysis concluded that utility ownership added the fewest incremental costs to ratepayers because of relatively low utility financing costs, attributable in part to lower ROE expectation. Furthermore, an individual storage project's construction is unlikely to meaningfully affect utility soft costs (such as services focused on engineering design, legal review, environmental services, etc.), since utility soft costs are fixed costs funded on a system-wide basis, and not a project-specific one.

Given this result, National Grid's analysis concluded that utility-owned storage can be competitive with other procurement options in general and, for the specific project analyzed, is the procurement option that most effectively minimizes incremental customer costs. Utility-owned storage should therefore be considered as a key tool in the toolbox to ensure the energy storage goals described in this filing are prudently achieved.

Section 6: Energy + Environmental Economics Analytical Support

As referenced earlier in the appendix, National Grid worked with the consultancy E3 to better understand use cases, economics, and other considerations involved in utility-owned storage providing transmission benefits. E3 prepared a report summarizing the results of that work in support of this filing.[17] While National Grid commissioned the report and supported E3 in its work, the findings are E3's.

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[17] *Utility-Owned Storage in New York State: Applications for Transmission System Services*, Energy and Environmental Economics, Inc. (E3), October 2024, linked at: https://www.nationalgridus.com/Energy-Storage-and-Electricity-Transmission and https://urldefense.com/v3/__https:/www.ethree.com/wp-content/uploads/2024/10/National-Grid-UOS-Filing-Support_20241016.pdf__;!!B3hxM_NYsQ!w9IW4tsc7lh36t1WUfmlMto3yw5zCE-PEFz7bQgnVCBHdN0NGBSAGwmlaWCelo2KODfis7_DhtAnxM8eR1Yy_5mYdHIebixx$)

The report examines not only site-specific use cases for storage in National Grid's New York service territory but also seeks to provide a more holistic view of the current climate for energy storage across the country, and for utility-owned storage specifically. As a result, it includes discussions of FERC, NYISO, NERC, and other policies not addressed elsewhere in this filing. It also includes some general discussion of storage as a transmission asset ("SATA") use cases, which can include market participation by the storage asset; however, National Grid is not pursuing any SATA opportunities that would involve direct utility participation in wholesale markets. National Grid and E3 believe this report will provide valuable additional perspectives on potential future considerations for utility-owned storage.

Appendix B

Consolidated Edison Company of New York, Inc. and Orange & Rockland Utilities, Inc. UIS Examples

Appendix B

Consolidated Edison Company of New York, Inc. and Orange & Rockland Utilities, Inc.

Additional detail and examples for downstate implementation of Utility Integrated Storage (UIS)

UIS application priorities vary by utility based on the regional needs of customers. Like all solutions, the benefits of UIS will vary with each application and implementation. Utility Integrated Storage (UIS) can be deployed to provide value and benefits concurrently and over time. The ability for storage to switch applications over time enables the asset to support different system needs and help enhance the reliability of the local grid over the entire lifetime of the UIS system. As non-market assets, UIS applications can help use flexible capacity to help de-load equipment, gain efficiencies through optimization and coordination of utility resources, and balance needs to maximize benefits to customers and the local grid. These benefits can include support of DER integration, increase reliability and resiliency for critical infrastructure, addition of clean energy access points, and enhance operational flexibility based on system needs.

As noted throughout this report, periodic re-evaluation of priorities is necessary to address emerging customer needs through the energy transition. This appendix provides additional detail and examples about the operations of UIS assets, the benefits they can deliver, and the initial prioritization for Con Edison and O&R.

UIS deployments will prioritize:

Tier I applications which serve near-term needs and can also provide benefits over time. The value of Tier I applications lies in their ability to fulfill multiple roles early in the energy transition while also supporting the reliability of transmission and distribution (T&D) systems.

Tier II applications which are important grid management tools that address more long-term system needs during the clean energy transition but do not individually provide enough benefit to consider energy storage deployment. However, if multiple Tier II applications are concurrently applicable to an area of need, storage can be considered for deployment. The value of Tier II applications lies in their ability to manage the middle period of the energy transition, providing the ability to switch between applications concurrently and over time.

Tier III applications that offer benefits that enhance the value of energy storage deployment, typically complementing Tier I and Tier II applications. They do not justify deploying energy storage on their own but add additional value for customers.

Selection criteria – UIS may be considered to solve an identified need if either:

1. A Tier I application supports an identified initial driving need
2. Multiple Tier II applications can concurrently support areas of need

Illustrative Examples

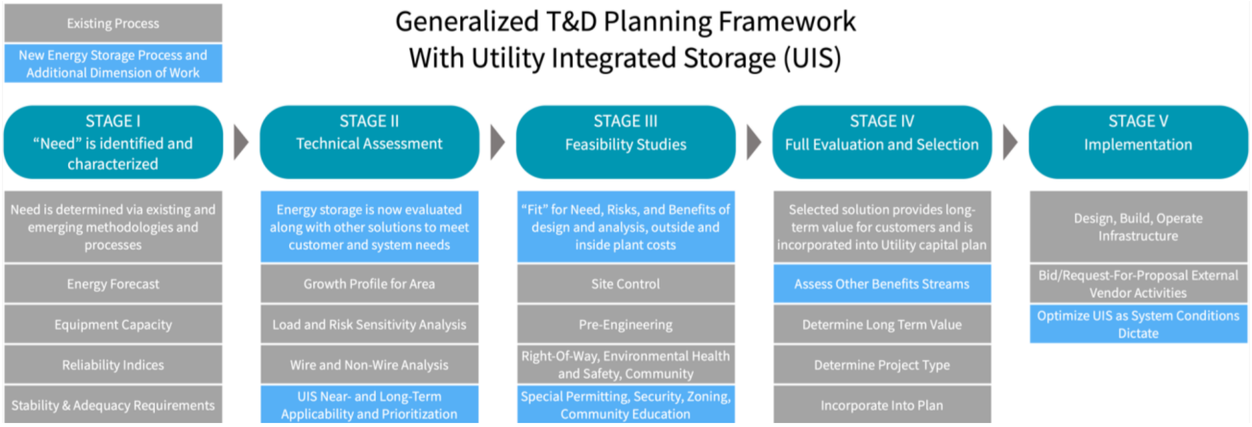
To illustrate how UIS can be used as a tool in our toolbox, we present the following illustrative example projects that demonstrate the full flexibility that storage can provide.

Applications for Utility Integrated Storage	Tier	Level
Bridge-to-Wires	I	D
Flexible Transmission Capacity	I	T
Flexible Distribution Capacity	I	D
Resiliency and Near-term Reliability	I	D
DER Integration and Hosting Capacity	I	D
Integrated Large Renewable Enablement	I	T
Peak Shaving	II	T&D
Grid Optimization	II	D
Renewables Balancing	II	T
Flexible Power Transfer	II	D
Reactive Power Control (Voltage Control)	III	T&D
Flexible Shunt Reactor (Inductor)	III	T&D
Clean Energy Access Point (Co-location of EV Charging / DER)	III	D

Figure 1 – Application Prioritization for Downstate

Example 1 – Evaluation Framework

The following is an example of how a Utility Integrated Storage project would proceed through the evaluation framework.



Generalized T&D Planning Framework
With Utility Integrated Storage (UIS)

Existing Process

New Energy Storage Process and Additional Dimension of Work

STAGE I "Need" is identified and characterized	STAGE II Technical Assessment	STAGE III Feasibility Studies	STAGE IV Full Evaluation and Selection	STAGE V Implementation
Need is determined via existing and emerging methodologies and processes	Energy storage is now evaluated along with other solutions to meet customer and system needs	"Fit" for Need, Risks, and Benefits of design and analysis, outside and inside plant costs	Selected solution provides long-term value for customers and is incorporated into Utility capital plan	Design, Build, Operate Infrastructure
Energy Forecast	Growth Profile for Area	Site Control	Assess Other Benefits Streams	Bid/Request-For-Proposal External Vendor Activities
Equipment Capacity	Load and Risk Sensitivity Analysis	Pre-Engineering	Determine Long Term Value	Optimize UIS as System Conditions Dictate
Reliability Indices	Wire and Non-Wire Analysis	Right-Of-Way, Environmental Health and Safety, Community	Determine Project Type	
Stability & Adequacy Requirements	UIS Near- and Long-Term Applicability and Prioritization	Special Permitting, Security, Zoning, Community Education	Incorporate Into Plan	

Figure 2 – T&D Planning Process with UIS

STAGE 1: "THE INITIAL DRIVING NEED" IS IDENTIFIED AND CHARACTERIZED

Utilities will continue to perform transmission and distribution system planning as they have in the past. The first stage in the evaluation framework is to identify system needs through existing utility processes.

In this example, the first need identified is at an Area Substation ("AS") in Queens. Area Stations typically serve large geographical areas and tens of thousands of customers via one or more large low voltage networks, 4kV grids, and other types of distribution systems. 4kV grid systems are typically characterized by large overhead residential customer load areas.

The Area Station presented here shows capacity constraints starting in 2027 with planned UWI (Utility Wire Infrastructure) capacity improvement starting in 2028. In the same area, there is also a second need identified downstream, at a 4kV Unit Substation ("USS"). This 4kV USS supplies into a 4kV grid system. This 4kV USS is estimated to require load relief upgrades starting 2031.

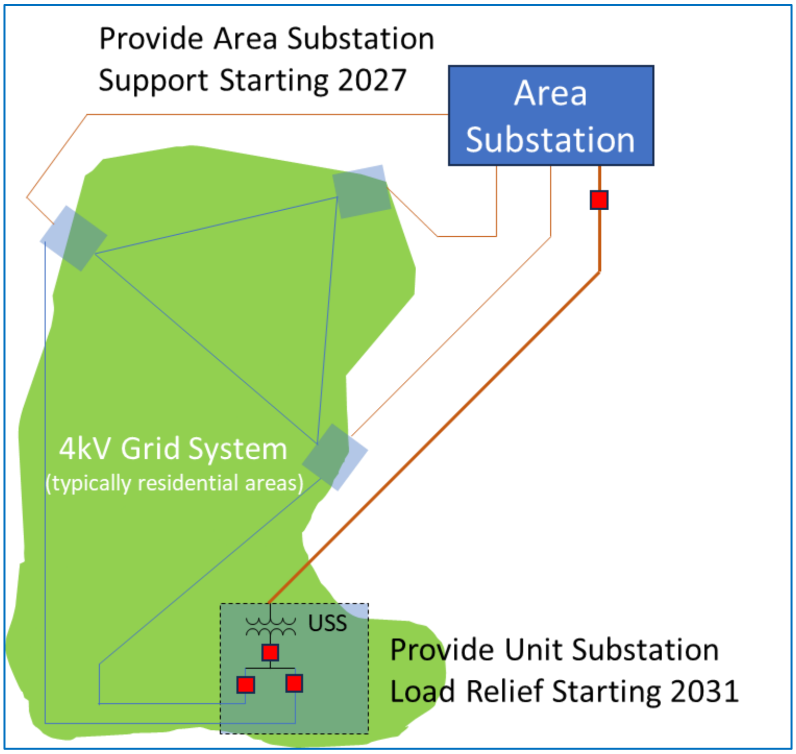


Figure 3 – Illustration of 4kV Grid Showing Initial Driving Needs

STAGE 2: TECHNICAL SOLUTION IS EVALUATED

At this stage, we consider the potential applicability of UIS and evaluate possible solutions for technical suitability. Solutions are considered either alone or in combination with UWI. Planners will also consider UIS flexibility for supporting near- and long-term benefits.

In this example, the identified needs fit into a potential tier 1 UIS deployment for Flexible Distribution Capacity. This is due to the multiple needs it could potentially help support in the near term, in an area conducive to ramp-up in customer load growth. The technical evaluation now assesses solutions to an equivalent mid-term 4MW need. A potential UIS solution would need to be located at the utility-owned 4kV USS in Queens to satisfy both initial driving needs discussed above. A key advantage of this location is that the installation of UIS does not require an outage on the main supply feeder to the unit substation transformer which minimizes the impact on the distribution system and its operation. Once the initial driving needs are assessed, the Utility would begin to assess if any additional benefits including Grid Optimization, increased hosting capacity, reliability, or resiliency can be provided by this potential solution.

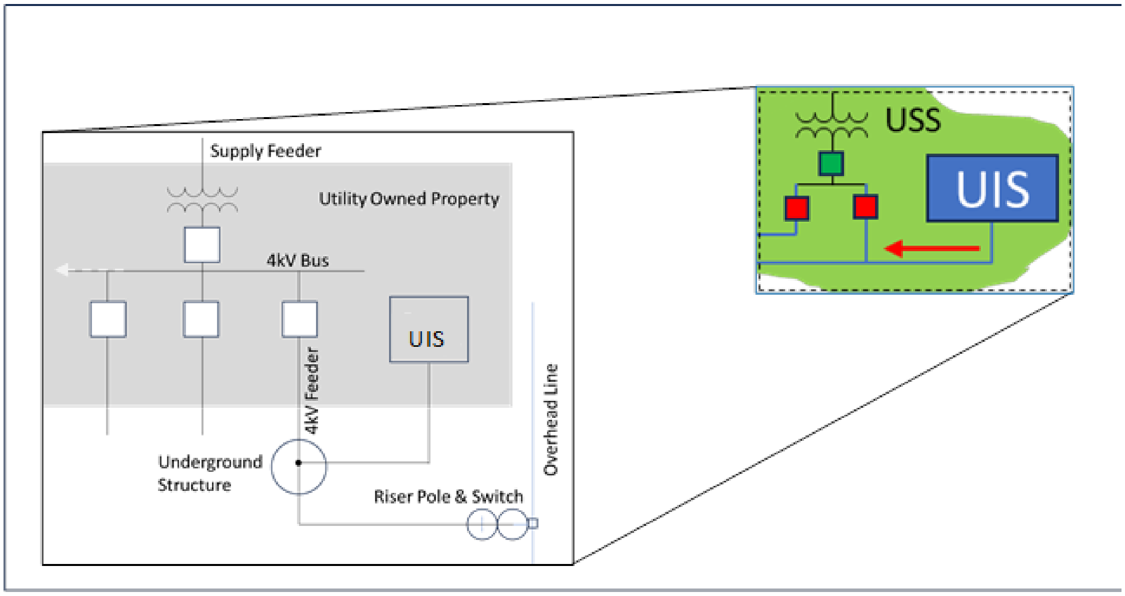


Figure 4 – Concept of Proposed Interconnection

STAGE 3: FEASIBILITY STUDIES

In this stage, all possible solutions including a UIS, must meet various project feasibility guidelines. These include meeting physical constraints such as siting, zoning, community engagement, flooding, fire, and environmental reviews and requirements. A significant aspect of community engagement for UIS is education. While local communities are typically familiar with utility wire infrastructure, there is less awareness about newer technologies such as utility scale energy storage. It is essential to support community education to inform communities about the value and safety of these technologies, which can help local communities adapt to the clean energy transition faster.

An assessment of constructability, considering the development timeline, resource availability, and costs would need to be conducted to satisfy technical needs. Aligning the solutions with other project schedules and system plans is essential, along with supporting opportunities for project coordination, bundling, and economies of scope and scale. Planners need to confirm that the feasibility of interconnection meets the technical requirements identified in the previous stage. Further technical reviews may be necessary after identifying site-specific interconnection options as part of the feasibility assessment.

In this example, the feasibility study also looked at the 24-hr load profile of the unit substation in the future years including the estimated the MW and MWh needed to provide the unit substation flexible capacity. Various UIS designs also are considered to assess the optimal solution. In this instance, the required 4MW need was designed as (2) 2MW UIS systems feeding the 4kV grid for reliability and to facilitate space constraints where the Utility has site control, at the Utility 4kV USS. The impacts and benefits for the distribution system were analyzed, and a high-level cost estimate was developed.

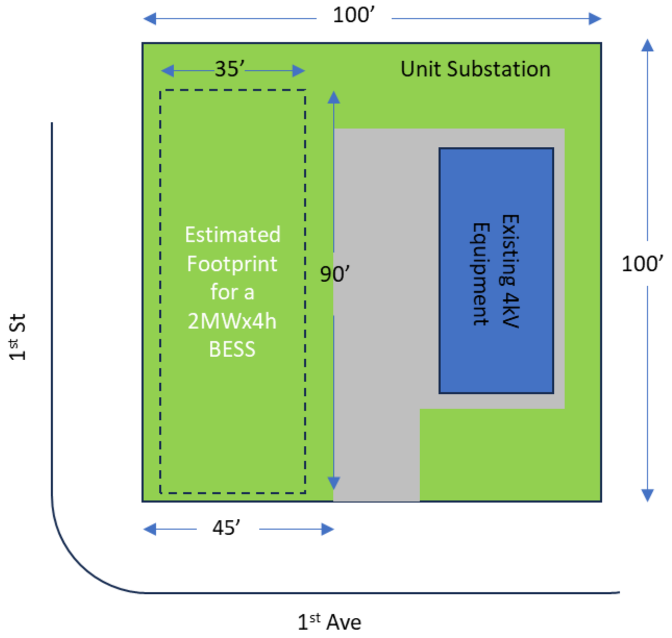


Figure 5 – Illustration of UIS Footprint in Utility Unit Substation Property

STAGE 4: FULL EVALUATION AND SELECTION

In this stage, utility planners will consider the cost and long-term customer value of possible solutions that have cleared the technical suitability and feasibility requirements. Factors may include how solutions can fulfill multiple short- and long-term needs, offer multiple sources of value, create planning optionality, and operational flexibility. Planners will consider the total near- and longer-term value of solutions and select the option that, in the judgement of the Utility, offers the best value for customers.

For any UIS project, consideration must be given to how different applications will be prioritized over the lifespan of the asset.

Below are several examples of how this single asset can support multiple UIS applications.

Flexible Capacity & Contingency Support

One of the initial driving needs of the UIS example is reducing the load below the equipment capacity to provide capacity flexibility at the distribution level, in line with the flexible distribution area capacity application described in the body of this report, and therefore represents a Tier I application. Figure 6 below illustrates how customer demand at the unit substation could exceed its rated capacity starting in 2031. In this example, when the customer demand surpasses the target limit, the UIS system starts to discharge energy into the 4kV USS grid to maintain the demand below the maximum capacity, at the appropriate level. This can help alleviate the stress on the 4kV USS equipment, overhead distribution lines, and the 27kV supply feeder(s) associated with the 4kV grid system. Since the 4kV USS is downstream of the area station, when the UIS system discharges to reduce the load at the 4KV USS, the upstream Area Substation that supplies the unit substation also experiences the same net reduction, thereby supporting both initial driving needs.

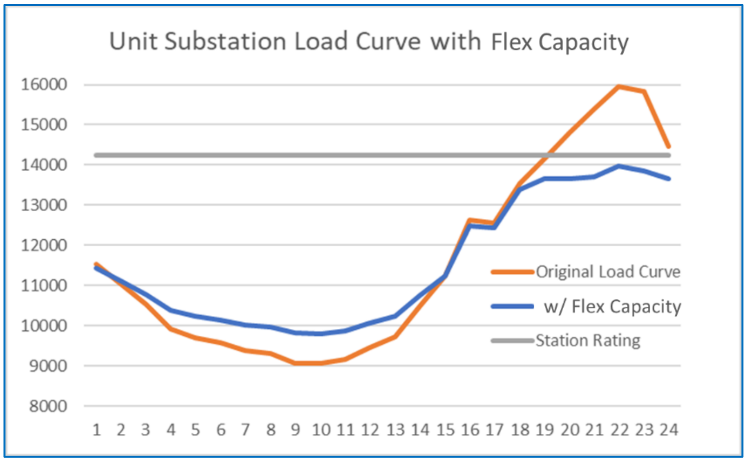


Figure 6 – Illustration of UIS Discharging Available Flexible Capacity

When customer demand is below the load limit threshold, the UIS dispatch cycle can be further optimized for VAR support. The net effect is to increase the feeder emergency rating and to reduce line losses. Refer to Example 2 below for additional detail.

Reliability and Resiliency

Placing the UIS system at a 4kV USS creates operational flexibility for the Utility, since it would be integrated with UWI to support the local grid under different operational scenarios, thereby providing a resiliency and reliability Tier I application. Under normal conditions, the UIS system can import or export power from either the 4kV USS or overhead line to maximize operational reliability and other customer benefits. Under certain conditions, such as when supply feeders go offline, the placement of UIS allows Utilities the flexibility to reconfigure the grid into different operational modes. In this example, the operational modes include:

- Operational Mode 1 (Post-Contingency 4kV USS Support) - If the main supply feeder to the 4kV USS is out of service, the UIS supplies power back to the 4KV unit substation to help support all overhead lines emanating from the 4kV USS to customers.

- Operational Mode 2 (Post-Contingency 4kV Overhead Support) - If the entire 4kV USS is out of service, it can be isolated via breakers. The UIS system can be used to supply power to the connected overhead lines to support the residential customers and the broader 4kV grid system.

- Operational Mode 3 (Pre-Contingency Support) - For forecasted weather and heat events, the Utility would gain optionality with the ability to hold the asset fully charged and strategically discharge as part of an emergency response plan.

- Operational Mode 4 (Restoration Support) - Depending on system conditions, temporary restoration of small pockets of interrupted customers along connecting overhead lines may be possible in lieu of, or in combination with, temporary mobile generation.

Voltage Support

During peak customer demand conditions, it’s possible for emergencies to cause a unit substation transformer or associated supply feeder to go out of service. Under certain situations, some customers near the unit substation could experience lower voltage. A UIS system located at a unit substation can improve voltage support when the supply feeder is out of service. Figure 7 shows how a UIS system located at the Utility unit substation can export real and reactive power during unplanned feeder outage conditions. The Energy Storage system allows for tailored reactive support to right size the grid need. In this example, the UIS is used to improve voltage an estimated 3%.

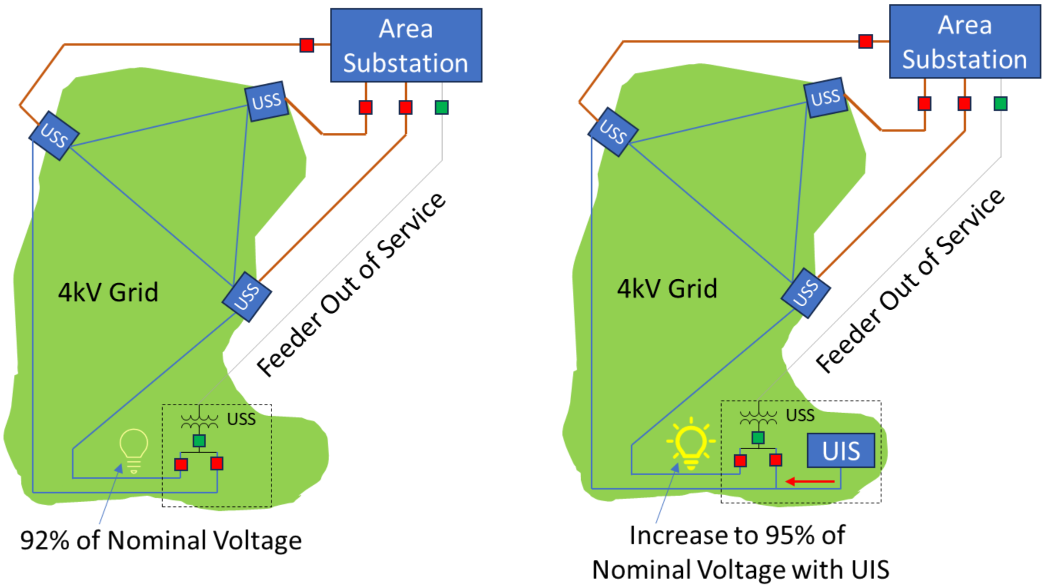


Figure 7 – Voltage Support

<u>DER Hosting Capacity</u>

In areas with high DER penetration, hosting capacity may be constrained if certain criteria such as thermal ratings or voltage quality are violated. Due to Con Edison’s network system, hosting capacity may also be limited if supply from distributed energy resources, such as residential solar or other DERs, creates reverse power flow which may cause breakers or another protection equipment to trip open. In this example, if generation supply exceeds the load on a 4kV transformer it may cause breakers at the unit substation to trip open which could cause customer outages. This characteristic is most apparent during low-load shoulder seasons of the year when solar production is at its highest and energy consumption is lower due to the milder weather. As illustrated in Figure 8, in some areas, this effect could limit DER hosting capacity. UIS located at the <u>USS</u> could absorb excess solar production and allow for a higher hosting capacity within the 4kV grid system.

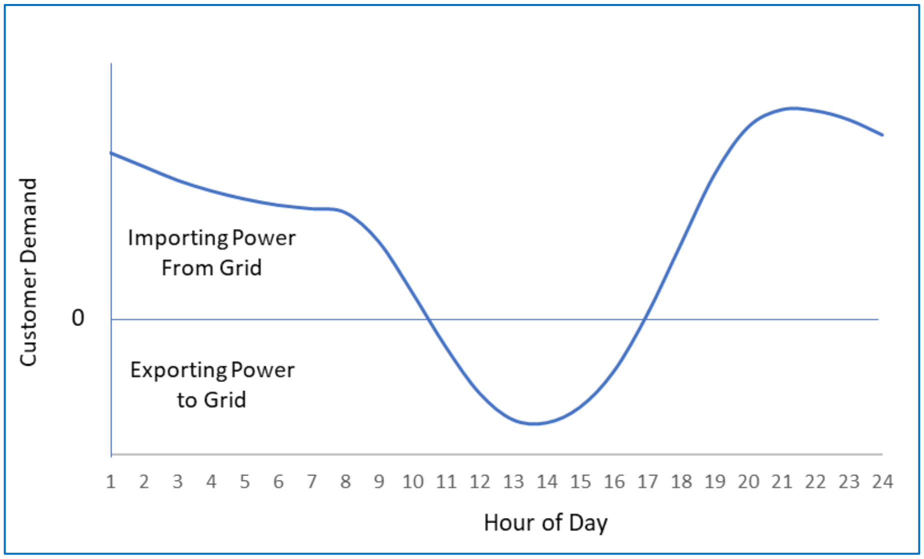


Figure 8 – 2023 Aggregate Residential Customers with PV Shows "Duck" Curve for Con Ed System

In this example, the size of the Unit station transformer is 10MVA. Adding the equivalent of 4MW of UIS at the unit station level is the equivalent of lifting the hosting capacity limitation of the unit substation above the transformer limit. After installation, the Utility would optimize battery charging to enhance hosting capacity as needed.

For this example, in addition to the benefits illustrated above, other potential benefits were identified, including:

Quantitative benefits that could be converted to dollar values:

- A renewable credit reflecting the value storage provides in unbottling and balancing renewable generation
- Incidental electricity cost savings

Quantitative benefits not converted to dollar values:

- Emissions reductions
- Reductions in peak generation

Qualitative benefits:

- Customer experience (Power Quality, Etc.)
- Reduced reliance on mobile generators

Policy support benefits:

- Supporting renewable deployment and emissions reductions as described in CLCPA goals.
- Supporting Disadvantaged Communities goals

Below is an illustrative view of the benefits provided by deploying a UIS solution starting in 2027 showing sources of near, mid, and long-term value and benefits to our customers. These are the benefits which cannot be delivered by a single wire solution. Planning over a longer horizon is necessary to meet customer demands of the clean energy transition. As with any solution, the long-term planning horizon of the clean energy transition increases the variability of benefits. However, the flexible nature of UIS enables various storage applications to support the evolving dynamics of the clean energy transition and maximize the value of the asset over its lifetime.

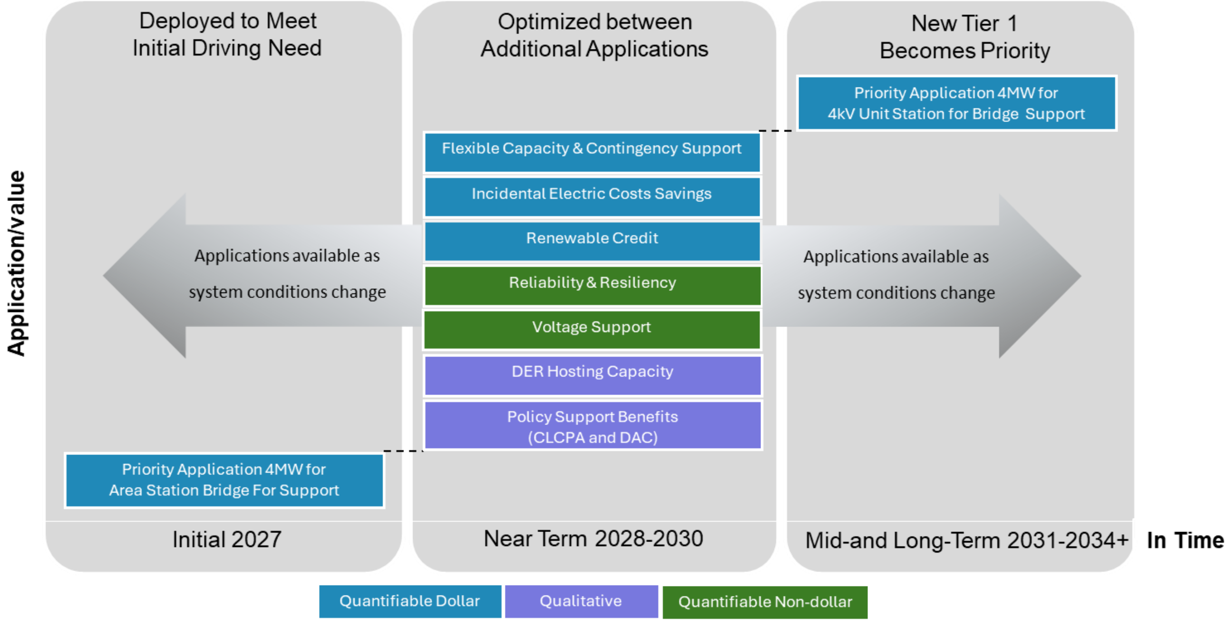


Figure 9 – Value & Benefits over Time

Con Edison notes that this example was evaluated in line with Stage IV of the evaluation process described in the body of the JU study filing.

STAGE 5: Implementation

Implementation involves design, construction, operation, integration, and optimization. Utilities will continue to select options that offer the greatest benefits for customers. As discussed in section V of this study, utilities will need to implement changes to operate, monitor, and evaluate the performance of UIS systems. This is illustrated in Figure 10, below. Utilities will need to optimize between different applications and emerging priorities over time to maximize the ability to perform each application illustrated in Figure 10. Utilities will also need to adjust operating parameters such as threshold (values) and trigger (events) based on evolving customer needs to maximize the value of each application.

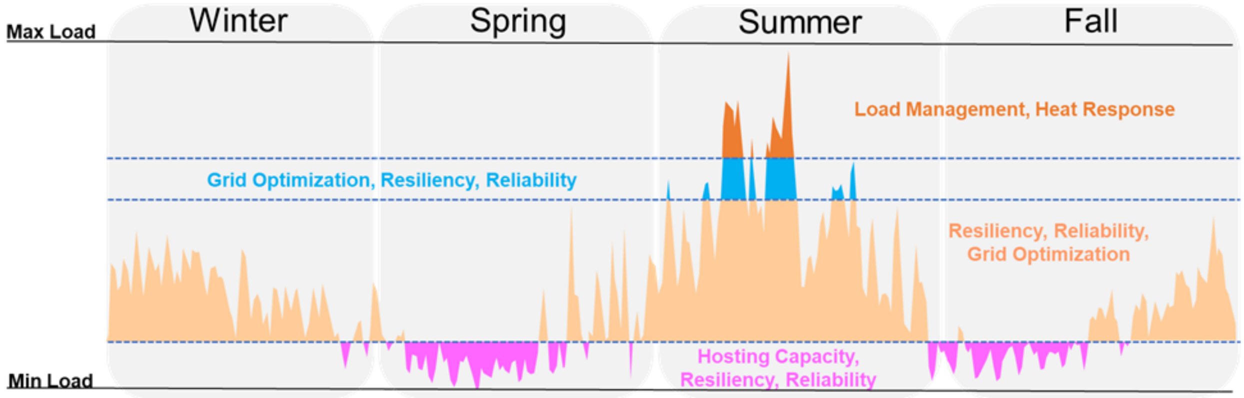


Figure 10 – Core Operation of UIS Applications transition over 12 months

Example 2 – Applications for Utility Integrated Storage

In Example 2 we discuss the technical applications in more detail. In this instance, a capacity need was identified at the area substation level starting in 2031 in the Bronx. The following illustrates how UIS placed in distribution networks (customer service areas) could support this need and offer a range of services to enhance grid operations, customer value, and policy objectives. Below, we highlight how we design the system and utilize the following applications:

Tier I:

1. Near-term reliability
2. Resiliency
3. DER Integration and Hosting Capacity

Tier II:

4. Peak Shaving
5. Grid Optimization
6. Flexible Power Transfer

Tier III:

7. Reactive Power Control
8. Clean Energy Access Point

This example illustrates a distinct method of grid optimizing and the ability to provide planning flexibility and support clean energy infrastructure, and new customer load profiles as they emerge through the energy transition. As before, site selection is based on area of need, as well as Utility right-of-way and site control. These decisions are focused on non-market, operational, and overall benefits the potential solutions could provide to customers. The example described here, drawing on the planning process outlined in the JU study, involves a Bronx 13kV network labeled X, which is situated next to the Westchester 13kV network labeled W. This site is ideal because the UIS system can be used to wheel power across different networks fed by different area substations. This is a new application that is not always feasible for distribution systems because networks may not be in phase. The UIS system serves to remove phasing constraints, provide power control, and optimize the load transfer from one network to another. The site is also in an area, which is expected to see a significant need for service for EV charging for fleet electrification that could benefit from a new make-ready concept.

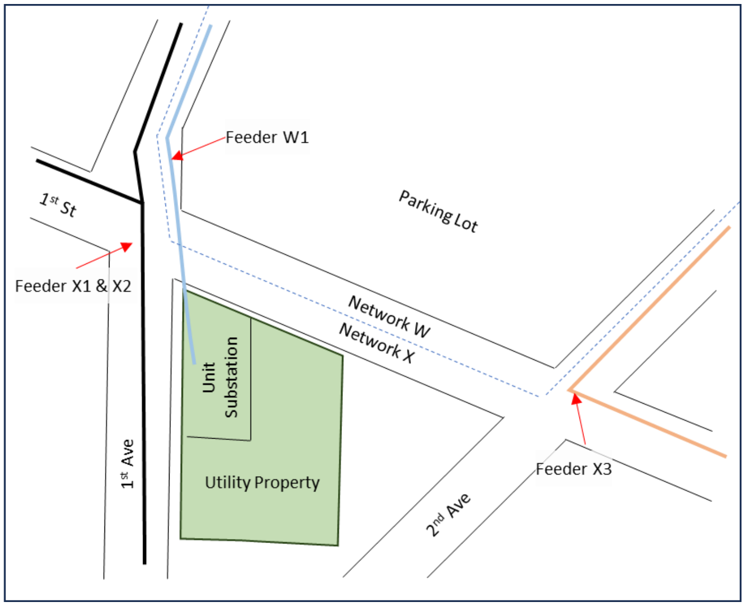


Figure 11 – Illustration of Project Location

Design

UIS systems are designed to integrate into the energy delivery system to perform various roles and provide multiple benefits.

Figure 11 shows the location and Figure 12 shows the conceptual design layout. The UIS system is designed as a 10MW site with two components. The first component of the system is 5MW with an Alternating Current (AC) low voltage service bus that can facilitate interconnection for developers seeking to install DC fast chargers via Make-Ready Fast Charging Infrastructure. Since the same AC-bus service system connects two feeders within the same network, energy from the battery and the reactive power from the inverter can be dispatched to the network even with the loss of one feeder. Additionally, since this system is located at the fringe of the network, the UIS system could also provide voltage support during abnormal system conditions. Lastly, the UIS system could also be optimized to reduce line losses. The second component is a 5MW system, serving two different networks connected by a Direct Current (DC) bus. This portion of the system has the capabilities of the AC system and could also facilitate the wheeling of power between the two neighboring networks. The UIS systems' DC bus allows distribution feeders from different networks to be connected via bi-directional inverters to wheel power from one to another in a controlled manner, something that is not practical by connecting feeders directly using an AC bus. Each inverter can control the amount of power imported from or exported to each feeder, and thus enable an adaptive storage dispatch cycle for grid optimization. The presence of the DC bus connecting the two feeders adds additional reliability as described below.

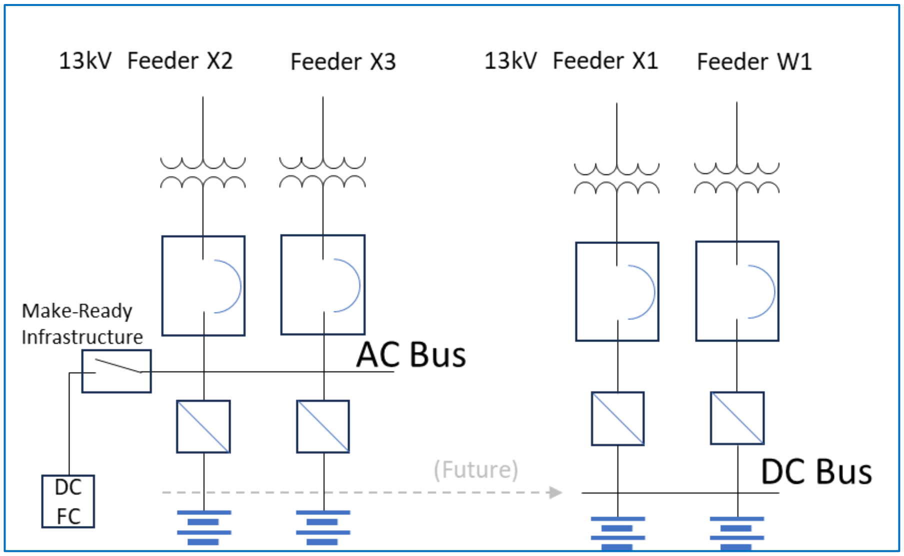


Figure 12 – Conceptual Design DC/AC BUS UIS

Applications for Utility Integrated Storage

UIS Flexible Operational Capacity & Grid Optimization

Market assets play a critical role by prioritizing economic market signals to help ensure resource adequacy. Figure 12 illustrates the typical charging and discharging cycle of a 4-hour storage asset responding to market signals. The storage is discharged during peak conditions but leaves the rest of the feeder loadings otherwise unchanged. Because the electric grid must be able to operate effectively no matter the customer load, including those of market storage assets, additional storage that responds to optimization of local grid operation rather than market signals, will be necessary. UIS systems fill this distinct and complementary need by prioritizing non-market local customer and grid needs first. Local grid optimization does not impact wholesale market conditions which optimize at the zone or sub-zone level.

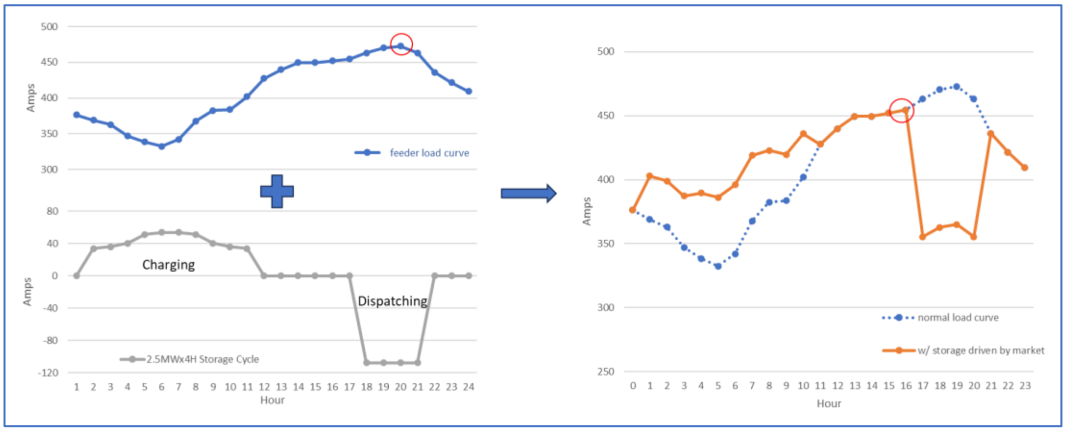


Figure 13 – Impact of a Market Energy Storage

Below, we discuss the **Grid Optimization** methodology that supports UIS dispatch adapted to changing grid loads. As illustrated in Figure 14, the feeder load curve in blue is modified to the grey curve with a much lower peak. The typical market curve in orange remains overlayed for comparison.

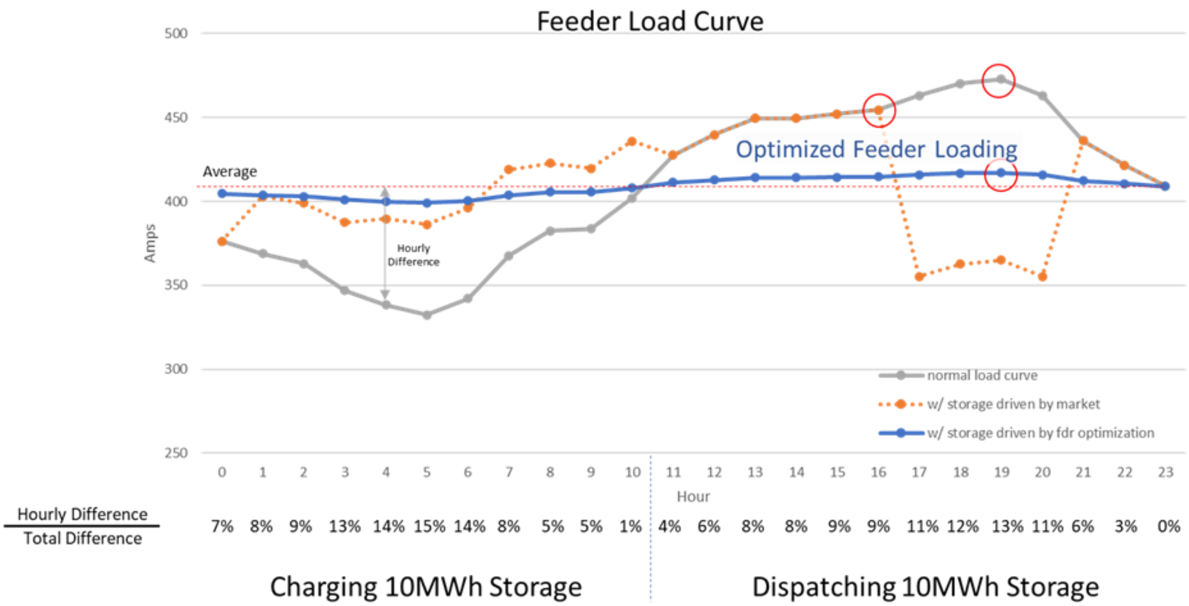


Figure 14 – Feeder Grid Optimization Energy Storage

Applying the Grid Optimization methodology for UIS operations, an initial 24-hour flow simulation analysis estimates the normal peak on the feeder X1 could be reduced by about 12% while boosting the emergency rating of the feeder by about 5% to help support grid operations. Achieving the feeder capacity added by Grid Optimization would require replacing multiple feeder cable sections.

The Grid Optimization applications are important operational grid management tools, applicable when system conditions during the year require it to help support grid flexibility. The objective of Feeder Grid Optimization is to bring the daily peaks below the optimization threshold. As shown in Figure 15, for feeder X1, although most daily peaks above the optimization threshold occurred during the summer period from June 1st to September 15th in 2023, UIS systems can shift with customer load profiles to support the dynamics of the clean energy transition. Working side by side, both market storage and UIS are integral to the future energy transition.

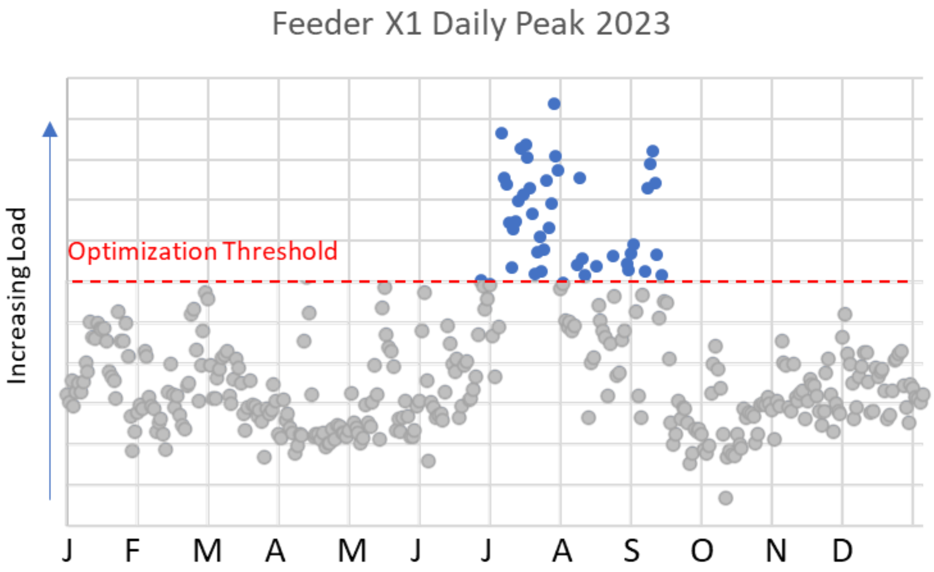


Figure 15 – January to December, Daily Peak Loading for Feeder X1 in 2023

Reactive Power Control and DER Hosting Capacity

Reactive power plays an important role in the flow and voltage control of Alternating Current (AC) electricity. Volt-Amp Reactive (VAR) power is needed by appliances like motors in refrigerators and washers. UIS systems can help provide local operational reactive power by maximizing the use of its inverters. In UIS systems, the amount of "real" (kW) power and (kWh) energy passed between the storage and the grid can vary with system conditions and time.

UIS systems can use the spare capacity of inverters to provide reactive support continuously. For example, in Figure 16 below, at 5AM (0500 hours) the UIS system inverters are charging power at a rate of 1,550 kW, leaving capacity to provide up to an additional 1,812 kVAR of reactive power to the feeder/grid for customer needs. At 1900 hours, the UIS system is discharging at a rate of 1,294 kW, allowing the UIS system to provide an additional 2,139 kVAR reactive power for customer needs. The UIS system can continue to supply reactive power to help support the local grid even after all the energy in the battery is exhausted by maximizing the use of the inverters. The net result of operating the UIS system this way is the reduction of load down to the grey curve, below the average line.

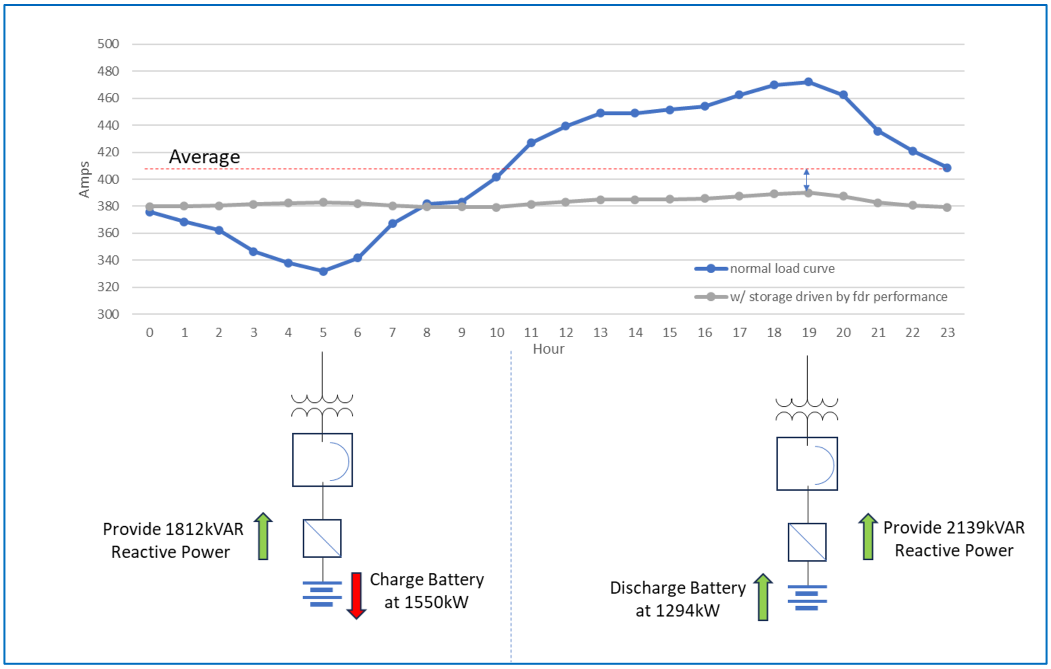


Figure 16 – Illustration of Reactive Power Control

Due to continuous VAR support from the inverters, there is about a 1MWh line loss reduction on the Network X feeders for a peak day. Using local electrical system characteristics (Load & Loss Factors), it is estimated that this UIS system could reduce line losses by more than 100MWh in one year.

The line loss reduction and ability to improve voltage can also help reduce criteria violations associated with DER hosting capacity. Over time, by optimizing real and reactive power, the system can adapt to changing system conditions to support additional DER integration.

Flexible Power Transfer

Utilities provide service and reliability to customers in different electrical and geographical areas which for technical and practical reasons cannot normally be interconnected. Figure 17 below illustrates the ability of the DC bus to facilitate the Flexible Power Transfer between two electrically isolated networks. This is a new and innovative application that leverages UIS systems to allow controlled power to flow back and forth between networks to share operational capacity in emergency situations. The illustration shows power transfer from a lightly loaded 13kV Westchester network feeder W1 to a more heavily loaded 13kV Bronx Network feeder X1. This allows for emergency support in the form of charging the storage from feeder W1 and discharging through feeder X1, wheeling power directly from feeder W1 to X1 through the DC-bus or providing emergency support to the X Network by de-loading feeder X1. Figure 16 illustrates the estimated impact of exporting 2.5MVA from Feeder W1 through the DC bus to feeder X1 continuously. The net impact is reducing the operational emergency peak load on Feeder X1 by about 12%, and the operational ability to increase 5% in headroom through Grid Optimization.

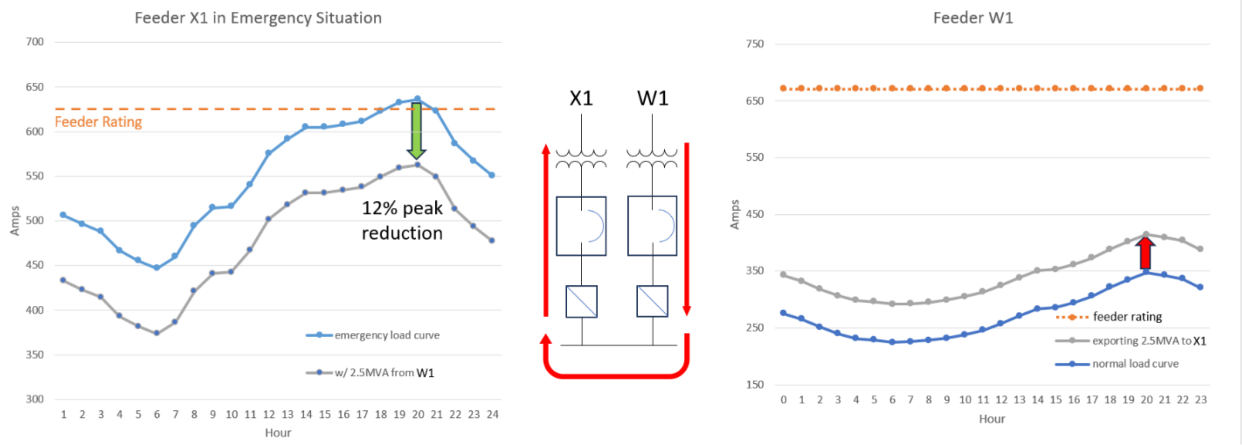


Figure 17 – Flexible Power Transfer

Reliability and Resiliency

The DC bus system will be another tool to increase reliability and resiliency. Flexible power transfer is envisioned as a tool that can help provide the Utility additional time to respond to emergencies and hedge against uncertain or sudden increases in customer demand. Although example 2 is focused on the deployment of UIS to support distribution networks, over time, more operational switching can be added to enhance the operational flexibility of the system to help support the surrounding 4kV grid as well.

Additionally, the UIS system could improve resiliency and help reduce societal impact such as local air pollution, noise pollution and carbon emissions. As previously discussed in example 1, depending on system conditions, the Utility would have the option to hold the UIS system fully charged as part of response plans to expected weather events.

Clean Energy Access Point

When feasible, a UIS deployment with an Alternating Current (AC) low voltage bus Make-Ready Infrastructure can help expand opportunities for future developers seeking to install DC fast chargers. By connecting directly to the AC bus, any EV charging site meeting minimum requirements in proximity may be able to interconnect without requiring a new dedicated service, and minimal system upgrades or system outages. This can reduce the cost and time associated with connecting these new large loads to the grid.

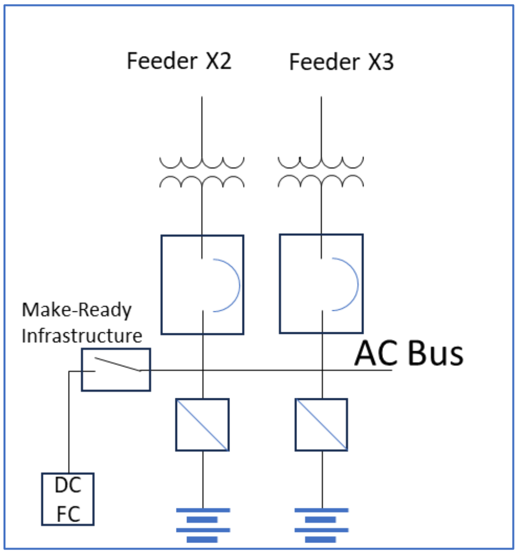


Figure 18 – Block Diagram of AC Bus System with Make-Ready Infrastructure

Conclusion

The applications of the storage proposal described above demonstrate how utility integrated storage (UIS) can help support customers' needs and grid flexibility during the clean energy transition. The implementation of UIS projects across the Con Edison and O&R system can be a valuable tool as a bridge to facilitate the clean energy transition. Con Edison and O&R respectfully requests that the Commission consider for approval the approach described above for evaluating and executing projects, whether authorized as part of a program or an individual project, within section IV and section VI of the JU report.