# Con Edison Challenge: Advanced Utility Controllers for DC-Tied Energy Storage Systems to Enhance Resiliency and Hosting Capacity

## Background

Con Edison is committed to integrating sustainable and technologically advanced solutions to meet the evolving needs of our energy distribution network. The DC-Tied Interconnections for Enhancing Hosting Capacity project aims to improve the resilience and efficiency of our primary feeder system in response to climate-induced heat waves and the rapid rise of Distributed Energy Resource (DER) interconnections. By modifying the direct current (DC) infrastructure of a conventional energy storage interconnection, this initiative would allow for power flow control and load management. The accompanying schematic (Figure 1) illustrates the approach, highlighting the interconnection point and key components of the DC-supported power distribution model. A major objective is to overcome the technical challenges of paralleling asynchronous feeders (due to phase angle differences), and feeders of varying voltage class in future iterations. This project is anticipated to yield the following grid and customer benefits:

- Enable more dynamic control of feeder capacities
- Facilitate voltage regulation
- Alleviate constraints associated with DER reverse power flow
- Strengthen network dependability during outages and contingencies
- Increase DER hosting capacity, thereby reducing interconnection costs
- Enhance grid resiliency

This innovative grid management solution will enhance grid resilience during peak demand periods, particularly over the summer months when feeder overloading poses the greatest risk. The system's ability to dynamically manage power flows during contingency scenarios will enable the company to more effectively mitigate feeder overloads.

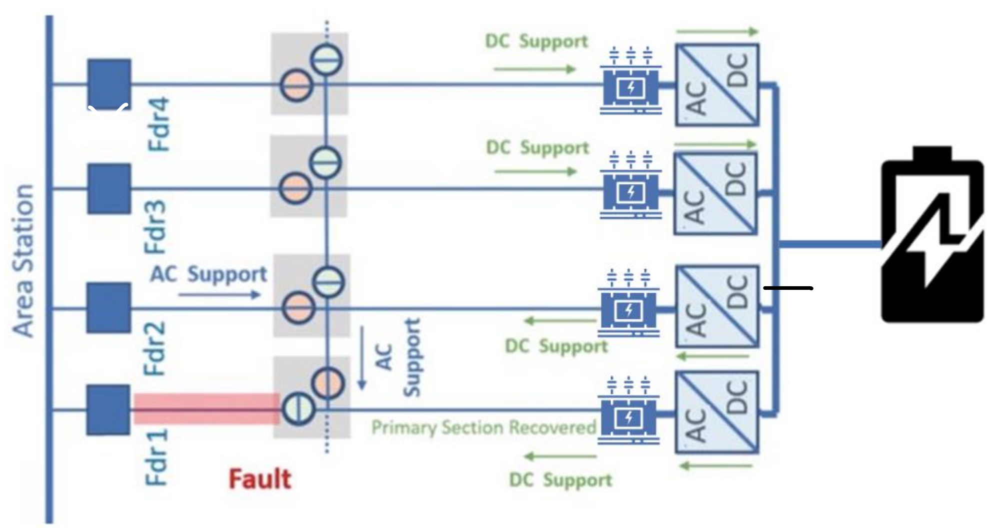


**Fig. 1**: Schematic illustration of the multi-terminal DC-tied energy storage system

Con Edison has performed transient-level simulations to understand the dynamics of the interconnection. A critical component of this interconnection is the development of a Utility Controller, designed to effectively orchestrate power routing. This includes issuing commands to customer-owned DER equipment and monitoring the status of the upstream grid, including any contingency statuses (see Figure 2). The findings from this research have informed the development of a Controller Requirements Document, detailed in Attachment 1 (pages 12-23), which lays the foundation for the design sought in the first phase of this Grid Challenge.

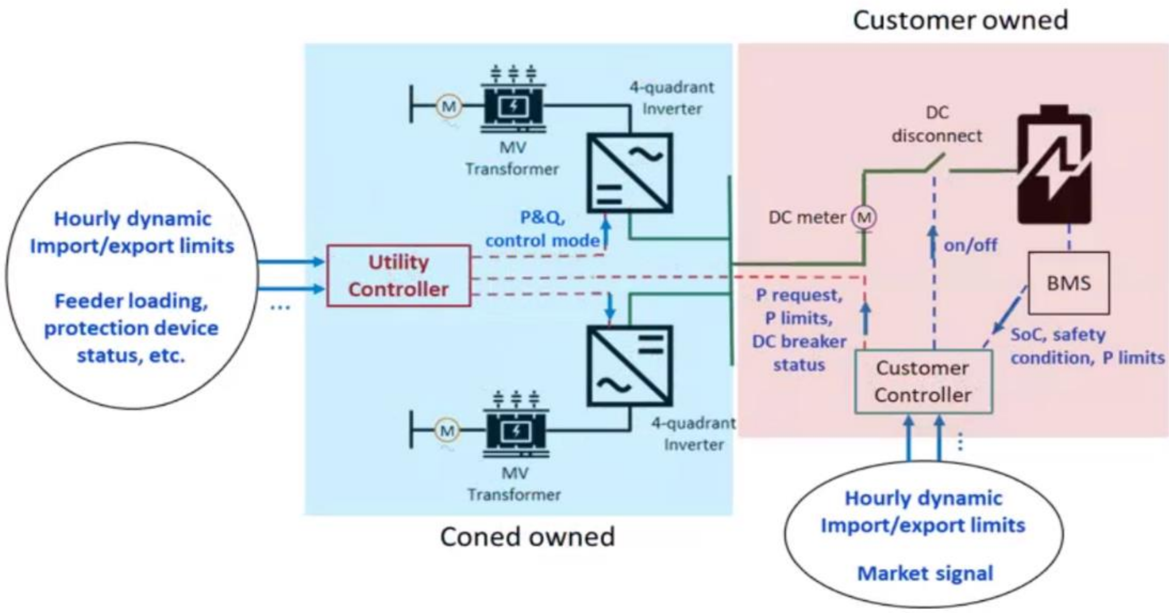


**Fig. 2:** Illustration of hardware, controllers, and communication

signals in the multi-terminal energy storage system

This Challenge seeks to advance the development and demonstration of the hardware and infrastructure components associated with the project.

## Technological and Strategic Business Goals

### High-Level Technical Goals

Con Edison, along with research and industry partners, is dedicated to advancing the DC-interconnection concept, aiming to significantly enhance the role of DC infrastructure in power distribution. The key technical goals of the project include:

1. **Dynamic Load Capacity Management:** Develop an advanced control system to dynamically manage and balance loads during peak demand periods, ensuring continuous power supply while preventing overloads.

2. **Reliable Operation During Contingencies:** Create robust control mechanisms that maintain grid stability during operational disturbances by managing inverter operations and coordinating grid interactions.
3. **Communication and Integration:** Enhance grid operations through seamless communication between the utility and customer controllers, and substation SCADA systems.
4. **Protection and Control Alignment:** Ensure the system integration aligns with existing grid protection strategies and enhances fault response capabilities.

**Anticipated Business Outcomes**

The DC-Tied interconnection represents a first-of-its-kind deployment, designed to serve as a demonstration for further study and analysis. It will facilitate a cost-benefit analysis to help the company evaluate potential cost savings and support the rationale for expanding the technology deployment on a larger scale.

This technology offers a scalable solution that can adapt to multiple utility infrastructures and circuit configurations, from meshed underground network systems to overhead radial designs. cost-effectively enhancing overall grid resilience and reliability. The outcomes intended to be measured in the project include:

1. **Increase in DER Hosting Capacity:** Enhance the grid's capacity to accommodate more Distributed Energy Resources (DERs) without compromising stability or requiring significant infrastructure upgrades.
2. **Potential Reductions in Interconnection Cost:** Assess the extent to which DC-tied power flow control can reduce interconnection costs for DER developers by enhancing power routing efficiency and managing power flow. These advancements are expected to minimize the need for extensive system upgrades.
3. **Reduction in Fault Current Contributions:** Measure how the proposed system can minimize fault current levels at interconnection points, thereby enhancing system safety and reducing the need for expensive protective equipment.
4. **Enhancements to Grid Resilience:** Evaluate the grid’s ability to withstand and recover swiftly from fault conditions, preventing service interruptions and ensuring reliable energy delivery.

## Challenge Focus

The DC-Tied Interconnection design boasts a wide array of potential applications within Con Edison's underground network system, the non-network system (which includes the Con Edison 4kV system, overhead main runs, and autoloops), as well as area station support applications. Initial evaluations have identified the network system as the most suitable area for initial deployment, owing to its extensive customer base and significant potential for resilience improvements, with a particular focus on the Bronx as the primary area for this Challenge.

In particular, networked areas characterized by a strong presence of New York City Housing Authority (NYCHA) housing, and Disadvantaged Customers (DAC) will be targeted for the project, as outlined in Figure 3. These regions support large customer bases and have a greater need for resilience enhancements, presenting clear opportunities for impactful improvements.

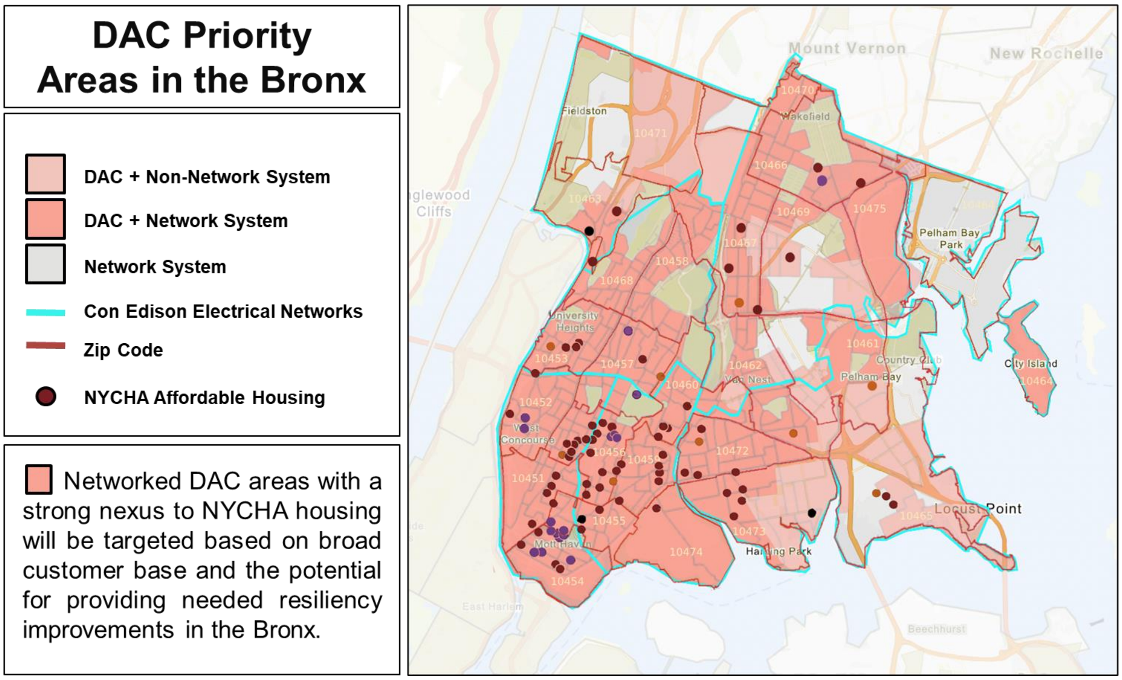


**Fig. 3:** Illustration of DAC priority demonstration areas in the Bronx.

## Project Objectives

Con Edison and NYSERDA aim to establish a comprehensive contractual framework that covers the entire project scope, incorporating critical go/no-go decision points to effectively manage risks. The funding model supports the iterative and long-term nature of research and development, ensuring all stages, from initial design to full-scale deployment, meet desired performance criteria. Proposers are encouraged to submit a phased development plan involving testing and validation, targeting key milestones leading to a full-scale demonstration in the 2027-2028 timeframe. The expected development lifecycle and phased deployment strategy includes:

<u>**Initial Laboratory Development and Validation**</u>

- **Hardware-in-the-Loop (HIL) Testing:** Begin with HIL testing utilizing the attached Controller Requirements Document to guide system design. This phase focuses on ensuring dynamic power routing and effective operation under various conditions through rigorous simulations and HIL testing, validating fundamental design and operational capabilities in a controlled environment.
- **Integration and Communication Protocols:** Develop and test communication protocols between proposed customer and utility equipment to ensure seamless integration under all operational and contingency scenarios, facilitating real-time and emergency responses.

- **Performance Metrics and Data Analysis:** Define performance criteria and gather data to evaluate efficiency improvements, preparing for subsequent field testing.

**Full-Scale Deployment Planning**

- **Development of Deployment Plans:** Create a detailed plan for broader deployment, incorporating lessons learned from initial tests to ensure seamless integration into the existing grid infrastructure.
- **Operational Integration and Feedback Implementation:** Use field data to refine and adjust the system, implementing continuous improvement mechanisms to address performance and integration challenges observed during field testing.
- **Validation:** Conduct thorough testing in both laboratory and field settings to validate the technology's reliability and safety before broader deployment, ensuring that all operational benchmarks are met.

## Project Timeline

The timelines provided are intended for illustrative purposes. Proposers are encouraged to present alternative plans that may deviate from these suggestions, whether by accelerating the schedule or running processes in parallel where feasible.

**Table 1:** Illustrative Project Phases with Key Go/No-Go Decision Points:

| Project Phase | Duration | Timeline | Go/No-Go Decision | Deliverables |
|---|---|---|---|---|
| **1. Controller Development** | 12 months | Month 1 – Month 12 | Assessment of development progress and results from initial testing. | Prototype controllers, interim reports, and cost assessments. |
| **2. Laboratory Testing** | 6 months | Month 13 – Month 18 | Evaluation of laboratory test results to decide on advancing to field testing. | Detailed testing reports and performance metrics. |
| **3. Engineering & Design** | 3 months | Month 19 – Month 21 | Approval of final designs and readiness for permitting. | Final design documents and integration plans. |
| **4. Permitting** | 6 months | Month 22 – Month 27 | Securing all necessary permits to proceed with procurement and construction. | All required permits and regulatory approvals. |
| **5. Procurement** | 9 months | Month 28 – Month 35 | Confirmation that all materials and services have been procured according to project specifications. | Contracts for materials and services, readiness reports for the construction phase. |
| **6. Construction** | 9 months | Month 36 – Month 44 | Evaluation of construction completion and operational readiness. | Completed installation, operational checks, and initial operational feedback. |

## Teaming and Joint Proposals

The team should present innovative, market-driven solutions for the Utility Controller and its demonstration. This multidisciplinary group should have expertise in system design, data analytics, communication protocols, and utility operations. The controller manufacturer should demonstrate capability of innovating upon pre-existing platforms and have experience with renewable energy, energy storage interconnections, and microgrids. They should have developed solutions for projects ranging from kilowatt to multi-megawatt scales and have an active R&D team for this challenge. The controller manufacturers and the developer (energy storage system installer) team should have experience forming strategic partnerships, demonstrate strong collaborative capabilities, and show a commitment to enhancing grid resiliency through innovative and practical solutions. The developer should be familiar with working in the Con Edison territory, installing large energy storage projects (at the megawatt scale), and in managing the interconnection review, permitting, and construction processes.

The team should highlight any projects showcasing expertise in dynamic control of feeder capacities, voltage regulation, and of managing Distributed Energy Resource (DER) power flow to alleviate grid constraints. Additionally, the team should demonstrate experience in enhancing network/circuit dependability during outages and contingencies, along with a proven track record of increasing DER hosting capacity and/or reducing interconnection costs.

The team should have a designated lead from each business and a strong project management structure to ensure effective coordination and execution of the project. Proposals should be unified and coordinated by a designated lead party overseeing the project's progression and clearly outlining the proposed project management structure.

Proposers must outline the development and deployment strategy, including the implementation process from installation to full operation, and answer the questions in Appendix A (Utility Controller Requirements Vendor Questionnaire).

## Additional Considerations

To ensure successful implementation and integration of the proposed solutions, proposals for the Con Edison Challenge should also be aware of the following additional requirements:

1. **Legal and Security Agreements:** Participants are required to enter into Non-Disclosure Agreements (NDAs) to protect the confidentiality of shared information.
2. **Provision of Resources:** Proposers are expected to supply all essential software and hardware necessary for a comprehensive solution (unless explicitly outlined), including auxiliary accessories and specialized tools for initial setup, routine inspections, testing, and ongoing maintenance.
3. **Compliance with Standards:** It is expected that all equipment and systems will be manufactured and tested in compliance with applicable federal, state, and local laws,

codes, and regulations. Proposers should ensure that the solutions align with current industry standards and practices.

4. **Technical Documentation:** detailed technical documentation, including installation guidelines, operational manuals, and maintenance instructions, must accompany all equipment and software developed.