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REV Demonstration Project:  
Electric School Bus V2G  
Q2 2020 Quarterly Progress Report

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**Dated: July 31, 2020**

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## 1.0 EXECUTIVE SUMMARY

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Consolidated Edison Company of New York, Inc. (“Con Edison” or the “Company”) submits this second quarterly report for 2020 on the progress of the Electric School Bus V2G REV Demonstration Project (the “Project”) it is implementing as part of the Reforming the Energy Vision (“REV”) proceeding, as required by the *Order Adopting Regulatory Policy Framework and Implementation Plan*, issued by the New York State Public Service Commission (“Commission”) on February 26, 2015.<sup>1</sup> Budget information is being filed confidentially with the Commission.

### 1.1. Project Background

On June 8, 2018, Con Edison submitted the Project for approval by Department of Public Service Staff (“DPS Staff”). On June 20, 2018, DPS Staff approved the Project. Con Edison filed an implementation plan for the Project with the Commission on November 13, 2018. The project is the first deployment of new, full-sized electric school buses in New York State. It is also the first to use school buses to perform “vehicle to grid” (V2G) charging, where the buses can discharge their batteries into the grid. The five e-buses serve the school district of White Plains and are operated by National Express.

The project includes the operation of the buses and adding new vehicle to grid technology. The buses have been operating since 2018. V2G reached a major milestone this quarter as the buses have successfully output power to the grid. When distributed generation utility interconnect approval is complete, the project will enter phase III: V2G operations.

Covid-19 has impacted two aspects of the project. Because of travel restrictions, Lion Bus Company cannot send technicians to the site. Three buses have been shipped to Lion, retrofitted, and returned to White Plains. The other two buses are doing less intensive V2G and can be retrofitted when travel restrictions ease. Additionally, National Express, the operator, has not been using the buses for regular service since the PAUSE orders were issued in March 2020. These impacts do not materially impact the project ability to test the demonstration hypothesis because V2G operations can be scheduled to provide adequate cycling of the vehicle batteries.

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<sup>1</sup> Case 14-M-0101, *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, Order Adopting Regulatory Policy Framework and Implementation Plan (issued February 26, 2015).

## 1.2. Project Overview

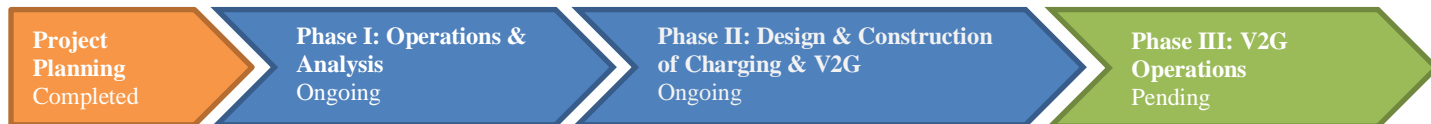


### Electric School Bus V2G REV Demo Project

The **School Bus V2G** (vehicle to grid) demonstration project (the “Project”) examines the technical and operational viability of using school buses as both a grid resource and transportation asset. Key tests include proving that electric school buses function well for transportation purposes, are reliable as grid assets, and that using them as grid assets does not cause excessive wear and tear on the equipment.

The buses have been used as transportation assets since September 2018. The buses began testing V2G on site in preparation for summer discharge.

Project Start Date: June 2018  
Project End Date: September 2021  
Budget: \$1.08M  
Q2 2020 Spend: *Filed Confidentially*  
Cumulative Spend: *Filed Confidentially*



#### Lessons Learned: Customers (bus operator)

- Reliable operation of the bus to date helped prove the technology to operator maintenance staff and drivers
- The operator is building experience with the e-bus that it can leverage competitive advantage

#### Lessons Learned: Market Partner

- V2G is custom built requiring several partners and disciplined project management for success
- Locally, NY-area operators need an e-bus provider that can provide the transportation, electrical infrastructure, and any V2G integration

**Application of Lessons Learned:** *The Company is working to operationalize V2G and reduce deployment costs.*

**Issues Identified:** The subcontractor required to provide the charger hardware and communication chips to enable V2G was replaced with Nuvve. This delayed the first summer discharge period. Project partners have been managing the problem and have an alternative that maintains the Project's fundamentals.

**Recent Milestones:** *Increasing reliability with on-board vehicle inverter to get closer to deployable solution.*

**Upcoming Milestones:** *Site Approval for Distribution Generation (3Q).*

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## 2.0 QUARTERLY PROGRESS

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### 2.1 Activities Overview and Updates

The partners have successfully commissioned V2G on three of the five buses.<sup>2</sup> The system works reliably, can be controlled through Nuvve's dispatch system, and produces high quality power.<sup>3</sup> To the best of the partners knowledge, this is the first original manufactured AC V2G project. AC V2G offers scalable market potential because it can minimize the additional equipment necessary to provide V2G.

### 2.2 Key Metrics

Due to the "New York State on PAUSE" executive order, National Express did not have staff on site to report uptime for the other vehicles. During this time, Lion retrofitted three buses with V2G capability.

### 2.3 Lessons Learned and Recommendations

The project has overcome technology integration challenges. While each component of the solution are existing mature products, having them perform in this new way required major engineering efforts on the part of Nuvve and Lion. Lion's project commitment has helped the project achieve V2G stage.

The lesson of project phase II is that V2G requires customer vehicle retrofits including a group of hardware and software solution providers, and technicians. The Company's goal is to prove its viability so that developers will improve the technology and standard V2G integration can be a feature on vehicles going forward.

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<sup>2</sup> The remaining two buses have fewer planned discharge events. They are planned to be retrofit either when COVID travel restrictions ease, or when it is necessary for the project's schedule.

<sup>3</sup> Nuvve Corporation is the vehicle to grid technology provider

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## **3.0 NEXT QUARTER FORECAST**

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### **3.1 Planned Activities**

The next major phase is to begin discharging the buses and monitor V2G impacts on the batteries. This will be accomplished through Lion's battery management system, which reports on pack voltage, a battery health indicator. V2G power quality will be observed through Nuvve's monitoring system, which provides a histogram of grid behavior with one second granularity.

The V2G dispatch schedule has been designed by Con Edison and approved by the project partners.

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## **4.0 APPENDICES**

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The following appendices are included at the end of this Quarterly Progress Report:

Appendix A: Description of Phases

Appendix B: Work Plan

Appendix C: Checkpoints and Milestone Progress

Appendix D: Procedures and Policies

## Appendix A: Electric School Bus V2G Description of Phases










Phase	0. Project Planning	1. Electric Bus Operations & Analysis	2. Design & Construction of Charging & V2G	3. V2G Operations
<b>Milestone (Stage Gate to Next Phase)</b>	<p><i>Agreements Completed</i></p> <ul style="list-style-type: none"> <li>• DPS approval</li> <li>• Partner contracts signed</li> </ul>	<p><i>Buses perform as vehicular transportation</i></p> <ul style="list-style-type: none"> <li>• Operating metrics measured by data collected by a diagnostic device installed on bus controller area network port</li> </ul>	<p><i>Design, install, and commission V2G</i></p> <ul style="list-style-type: none"> <li>• Retrofit buses with on-board inverter</li> <li>• Complete site work for Con Edison approval</li> </ul>	<p><i>Operate EV buses as grid assets</i></p> <ul style="list-style-type: none"> <li>• Project ends</li> </ul>
<b>Key Elements</b>	<ul style="list-style-type: none"> <li>• Con Edison – First Priority Agreement</li> <li>• Con Edison – National Express Agreement</li> <li>• DPS approval of project proposal and implementation plan</li> </ul>	<ul style="list-style-type: none"> <li>• Meet minimum range requirement of 65 miles for 80 kWh during peak HVAC use</li> <li>• Provide necessary information to the drivers so that bus range and readiness could be reasonably anticipated</li> <li>• Achieve vehicle uptime of 95% or greater</li> </ul>	<ul style="list-style-type: none"> <li>• Install the bi-directional charging stations</li> <li>• Complete the charger-side software</li> <li>• Modify the buses' battery management systems</li> <li>• Meet Con Edison SIR requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Perform vehicle range analysis before and after V2G periods</li> <li>• Vary V2G discharge protocols to provide data on V2G impacts on battery range.</li> </ul>
<b>DER Categories</b>	N/A	<ul style="list-style-type: none"> <li>• Electric vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• Electric vehicles</li> <li>• Battery energy storage</li> </ul>	<ul style="list-style-type: none"> <li>• Electric vehicles</li> <li>• Battery energy storage</li> </ul>



## **Appendix B: Work Plan**




Note: these work plans do not account for delays due to COVID-19, as those are not possible to capture accurately at this time.

## Appendix C: Checkpoints and Milestone Progress

Checkpoint/Milestone	Timing*	Status
Buses Perform as Expected as Transportation	Phase 1 Midpoint / End	  
Network integration and System testing	Phase 2 Midpoint / End	  
Battery and vehicle impacts evaluated and documented	Phase 3 Midpoint / End	  

\*Detailed descriptions of the Phases can be found in the Appendices.

### Legend

 On Schedule	 Delayed w/out Major Impact	 Delayed or Stopped – Project Goals Impacted
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### Planned Activities

#### .1.1.1 *Planning*

None

#### .1.1.2 *Electric Bus Operations & Analysis*

- Delivery of EVSE product

**Status:** **Green**

**Expected Target by Phase 1 Midpoint:** No vehicle failures due to below specification range or misleading data provided to driver.<sup>4</sup>

**Actual by Phase 1 Midpoint:** No vehicle failures due to below specification range or misleading data provided to driver.

**Solutions/strategies in case of results below expectations:** Use diagnostic data to determine cause of failures. Work with customer (National Express) to pursue any out of specification vehicle failures with manufacturer.

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<sup>4</sup> Maximum range for these vehicles is 80 miles per charge. Use of heating, air-conditioning and regenerative braking are all factors that can affect range. An example of misleading data provided to the driver would be the bus reporting 40 miles of driving range when in fact only 20 is available. This would make the vehicle unreliable from the driver's perspective.

### **.1.1.3 Design and Construction of Charging and V2G**

Status: **Yellow**

**Expected Target by Phase 2 Midpoint:** Inverter hardware works 100% of the time after pre-summer V2G period diagnostic testing. Software responds to all communication signals and control V2G discharge. This milestone is delayed, but the stakeholders will make up for the lost summer 2019 period by doing additional V2G during holidays and weekends.

**Actual by Phase 2 Midpoint:** V2G accomplished on-site with non-school bus test vehicle. V2G integration in progress at Lion testing facility

**Solutions/strategies in case of results below expectations:** Software troubleshooting methodology from past V2G projects, onsite testing, and potential hardware replacement. Testing of onsite hardware separate from vehicle integration to isolate problem.

### **.1.1.4 V2G Operations**

Status: **Green**

**Expected Target by Phase 3 Midpoint:** V2G use expected to have little quantitative or perceived impact on the vehicle's primary transportation asset value. Performance targets are .3%-2% per season.

**Actual by Phase 3 Midpoint:** N/A

**Solutions/strategies in case of results below expectations:** Reduce depth of discharge and peak state of charge to see if battery wear impacts can be reduced to expected parameters. Explore cell temperature controls.

## **Appendix D: Procedures and Policies**

### **CYBERSECURITY AND PERSONALLY-IDENTIFIABLE INFORMATION PROTECTION**

Consistent with Commission policy related to cybersecurity and the protection of personally-identifiable information (“PII”), each partner agreement executed for the implementation of the Project includes specific protections related to cybersecurity and PII. This protection is critical in encouraging customers to sign up with new and innovative services offered by utilities.

### **ACCOUNTING PROCEDURE ESTABLISHED**

On February 16, 2016, in Case 15-E-0229, Con Edison filed an accounting procedure for the accounting and recovery of all REV demonstration project costs.<sup>5</sup> This accounting procedure establishes a standardized framework that will govern how the Company categorizes and allocates the costs of the REV demonstration projects, and will facilitate analyzing each project to determine the overall financial benefits of the program to customers.

### **COSTS, BENEFITS, AND OPERATIONAL SAVINGS**

Budget information for all of the Company’s REV demonstration projects is being filed confidentially with the Commission, concurrently with the filing of this document. All costs filed are incremental costs needed to implement the projects. To date, no tax credits or grants have been available to reduce the net costs of the projects, but Con Edison will take advantage of such offsetting benefits when, they are available. Due to the early stage of implementation for the Project, there are no operational savings to report at this time.

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<sup>5</sup> Case 15-E-0299, *Petition of Consolidated Edison Company of New York, Inc. for Implementation of Projects and Programs that Support Reforming the Energy Vision, General Accounting Procedure* (issued February 16, 2016).