



REV Demonstration Project:
Electric School Bus V2G
2019 1Q Quarterly Progress Report

Dated: April 30, 2019

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1.0 EXECUTIVE SUMMARY

Consolidated Edison Company of New York, Inc. (“Con Edison” or the “Company”) submits this quarterly report 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, 2015.¹

1.1 PROGRAM ACHIEVEMENTS

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. In Q1 2019, the Company focused on the implementation of the Project, specifically integration of vehicle to grid technology.

1.2 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, where applicable, 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.

1.3 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.² 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.

¹ 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).

² 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.

1.4 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 reduce overall project costs Con Edison worked closely with NYSERDA to take advantage of an expiring grant program.³ Due to the early stage of implementation for the Project, there are no operational savings to report at this time.

1.5 ELECTRIC SCHOOL BUS V2G

The Project is designed to examine the technical and operational viability of using school buses as both a grid resource and transportation asset. Key tests include determining whether electric school buses function well for transportation purposes, are reliable as grid assets, and that their use as grid assets does not cause excessive wear and tear on the equipment. Con Edison has partnered with First Priority Green Fleet ("First Priority"), who is responsible for project management, design and construction of vehicle and site hardware, and vehicle to grid (V2G) operations and analysis.

In Q1 2019, Con Edison, First Priority, BTC Power ("BTC") and Lion Electric ("Lion") worked on V2G implementation, with site interconnection approval and internal and external stakeholders working to advance the project through weekly and semi-weekly check-ins on key project deliverables

³ The federally funded NYT-VIP program.

2.0 ELECTRIC SCHOOL BUS V2G – QUARTERLY PROGRESS

2.1 DEMONSTRATION HIGHLIGHTS

2.1.1 Q1 2019- Major Task Completion

- Project Planning:
 - All major project planning complete
- Phase 1: Electric Bus Operations & Analysis:
 - Buses operational for 170 school days with 98% uptime
- Phase 2: Design and Construction of Charging & V2G Infrastructure
 - Site interconnection plan approved (pending meter deposit fee from National Express)

2.1.2 Activities Overview

Project Planning: In Q4 2018 the Project team entered into partner agreements with First Priority, the project implementor, and National Express, the bus owner and operator.

Phase 1: Electric Bus Operations and Analysis

On April 5, 2019 Con Edison hosted a half day symposium for the school bus industry. National Express and project partners participated in three panels, explaining the project and their vehicle experiences.

The Project team is preparing the buses and infrastructure for V2G deployment. Con Edison approved First Priority's interconnect requirements application.

The electric school buses performed their primary student transportation function well. This was the key phase one goal. National Express reported 98% average operational uptime. The drivers that used to operate the non-electric school buses have continued to operate the electric vehicles and continue to report high vehicle satisfaction, according to the quarterly survey of National Express performed by First Priority.

In December First Priority successfully installed cellular data loggers that are intended to capture miles travelled, energy per trip, state of charge (SoC), and energy per mile. These data help detail the cost of operating an electric vehicle and the range in real world driving and weather conditions. It appears that data loggers are accurately reporting miles travelled and vehicle location but are not currently

calculating energy metrics accurately. This issue has been identified by First Priority and Lion and will be addressed after the V2G integration is completed. In the interim, the Company is working with National Express to examine electric bills to determine financial impacts of bus charging.

Phase 2: Design and Construction of Charging and V2G Infrastructure

The development of V2G is ongoing. Subcontractor BTC has not delivered the computer boards necessary for the communication platform to communicate with the school bus. Lion and FPGF have proceeded with semi-weekly meetings to solve and mitigate the issue. The companies are analyzing several solutions that preserve the project timeline and the hypothesis for testing a scalable hypothesis.

2.1.3 Key Metrics



The following data supports the Phase 1 goals of reliability and bus performance.




- E-school bus days of operation: 170
- Vehicle failures due to out of specification range: 0
- Misleading range data provided to driver: 0

2.1.4 Next Quarter Forecast




In Q2 2019, the Project team will continue numerous Phase 2 V2G aspects, including installing the bi-directional charging stations, completing the charger-side software, and modifying the buses’ battery management systems. This is in preparation for Phase 3 V2G commissioning anticipated during the summer of 2019.

2.1.5 Checkpoints/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	

Checkpoint/Milestone	Timing*	Status
Battery and vehicle impacts evaluated and documented	Phase 3 Midpoint / End	  

Legend

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

2.1.6.1 Customer Acquisition

Status: **Green**

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

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.

2.1.6.2 Construction/Commissioning and Integration

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.

⁴ 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.

Actual by Phase 2 Midpoint: N/A

Solutions/strategies in case of results below expectations: Software troubleshooting methodology from past V2G projects, onsite testing, and potential hardware replacement.

2.1.6.3 Battery and vehicle impacts evaluated and documented

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 brought to within expected parameters. Explore cell temperature controls.

2.2 CHANGES TO THE PROJECT DESIGN

None at this time.

2.3 WORK PLAN & BUDGET REVIEW

2.3.1 Phase Review

The Project team has completed its Project Planning and made progress on Phase 1 (Bus Operations and Analysis) and Phase 2 (Design and Construction of Hardware and V2G Infrastructure). The Project team is verifying several methods for achieving V2G discharge for summer 2019.

2.3.1.1 Phase Progress

2.3.2 Work Plan

Action Nbr.	Phases, Activities/SubTasks	Milestones	Lead	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Demonstration Planning														
0.1	Obtain Commission Approval	PSC approval received	Con Ed	■										
0.2	Finalize contract with NELLC	Contracted executed	Con Ed		■									
0.3	Finalize contract with FPGF	Contract executed	Con Ed			■								
Phase I: Electric Bus Operations and Analysis														
1.1	Buses shipped to NJ from Montreal	Buses arrive in NJ	FPGF	■										
	Buses pre-inspected, customized, detailed, prepped	Buses prepped for delivery	FPGF	■										
1.2	Buses delivered and inspected	Buses pass DMV inspection	FPGF		■									
1.3	FPGF provides operational/technical training	Nat'l personnel certified to operate ebuses	FPGF			■								
1.4	Buses operational	Buses commence on routes	FPGF				■	■	■	■	■	■	■	■
1.5	Buses generate performance analytics	Data collected from CAN bus and telematics	FPGF											
1.6	Quarterly Data analysis, measurement and evaluation	Analyses/findings produced and reported quarterly	FPGF											
1.7														
Phase II: Design and Construction of Charging and V2G Infrastructure														
2.1	Site assessments and engineering drawings	Plan and drawings submitted	FPGF		■									
2.1	Electrical service request	Con Ed receives service request	FPGF			■								
2.3	Utility assessment and service plan	Con Ed issues service plan	Con Ed				■							
2.4	EVSE assessment and site plan	Healy Electric completes EVSE site plan	FPGF					■						
2.5	Ordering of equipment/hardware	EV Connect orders hardware/equipment	FPGF						■					
2.6	Installation of networked charging stations (without V2G)	5 charging stations installed	FPGF							■				
2.7	Testing of interface with buses	Testing concludes with full functionality	FPGF								■			
2.8	Chargers operational	Charging stations fully operational	FPGF									■		
2.9	EV Connect provides operational training	WPBC personnel knowledgeable of charger operations	FPGF										■	
2.10	Electricity consumption patterns analysis	Duty and charge cycles established	FPGF											■
2.11	Design and software coding	V2G software coding completed	FPGF					■						
2.12	Charging stations upgrade with inverters and software	Charging stations upfitted with inverters, one at a time	FPGF						■					
2.13	Buses modified (BMS modifications and SAE Combo plugs)	BMS systems reengineered; SAE Combo plugs/inverters added one at a time	FPGF							■				
2.14	Network integration and system testing	charging stations and buses tied to grid through EMP	FPGF								■			
Phase III: V2G Operations and Analysis														
3.1	V2G launch (summer 1)	V2G fully operational	FPGF									■		
3.2	V2G battery baselining (summer 1)	V2G baseline established	FPGF										■	
3.3	V2G analysis (fall 1)	Battery and vehicle impacts evaluated and documented	FPGF											■
3.4	V2G commissioning & battery baselining (summer 2)	V2G deployed	FPGF											■
3.5	V2G analysis (fall 2)	V2G performance evaluated and documented	FPGF											■
3.6	Data collection from Energy Management Platform	Data collected and logged from EMP	FPGF											■
3.7	Quarterly Data analysis, measurement and evaluation	Analysis completed with findings/recommendations; reports filed	FPGF											■

2.3.3 Updated Budget

Budget information is being filed confidentially with the Commission.

2.4 CONCLUSION

2.4.1 Lessons Learned

Phase 1's primary goal was to determine whether the buses function well in providing transportation. The buses are meeting expectations. Phase 2 has demonstrated that the V2G can be compatible with the CESIR process.

2.4.2 Recommendations

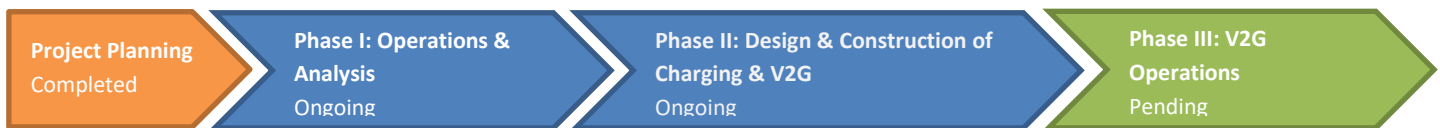
None at this time.

Electric School Bus V2G REV Demo Project

The **School Bus V2G** (vehicle to grid) demonstration project is designed to examine 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 performing as transportation since September 2018. A necessary v2g component is delayed by a subcontractor and project partners have identified several promising alternatives.

Project Inception: June 2018
 Project Launch: September 2018
 Project End Date: September 2020
 Budget: \$1.08M
 Q1 2019 Spend: *Filed Confidentially*
 Cumulative Spend: *Filed Confidentially (on budget)*



Lessons Learned: Customers (bus operator)

- Success requires embracing operational changes for maintenance staff and drivers
- The buses have succeeded because they have been reliable, with a minimum of fit & finish issues
- The company hopes to use e-busses as a competitive advantage

Lessons Learned: Market Partner

- Con Edison is one of the first test markets of V2G and they are uncertain of national demand
- Locally, NY-area operators need an e-bus provider that can provide the transportation, electrical infrastructure, and any V2G integration

Lessons Learned: Utility

- V2G, as designed in this project, can go through existing DG interconnect processes
- Public interest and public policy in support of electric school buses is increasing

Application of Lessons Learned: *Electric school buses can be successfully operated by a vehicle operator that is motivated, committed and sophisticated enough to accept the need for operational changes. The company's recent symposium, which included several NYC-area bus operators, suggested that the sector is early in the adoption curve and that there is market interest.*

Issues Identified: The subcontractor required to provide the charger hardware and communication chips to enable V2G has not delivered its solution on schedule. This will likely reduce the summer discharge period. Project partners have been managing the problem and are actively analyzing several alternatives that maintain the project's fundamentals.

Recent Milestones: a) No vehicle failures from technical causes or otherwise b) 170 days of school bus operations

Upcoming Milestones: *Initiate summer discharge. installation of v2g charging stations, software design, and integration of V2G controls into the vehicle.*

