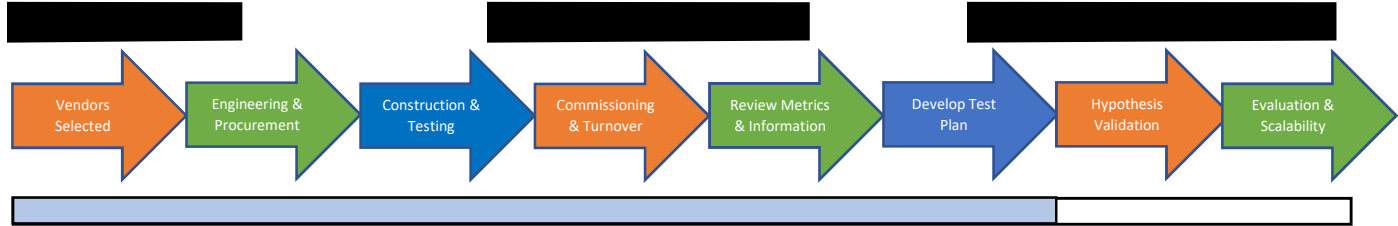


Project Start Date: 6/08/2018

Project End Date: 12/31/2020



Project Summary: The Integrated EV & Battery Storage Project is demonstrating how battery storage can improve the economics of EV adoption and minimize its impact to the electric grid. The project is demonstrating how battery storage can be integrated with DC fast and level 2 EV chargers in order to manage cost impacts while optimizing the value of the battery system. The system is located at the RG&E Operations Center at 1300 Scottsville Rd in Rochester, NY and consists of two DC fast chargers, five level 2 chargers, and a 150 kW / 600 kWh stationary battery.

Lessons learned:

- **Utility Operations**

- Coordination of breaker protection relays can be difficult when an inverter and battery are involved. Since this is newer technology and inverters are historically sensitive to issues encountered on adjacent circuits, especially ground faults, a detailed relay coordination study and modeling should be performed and reviewed prior to commercial operation.
- Operation and monitoring during the early stages of commercial operation revealed an issue with Powin's batteries where load noise generated by the inverter was affecting the battery management system, preventing it from monitoring itself accurately causing frequent battery system disconnection. It was determined that the best solution to this issue is to replace the original batteries with Powin's 2nd generation batteries
- Initial results show the impact of the battery in significantly reducing the building peak demand and improve building load factor. Proper sizing of the battery upfront, and adjustment to charge/discharge settings of the battery (by analyzing historical building load data) has been the key to achieve this performance. Effective peak demand reduction can reduce the monthly bills of the building.

Issues Identified: Noise generated by the inverter was impacting self-monitoring capabilities of the batter management system.

Solutions Identified: In order to resolve this issue the battery stacks has been replaced in Q2.

Recent Milestones/Targets Met:

- Phase 2 – Plan: Develop Test Plan and Determine Roles & Responsibility

Upcoming Milestones/Targets:

Phase 2 - Execute

- Continued development and refinement of the use case process and operational procedures
- Continuation of data collection on the battery and system performance at the site
- Continued validation and reporting of use case progress with the collected test data
- Continue to work with internal resources to increase the use of the Level II and DC fast charges
- Continue to monitor for adjacent feeder events that could the battery breaker to trip to gain experience with protection coordination of sensitive inverter-based battery equipment
- Updating of the battery software and rebalancing of the battery system

Reforming the Energy Vision

Demonstration Project Q1 2020 Report

Integrated Electric Vehicle Charging & Battery Storage System



Table of Contents

1.0 Executive Summary.....	3
2.0 Demonstration Highlights since the Previous Quarter	4
2.1 Activity Overview	4
2.1.1 Battery and main breaker setting coordination	Error! Bookmark not defined.
2.1.2 Development of use case process and operational procedures.....	4
2.1.3 Data collection on the battery and system performance at the site.....	4
2.2 Metrics and Checkpoints.....	4
2.1.1 Reducing Circuit Peak Demand	5
2.1.2 Building Load Factor.....	7
2.1.3 Demand Response	8
2.3 Issues	8
3.0 Work Plan.....	10
3.1 Budget Review.....	10
3.2 Updated Work Plan	10
3.3 Next Quarter Planned Activities.....	11
4.0 Conclusion / Lessons Learned	12

1.0 Executive Summary

Rochester Gas and Electric Corporation (RG&E or the Company) submits this quarterly report on the progress of the Integrated Electric Vehicle (EV) Charging and Battery Storage System Demonstration Project (Integrated EV & BSS Project). The Integrated EV & BSS Project is demonstrating how battery storage can improve the economics of EV adoption and minimize its impact to the electric grid. The Integrated EV & BSS Project is demonstrating how battery storage can be integrated with DC fast and level 2 EV chargers to manage cost impacts while optimizing the value of the battery system. The system is located at the RG&E Operations Center at 1300 Scottsville Road in Rochester, New York. The system consists of two DC fast chargers, five level 2 chargers, and a 150KW and 600kWh stationary battery with a Battery Management System (BMS) to optimize all resources, including building demand.

The Integrated EV & BSS Project consists of two phases, including: Integrated System Installation (Phase I), and Hypothesis Validation and Reporting (Phase II). The entire project is anticipated to take approximately thirty-two months, which includes site preparation, construction, and commissioning of the EV chargers and battery system as well as the validation and testing of the hypothesis, use case functionality and final analysis.

With the completion of installation and commissioning in Q2 2019, the project has been focused on the hypothesis validation phase by implementing the use case processes and procedures, along with continued data collection on the battery and system performance at the site.

Anticipated plans for Q2 2020 include:

- Continued refinement of the use case process and operational procedures
- Continued data collection on the battery and system performance at the site
- Continued validation of use cases with the collected test data
- Increasing the usage of the DC fast and Level II EV chargers to demonstrate the variable load impacts to the battery system
- Continued monitoring for adjacent feeder events that could cause the battery breaker to trip
- Updating of the battery software and rebalancing of the battery system

The following report provides a progress update on the tasks, milestones, checkpoints, and lessons learned to date.

2.0 Demonstration Highlights since the Previous Quarter

2.1 Activity Overview

Activity completed and results for Q1, 2020 included:

- Refinement of the use case process and procedures
- Continued data collection on the battery and system performance at the site
- Increasing the usage of the DC fast and Level II EV chargers to demonstrate the variable load impacts to the battery system
- Monitoring of adjacent circuit outages to see the impacts to the battery breaker coordination

2.1.1 Refinement of use case process and operational procedures

The project team has continued refining the process for the collection of use case data and of operational procedures for reviewing use case performance and effectiveness on a regular basis. Development of procedures to address operational issues encountered (breaker setting coordination, battery site upgrades, etc.) are also being addressed and refined as more experience is gained. Activity in the first quarter included continuing to refine metrics to track use cases.

2.1.2 Data collection on the battery and system performance at the site

Collection of battery performance data and system performance monitoring has been the main focus of activities in the first quarter of 2020 and will continue on through the end of the year. Detailed metrics highlighting use case performance can be found in section 2.2 below.

2.1.3 Increasing the use of the DC fast and Level II EV chargers at the site

The project team has developed a strategy to increase the battery charger usage by employees the details of which are can be found in section 2.3.2 below.

2.1.4 Monitoring of adjacent circuit outages to see impacts to breaker coordination

During the 1st quarter of 2020 there were no adjacent feeder or battery breaker trips at the Scottsville Road facility. The team will continue to monitor for adjacent feeder trips to determine if additional main breaker coordination is needed or if the current settings are sufficient to avoid future mis-coordination events.

2.2 Metrics and Checkpoints

The demonstration project team has completed all the milestones up to “Phase 1 – Execute” and milestones “Phase 2- Initiate” and “Phase 2 – Plan” portion of the project as defined in the Implementation Plan. Since early August, the project team has spent most of its time on data collection and hypothesis validation.

2.2.1 Reducing Building Peak Demand

The “Reducing building Peak Demand” use case has been identified as one of the metrics that can measure the impact of battery storage on reducing the peak demand of building. Figure 1 shows the maximum daily load of the building with and without the presence of battery storage. As it can be seen, the battery storage has significantly reduced the peak demand. The average daily peak demand reduction on the circuit during first three months of 2020 was 19kW, 16kW and 14kW, respectively.

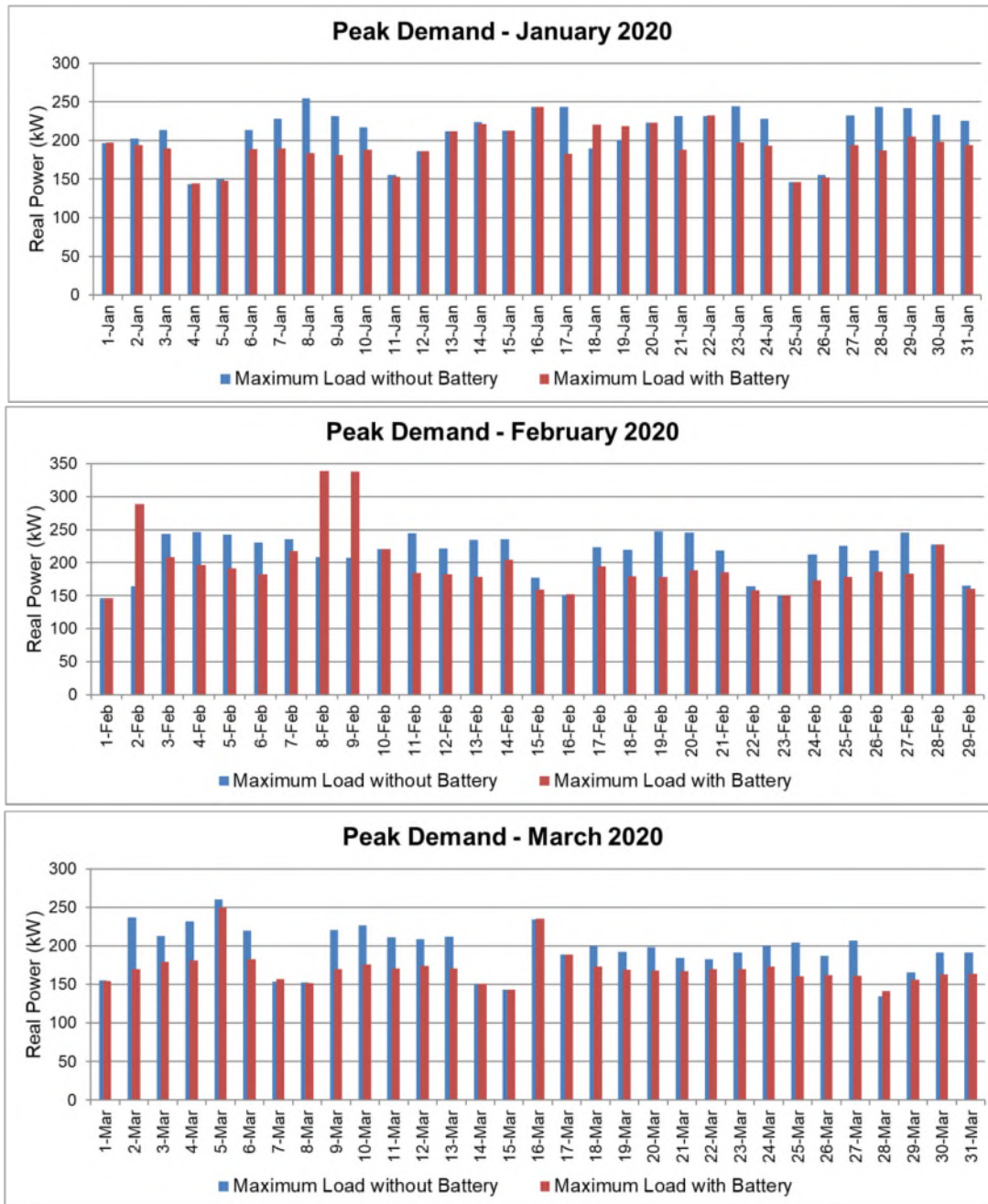


Figure 1. Daily building peak demand w and w/o presence of battery storage

Figure 2 shows the average hourly load of the building with and without the presence of battery storage during first three months of 2020. As it can be seen, the battery storage had a decent performance shifting peak load to off-peak hours by discharging during peak hours (5AM-3:30PM) and charging during off-peak hours (3:30PM-4AM).

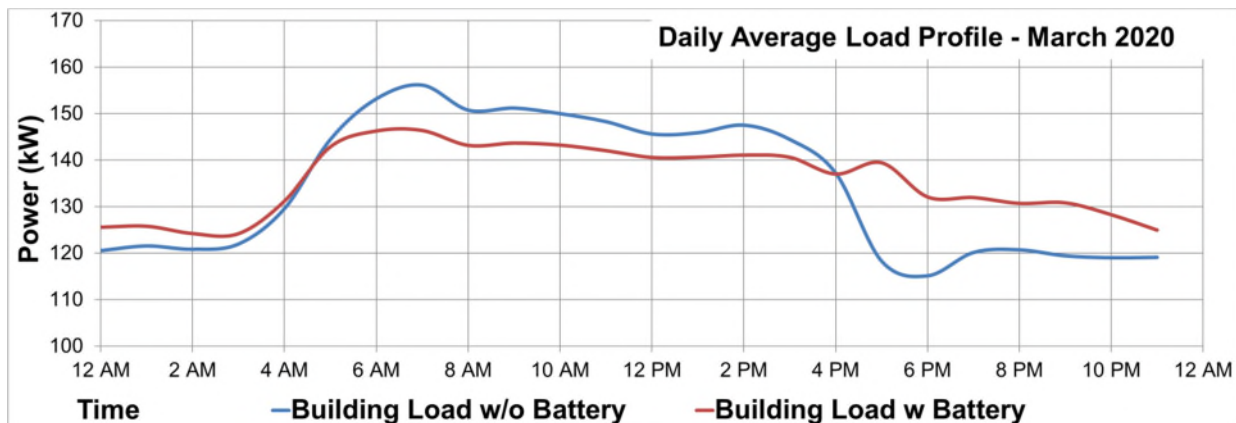
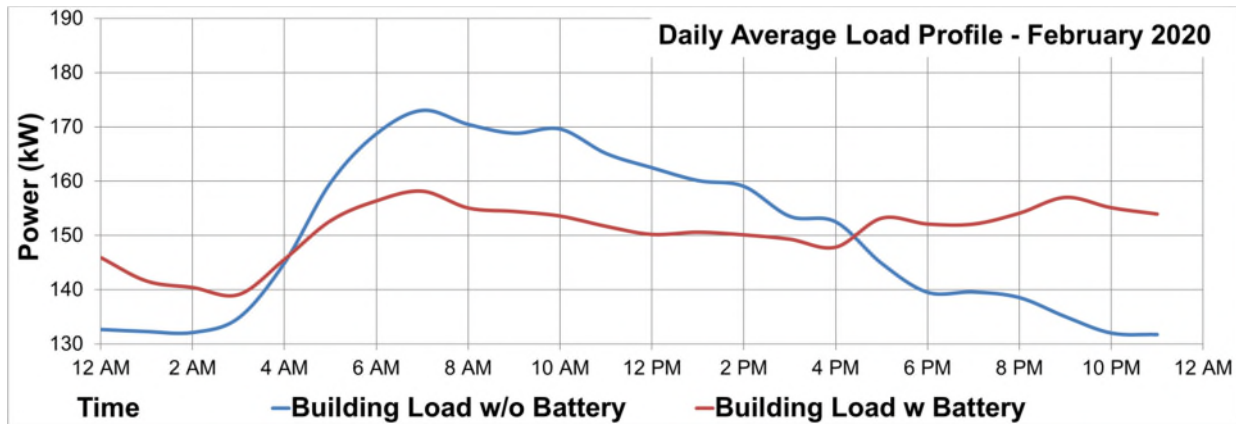
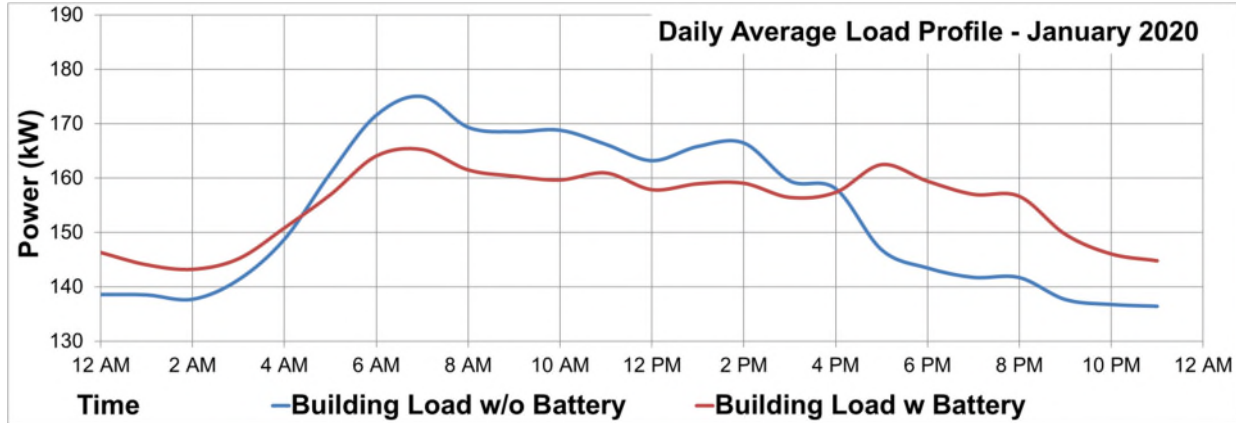


Figure 2. Average hourly building peak demand w and w/o presence of battery storage

2.2.2 Building Load Factor

Another metric defined to track the performance of the battery is “Building Load Factor” use case. The load factor is defined as the average load divided by maximum load. Using the definition and data collected, we tracked building’s load factor daily. As shown in Figure 3, the battery storage has significantly improved the load factor. The average daily building load factor improvement during the first three months of 2020 was 7.7%, 7.9% and 10.3%, respectively.

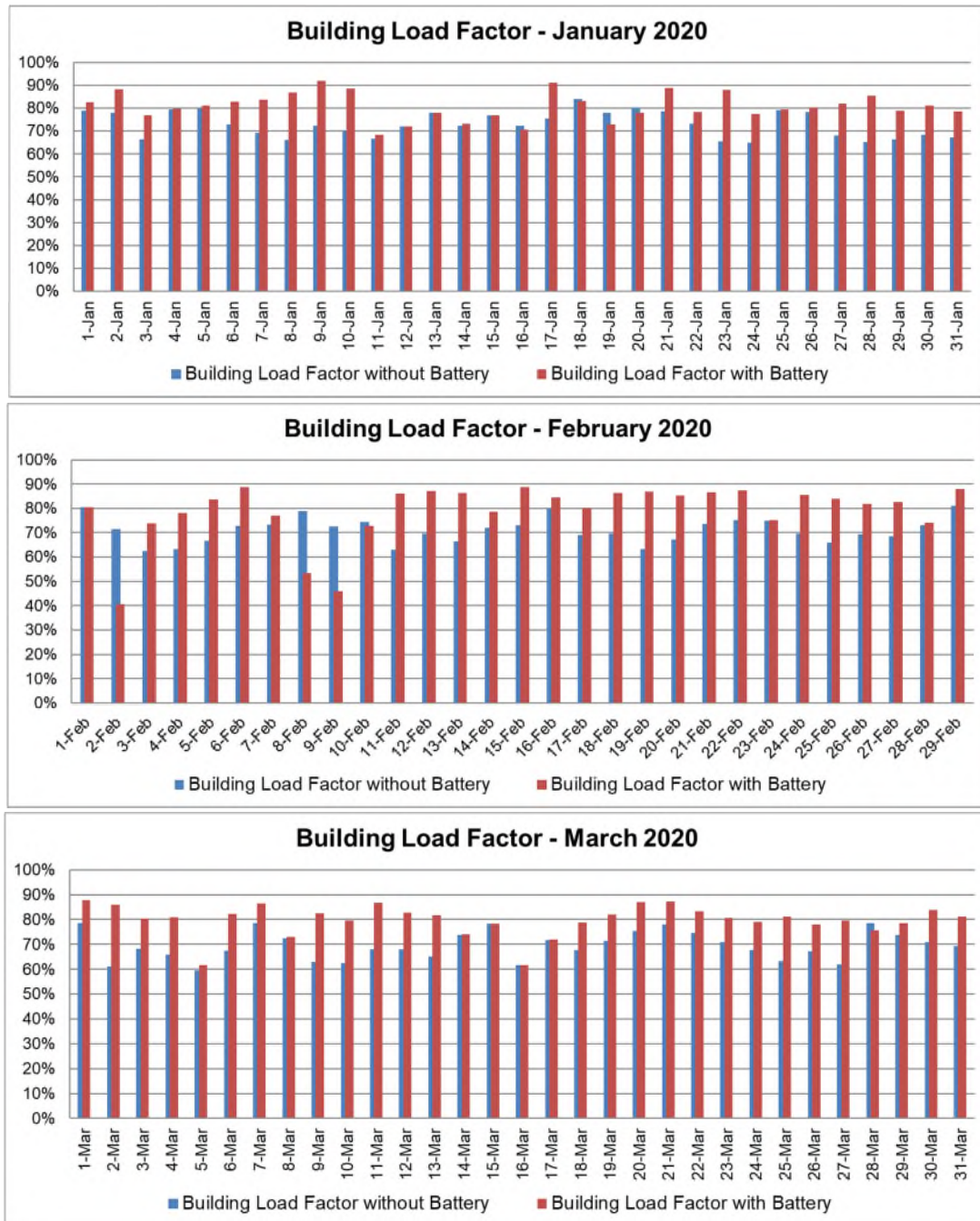


Figure 3. Building load factor w and w/o presence of battery storage

2.2.3 Demand Response

No demand response events were called in Q1 2020 so there is no update to Table 1 below. Table 1 shows the details of 6 RG&E demand response events during month of July 2019. The project team managed to participate in 4 out of 6 events. The potential saving from the official participation could have been \$1,130.

Table 1: Demand Response Events Participated in July 2019

	Event Date	Time Period	Baseline (kW)	Actual Load (kW)	Actual Reduction (kW)
July 10, 2019 14:00-18:00	7/10/2019	3:00 PM	245.14	155.35	89.8
Performance Factor	7/10/2019	4:00 PM	230.4	154.81	75.59
Total kW	7/10/2019	5:00 PM	228.26	146.3	81.97
Performance Payment	7/10/2019	6:00 PM	159.07	75.74	83.33
July 11, 2019 14:00-18:00	7/11/2019	3:00 PM	227.02	218.18	8.84
Performance Factor	7/11/2019	4:00 PM	213.36	217.03	-3.67
Total kW	7/11/2019	5:00 PM	211.38	213.21	-1.83
Performance Payment	7/11/2019	6:00 PM	147.31	172.01	-24.7
July 16, 2019 14:00-18:00	7/16/2019	3:00 PM	241.84	265.13	-23.29
Performance Factor	7/16/2019	4:00 PM	221.44	254.42	-32.98
Total kW	7/16/2019	5:00 PM	212.89	240.73	-27.84
Performance Payment	7/16/2019	6:00 PM	151.67	154.61	-2.94
July 18, 2019 14:00-18:00	7/18/2019	3:00 PM	273.22	160.62	112.6
Performance Factor	7/18/2019	4:00 PM	252.4	155.72	96.68
Total kW	7/18/2019	5:00 PM	241.81	144.35	97.46
Performance Payment	7/18/2019	6:00 PM	173.49	75.95	97.54
July 19, 2019 14:00-18:00	7/19/2019	3:00 PM	273.22	168.63	104.59
Performance Factor	7/19/2019	4:00 PM	252.4	143.39	109.02
Total kW	7/19/2019	5:00 PM	241.81	138.08	103.73
Performance Payment	7/19/2019	6:00 PM	173.49	105.39	68.1
July 29, 2019 14:00-18:00	7/29/2019	3:00 PM	272.28	103.71	168.57
Performance Factor	7/29/2019	4:00 PM	259.91	101.05	158.86
Total kW	7/29/2019	5:00 PM	253.71	98.66	155.06
Performance Payment	7/29/2019	6:00 PM	207.16	118.25	88.92
Scottsville Road	Enrolled Load Reduction (kW) (July)	July Performance Factor	July Reservation Payment	July Performance Payment	July Total Payment
CSRP-Reservation and Performance	100	0.63	\$ 283.50	\$ 845.91	\$ 1,129.41

2.3 Issues

2.3.1 Total available kWh

Upon installation of the 2nd generation Powin battery in Q2 2019, the team started operating the battery and collecting data. The analysis of data showed that out of the total battery capacity of 700kWh, only 520kWh could be used. The issue was communicated to the manufacture and Powin stated that once the upgraded battery software is available, it will increase the available capacity. The software upgrade took place on October 4th, but the team was still unable to achieve full capacity performance. The Avangrid team has been actively working with the manufacture to address this issue and believe we have a resolution that involves installation of a software upgrade and then subsequent rebalancing of the battery system. The work is scheduled for the middle of the 2nd quarter and the details of the results will be reported in the next quarterly report.

2.3.2 Limited use of EV chargers

Upon collection of data in Q3 2019, the team has noticed lower than expected use of the EV chargers. The team is working with internal communication channels in the company to encourage employees and fleet management to increase utilization of the chargers. The team began incorporating the following strategies to increase use of the chargers in Q1 2020:

- Transfer of additional EV's to the operational center for employee use
- Increased employee communications on utilizing the pool EVs and chargers
- Potential assignment of EV's to employees as a full-time company vehicle
- Internal communication to employees on the availability of the chargers for personal vehicle charging

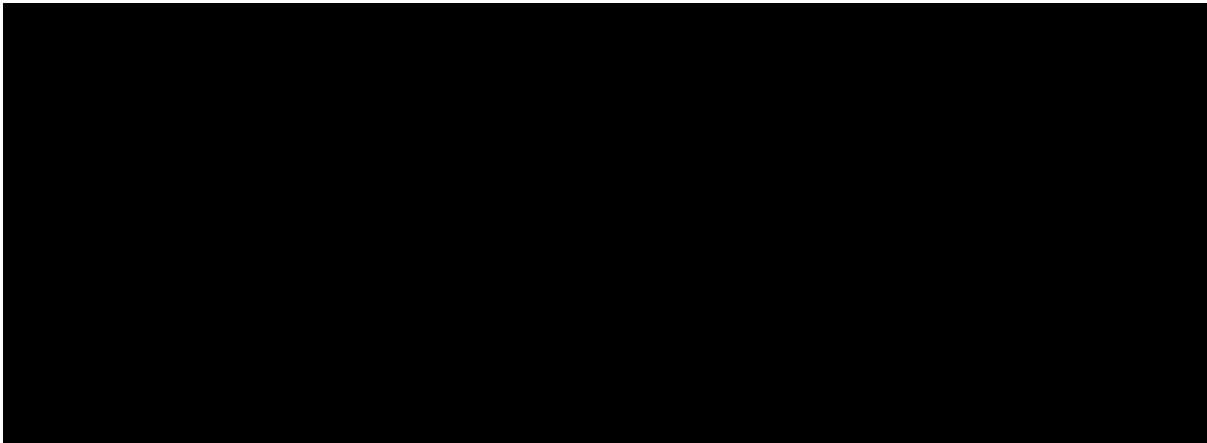
Implementation of these strategies has been impacted by the various in-person workforce restrictions related to the Governors COVID-19 executive orders. It is expected that this impact will continue throughout Q2 2020.

3.0 Work Plan

3.1 Budget Review

The project budget and actual spend through Q1 2020 is outlined in Table 1.

Table 1: Budget Review



3.2 Updated Work Plan

Milestone	Description	Date
Phase 1 - Initiate	Vendors Selected and Kick Off Meeting	Complete
Phase 1 - Plan	Engineering and Procuring Equipment	Complete
Phase 1 - Execute	Construction and Testing	Complete
Phase 1 - Closeout	Commissioning and Turnover	Complete
Phase 2 - Initiate	Review Metrics and Information Gathering	Complete
Phase 2 - Plan	Develop Test Plan and Determine Roles & Responsibility	Complete
Phase 2 - Execute	Hypothesis Validation and Data Collection	January 2019 – December 2020
Phase 2 -Closeout	Results and Report Creation, Scalability Analysis, Demonstration Project Completion	October 2020 - December 2020

The work plan shown above as developed as part of the Implementation Plan has no changes to the current milestones. Milestones “Phase 1 – Initiate, Plan, and Execute” as well as “Phase 2 – Initiate and Plan” are all complete. The project continues to focus on the “Phase 2 – Execute” milestone.

3.3 Next Quarter Planned Activities

In Q2, 2020 the project team aims to continue the following tasks:

Phase 2 - Execute

- Continued development and refinement of the use case process and operational procedures
- Continuation of data collection on the battery and system performance at the site
- Continued validation and reporting of use case progress with the collected test data
- Continue to work with internal resources to increase the use of the Level II and DC fast charges
- Continue to monitor for adjacent feeder events that could the battery breaker to trip to gain experience with protection coordination of sensitive inverter-based battery equipment
- Updating of the battery software and rebalancing of the battery system

4.0 Conclusion / Lessons Learned

Our experience since commercial operation of identifying and working to resolve technical issues with the battery system continues to expand our technical knowledge of this system and has led to a greater appreciation for the current state of maturity of battery storage technology. We continue to remain diligent in monitoring, testing, and resolving any system anomalies. As a demonstration project, it is important to remain flexible and to use implementation and operational learning to ensure future success of these and other battery storage projects.

Lessons Learned During Operational Phase:

- Data collection on battery performance is critical and needs to be simplified as much as possible. During the initial data mining process, we identified an opportunity to combine data from two different systems. The developed solution was to install an additional system meter which will allow all data to be compiled in one single system simplifying data collection.
- The performance and capabilities of large scale battery systems are still being refined. Operation and monitoring during the early stages of commercial operation revealed an issue with Powin's batteries where load noise generated by the inverter was affecting the battery management system, preventing it from monitoring itself accurately causing frequent battery system disconnection. It was determined that the best solution to this issue is to replace the original batteries with Powin's 2nd generation batteries
- Coordination of breaker protection relays can be difficult when an inverter and battery are involved. Since this is newer technology and inverters are historically sensitive to issues encountered on adjacent circuits, especially ground faults, a detailed relay coordination study and modeling should be performed and reviewed prior to commercial operation.
- Initial results show the impact of the battery in significantly reducing the building peak demand and improve building load factor. Proper sizing of the battery upfront, and adjustment to charge/discharge settings of the battery (by analyzing historical building load data) has been the key to achieve this performance. Effective peak demand reduction can reduce the monthly bills of the building.