Smart City
REV Demonstration Project
City of Schenectady, New York
Case 14-M-0101

Quarterly Report – Q1 2020

April 30, 2020

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1.0 Executive Summary

Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid" or the "Company") has partnered with the City of Schenectady ("Schenectady" or the "City") to demonstrate a smart city solution. Using the Company's outdoor lighting infrastructure as a platform for advanced outdoor lighting services, the Company and the City are deploying smart city technologies and testing the business models that will animate the advanced outdoor lighting and the smart city markets (the "Project").

The Project is intended to identify innovative smart city solutions that will help the City expand the breadth and efficiency of the services it provides to its residents. This approach aligns with the Company's efforts to test, scale, and deploy clean energy solutions in line with its *Northeast 80x50 Pathway*, the Reforming the Energy Vision ("REV") objectives, and the State's clean energy agenda, including the Climate Leadership and Community Protection Act ("CLCPA"). Specifically, the partnership between the Company and the City will test whether the Company's outdoor lighting infrastructure can facilitate the adoption of smart city technologies by deploying approximately 4,275 efficient light-emitting diodes ("LED") outdoor lighting fixtures, network lighting control ("NLC") nodes, and smart city technologies. The upgrades will effectively turn Schenectady into a smart city, capable of saving energy, more efficiently providing municipal services, and opening the door to further innovation.

During the first quarter of 2020, the Company completed a myriad of tasks, to include:

- Successfully installed all 75 smart city technologies in Zone A.
- Conducted field surveys to identify remaining streetlights requiring conversion and additional suitable locations for the remaining Zone B smart city technologies.
- Participated with the City in additional vendor partner technology training.
- Resolved several connectivity issues with the multipurpose network, NLCs, and smart city technologies.
- Moved toward contract negotiations with Rensselaer Polytechnic Institute ("RPI") to conduct lighting research. Furthermore, the City and the Company held a kickoff meeting with local universities and the medical institution to explore partnerships opportunities.
- Began planning for solution penetration testing to identify new security vulnerabilities within the deployed technologies.
- Continued to gain experience through NLC chip meter testing.

Finally, though the COVID-19 situation presented several delays, the Project shifted its efforts to identify emerging and more cost-effective technologies by issuing a request for proposal ("RFP") for Phase 2.

2.0 Highlights Since Implementation Plan Filing

The tables in Sections 2.1 and 2.2 below provide detailed descriptions of the major activities completed in the last quarter, as well as the challenges, lessons learned, and risk mitigation strategies from this work.

2.1 Major Task Activities

The Company worked on eight significant tasks during the first quarter of 2020. First, the Company completed the installation of smart city technologies in Zone A, deploying a total of 75 Cimcon® NearSky 360™ devices, each with an analytic sensor. An example of the technology configuration is represented in Figure 1. The use cases deployed in this zone are public safety, pedestrian and vehicle analytics, road surface temperature monitoring, and environmental monitoring. The software platform for smart city technologies was commissioned and completion is anticipated early next quarter.

Figure 1. An intelligent streetlight with a NearSky 360™ device and a road surface temperature sensor on an aluminum streetlight pole.

Second, the Company conducted field surveys for additional suitable locations to install the Current® by GE CityIQ™ smart city technology in adherence to the National Electric Safety Code (NESC") rule H238B-2 requirements. A total of 216 units were deployed in Q4 2019, and the City and the Company identified 24 new pole locations deemed suitable for further deployment. The remaining ten locations require make-ready services to complete the targeted 250-unit CityIQ® smart city technology deployment in Zone B. Make-ready services will require additional time because field surveys and engineering design are required for each location. The Company anticipates fieldwork related to remaining Phase 1 activities to resume late May to June 2020. The forecast is of course dependent on when the state COVID-19 related construction restrictions are lifted and whether contractor resources are then available for this work. The remaining Phase 1 tasks involves upgrading 120 LED streetlights with NLCs and the installation of 34 CityIQ™ nodes in Zone B.

Third, Zone B vendor partners held training sessions for the City after the delivery of the XAQT® analytics software and Genetec® public safety software delivered through the CityIQ™ platform. The XAQT® analytics software allows the City to leverage data collected through the smart city

sensors to provide actionable intelligence to city departments. The analytics can benefit the City by creating operational efficiencies and deeper insights into pedestrian traffic, vehicle traffic, public parking, and environmental conditions throughout the zone. The Genetec® software provides the Schenectady Police Department with direct access to video surveillance data to be used for investigative purposes within the CityIQ™ platform. The analytics can benefit the Schenectady Police Department by improving emergency preparedness, increasing situational awareness, and enhancing operational efficiency. Both Genetec® and XAQT® software analytics were provided in-kind by vendor partners AT&T® and Current® by GE for the first-year term.

Fourth, the Project team resolved several connectivity issues with the multipurpose network deployed in Zone A, which had affected the functionality of the NLC software platform. At the end of the quarter, most software platform functionality was restored. Despite the observed issues, the NLC software platforms in both zones are providing useful insights to both the City and the Company. The City can begin creating dimming schedules based on a neighborhood's needs to begin generating incremental energy savings. The Company receives period streetlight outage reports and NLC statuses for service repairs. The Company also replaced several CityIQ™ nodes during the quarter due to product issues.

Fifth, the Project continued stakeholder engagement to formulate partnership opportunities, knowledge sharing, and innovation development. Towards that end, the Company advanced the RPI collaboration for lighting research toward contract negotiations. The lighting research will provide insights into the associated factors for maximizing streetlight dimming at night based on vehicle and pedestrian traffic in high-traffic and low-traffic areas of the city. The Company anticipates a delayed start for this research as RPI transitioned to remote learning due to the COVID-19 situation. Also, the Company and the City engaged with several stakeholders during the quarter outlined below in Section 2.3.

Sixth, the Company's information technology ("IT") group began planning activities related to cybersecurity assessment and penetration testing of Phase 1 technologies. The in-depth assessment and penetration testing provide additional assurance to the City that the technologies deployed meet industry best practices and standards. Addressing cybersecurity is an essential and iterative process of monitoring, identifying, and addressing vulnerabilities. Due to the COVID-19 situation, both vulnerability assessment and penetration testing will be delayed until travel restrictions are lifted.

Seventh, the Company continued to gain experience related to the integrated chip meter technology imbedded within the NLC. Through involvement in the ANSI C136.50 industry committee, the Company shared its meter testing experience and brought back industry insights to further evaluate NLCs deployed on the Project. The Company also recently purchased a multipurpose WECO® test board which will enable preliminary tests of NLCs. The knowledge gained will also be useful in evaluating new NLCs proposed to the Company for Phase 2. Furthermore, the Company is exploring how meter data from NLC software platforms can integrate with the existing billing systems and the relevant upgrades required for integration. Lab testing of NLCs will also be delayed due to the COVID-19 situation.

Finally, the Company released an RFP to procure Phase 2 technologies for the remaining zones (zones C, D, and E). The RFP provides the opportunity to evaluate both maturing and emerging technologies that may offer improved performance at lower costs. The RFP also closed during the

quarter, resulting in eleven bid proposals to the Company. In this next quarter, the Company will work with the City to evaluate bids proposals to procure robust and cost-effective solutions.

Remaining Phase 1 tasks are field work related, which were suspended because of the emerging COVID-19 situation. Given Phase 2 relies on the completion and outcomes from Phase 1, the Company expects Phase 2 deployment to begin in August 2020, assuming relevant construction restrictions are lifted by then. The Company will continue Phase 2 technology procurement and planning activities in the next quarter to its best ability, given the challenges presented by the pandemic. The updates are included as part of the revised work plan included as Appendix A. Also, the Company provides a further description of general Project milestones below:

Anticipated Start /End Date	**Adjusted Start/End Date**	**Checkpoint/ Milestone**	**Status**	
October 2018 to December 2018		Install LED (Proof-of-Concept Stage; Max. 20 Fixtures)	Completed	
October 2018 to June 2019	October 2018 to June 2020	Install LED & NLC Nodes (Zone A & B; Approx. 2,250 Fixtures) Compare vendor solutions	Delayed Completion	
October 2018 to December 2019	October 2019 to June 2020	National Grid Install Smart City Sensor Nodes (Zones A & B)	Delayed Completion	
July 2019 to June 2021	January 2020 to June 2021	LED and NLC Node Steady State (Evaluate operational capabilities)	On Track	
July 2019 to December 2019	July 2020 to October 2020	Install LED and NLC Nodes (Zones C, D, & E; Approx. 2,000 fixtures)	Delayed Start	
June 2019 to March 2020	July 2020 to October 2020	National Grid Install Smart City Sensor Nodes (Zones C, D, and E; Max. 100 nodes)	Delayed Start	
October 2018 to June 2020	January 2020 to July 2020	City Install Smart City Device Attachments to Smart City Sensor Nodes (All Zones)	Delayed Completion	
October 2018 to March 2019	October 2018 to October 2019	National Grid Implement Multi-Purpose Internet of Things (“IoT”) Mesh Network	Completed	
October 2018 to December 2019	September 2019 to October 2020	National Grid Install IoT Mesh Network Sensors, and Meters (Gas ERTs;	Delayed Completion	

Anticipated Start /End Date	Adjusted Start/End Date	Checkpoint/ Milestone	Status	
		Temperature Sensors; Environmental Sensors; Etc.)		
January 2019 to June 2020	June 2020 to October 2020	Explore potential Third-Parties Sensors (Smart-Home Devices; Electric Vehicle ("EV") Chargers; Water Leak Sensors; Water Shutoff Valves; Water Meters; Vacant-Home Sensors; Parking Management Sensors; Etc.)	Delayed Start	
September 2019 to June 2021	November 2020 to June 2021	Steady State Review and Evaluations	Delayed Start	

2.2 Challenges, Changes, and Lessons Learned

Below is a high-level description of lessons learned which the Company is using to inform its ongoing work and future smart city deployments:

1. Because smart city technologies are non-traditional attachments to utility infrastructure, technology providers must provide product specification drawings and mounting methods for the Company to ensure code compliance before installation.
2. Once the utility provides installation guidelines, a field survey must be conducted on the proposed location to ensure existing conditions can safely accommodate the installation. The NESC H238B-2 requirement for the Current® by GE Digital Infrastructure node added complexity to the Project. However, this important lesson learned is a testament to the Company's strong culture of doing business through safety-by-design principles.
3. After starting to deploy street lights with NLC nodes, the Company and the City recognized the potential benefits offered through the technology. The lighting platform provides the City with greater control, convenience, and the potential to unlock additional energy savings through platform capabilities. The Company also recognized the value the technology can bring to enhance outdoor lighting services, deliver more carbon savings, and increase customer convenience.
4. Some smart city technologies are manufactured abroad, resulting in longer product lead times. This has created approximately three months of delays due to manufacturing and overseas transport. The Company used this lead time to conduct additional due diligence and prepare for the installation process.
5. Depending on the advanced network lighting solution, the installation needs to follow the optimal deployment scheme for the technology. Whether it is a point-to-many-points solution, cellular, or mesh technology, the deployment scheme should involve close

communication and guidance with the manufacturer. This allows the technology to function as desired from the start.

6. Currently, there is no approved national metering accuracy standard for NLC nodes. While ANSI standard C136.50 is being designed, the Company believes ANSI standard C12.20 is a reasonable proxy to test NLC nodes for the Project. Additional time will be needed for lab testing of NLC nodes to incorporate the components of both ANSI standards.
7. The initial observations of the Project have identified a variety of NLC technology benefits that provide opportunities to enhance outdoor lighting services and provide operating cost efficiencies.
8. Continued involvement in the ANSI C136.50 NLC industry committee will build on the Company's meter testing experience for preliminary tests. The knowledge gained will enable the Company to formulate business models for various technology applications to provide customers with alternate service options and rate structures.
9. NLC metering accuracy specifications and industry accepted testing requirements are needed before NLC meter data can be used for billing purposes. In addition, integration of NLC meter data into the Company's billing system may require system upgrades.

The above challenges and lessons learned are also captured in the table below, which identifies the corresponding adjustment to the Phase 1 deployment and Phase 2 startup schedule:

Issue or Change	**Strategies to Resolve**	**Resulting Change to Project Scope/Timeline?**	**Lessons Learned**
Existing street lighting services do not offer operational controls to the municipality. Traditionally, streetlight outages must be reported to the Company, similar to power outages. Also, NLC platforms provide alerts and outage reports directly to the Company.	The Company will seek to work with the Department of Public Service ("DPS") Staff to identify additional opportunities for incorporating NLC nodes into customer offerings, driving more significant energy savings and contributing to the State's energy goals.	N/A	The initial observations of the Project have identified a variety of NLC technology benefits that provide opportunities to enhance outdoor lighting services and provide operating cost efficiencies.
The global COVID 19 pandemic presented project delays in completing the remaining Phase 1 task and beginning Phase 2 technology procurement. The City is also prioritizing pandemic response,	The Company will focus on planning and preparation activities. Most Phase 2 technology procurement can continue through remote communication. The Project team will continue to work	The Project team anticipates a moderate impact on the Project timeline. Remaining Phase 1 tasks are planned for late May 2020 and Phase 2 construction is to begin in August 2020. Given the uncertainty presented by the global pandemic,	The pandemic created disruptions to the Project as construction-related activities have been suspended. Further delays are likely due to potential supply chain issues and construction backlogs.

Issue or Change	Strategies to Resolve	Resulting Change to Project Scope/Timeline?	Lessons Learned
which may introduce further Project delays.	closely with the City to adjust Project timelines.	however, these forecasts may change.	
Without industry-accepted NLC meter testing standards, manufacturers are unable to provide certified meter performance test results. Specific devices were identified as non-compliant with standard meter data output capabilities.	The Company's meter testing experience on this Project is being shared within the industry committee forums developing the ANSI C136.50 NLC metering testing standard.	The Company will continue to share the experience with the ANSI C136.50 industry committee. Testing of NLC imbedded meters will resume after relevant COVID-19 restrictions are lifted.	Continued involvement in the ANSI C136.50 NLC industry committee will build upon the Company's meter testing experience for preliminary tests. The knowledge gained will enable the Company to formulate business models for various technology applications to provide customers with alternate service options and rate structures.
The Company is unable to use the meter data from NLCs for billing until an industry accepted standard is defined, the metering is accepted by the Public Service Commission ("PSC"), and necessary tariff changes are adopted. The Company's billing system may also require system upgrades to allow for meter data integration.	N/A	The Company will continue to bill the City based on the approved LED streetlight tariff. During the Project term, energy calculations will be conducted annually with the City to identify incremental energy savings through dimming. The Project will issue a credit on the City's annual white-bill for services delivered through this Project.	NLC metering accuracy specifications and industry accepted testing requirements are needed and the metering needs to be accepted by the PSC before NLC meter data can be used for billing purposes. In addition, integration of NLC meter data into the Company's billing system may require system upgrades.

2.3 Stakeholder Engagement and Knowledge Sharing

Following the four community meetings held in December 2019, the Company and the City were invited by The Schenectady United Neighborhoods community organization to present the goals of the Project and showcase the technologies being deployed.

The Project team coordinated an innovation kickoff meeting with local universities and institutions at the Schenectady City Hall. The kickoff meeting invited Union College, Clarkson University, University of Albany, Hudson Valley Community College, and Ellis Medicine to explore collaboration opportunities to build upon the existing innovation happening at the individual institutions, spur innovation in the City, and develop solutions that could benefit all communities.

The Company also engaged with Georgia Power, a utility company headquartered in Atlanta, Georgia, to share lessons learned on its smart city initiatives. The insights include the successes and limitations of technology deployed within Georgia Power's service territory.

3.0 Next Quarter Forecast

The COVID-19 situation presents several challenges to completing the remaining Phase 1 tasks. Should the situation improve and field activities resume, the Company will focus on completing the outstanding construction activities in Phase 1 and planning activities for Phase 2.

In the second quarter of 2020, the Company expects to perform the following tasks:

- Complete remaining street light deployments in both zones A and B;
- Pursue make-ready work for the remaining smart city technologies in Zones A and B;
- Evaluate the deployed technologies in Phase 1;
- Execute a contract with RPI for the lighting research;
- Conduct light output measurements in Zone A then compare values with Zone B;
- Review Phase 2 shortlisted vendors for technology completeness and cybersecurity;
- Procure the smart city solution for Zones C, D, and E; and
- Complete lab testing of NLCs and prepare recommendations in the next quarterly report.

4.0 Work Plan and Budget Review

4.1 Updated Work Plan

The Company made updates to the work plan outlined in the Project Implementation Plan to reflect changes in the status and ongoing workstreams. Given the complexities encountered on the Project, the Company updated the Project work plan to capture the following components:

1. Extend remaining Phase 1 activity into June 2020;
2. Extend lab test NLC nodes into June 2020;
3. Extend Procurement of Phase 2 technologies into June 2020;
4. Extend Phase 2 deployment into October 2020;
5. Continue to assist the City with City-owned attachments into July 2020; and
6. Delay Phase 3 steady-state evaluations to begin in November 2020

The updated work plan is included in Appendix A.

4.2 Current Budget

Project Task	1st Quarter Actual Spend	Project Total Spend to Date	Project Budget	Remaining Balance
CapEx				
Smart Lighting	$191,762	$408,939	$2,170,000	$1,761,061
Network	$0	$235,180	$390,000	$154,820
Smart Sensor	$408,331	$1,598,923	$3,100,000	$1,501,077
Project Support	$0	$158,997	$100,000	($58,997)
Lighting System Evaluations	$0	$9,463	$150,000	$140,537
Smart city Data Analytics	$0	$0	$100,000	$100,000
Data Platform	$120,092	$239,088	$250,000	$10,912
Network Management	$153,406	$153,406	$250,000	$96,594
OpEx				
Smart Lighting	$0	$0	$180,000	$180,000
Network	$0	$0	$715,000	$715,000
Smart Sensor	$0	$0	$180,000	$180,000
Total	$873,592	$2,803,996	$7,585,000	$4,781,004

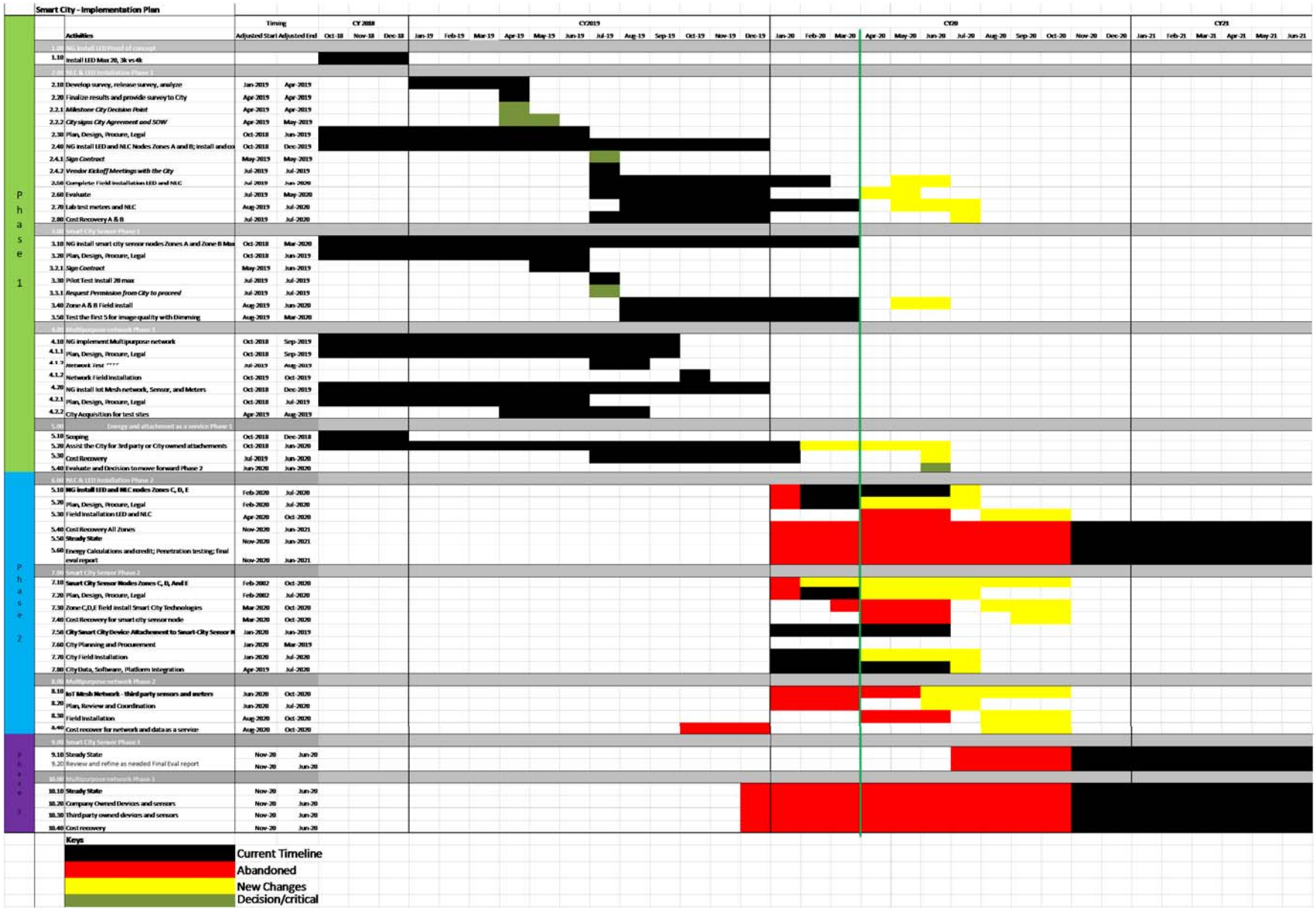
5.0 Quarterly Report Template

Quarterly Report Template	
Milestones:	
Project Milestones Accomplished:	1. Completed Phase 1 Zone A smart city technology deployment consisting of 75 Cimcon® NearSky 360™ units and ancillary sensors. 2. Released and closed Phase 2 RFP
Next Project Milestone:	1. Pursue make-ready services, complete smart city sensor deployment, and remaining Phase 1 tasks. 2. Evaluate the deployed technologies for Phase 1 to inform Phase 2. 3. Shortlist Phase 2 bids, host vendor presentations, and award a contract. 4. Complete lab testing of NLC nodes and report findings.
Tasks/Timeline:	

Quarterly Report Template	
Completed Project Tasks Since Last Quarterly Report:	1. Completed smart city technology deployment in Zone A. 2. Held technology training for City staff. 3. Led innovation kickoff meeting with local universities and institutions 4. Progressed the application for City-owned attachments towards engineering design.
Changes or Impacts to Schedule Since Last Quarterly Report:	1. Extend remaining Phase 1 activities into June 2020; 2. Extend lab test NLC nodes into June 2020; 3. Extend Procurement of Phase 2 technologies into June 2020; 4. Extend Phase 2 deployment into October 2020; 5. Continue to assist the City with City-owned attachments into July 2020; and 6. Delay Phase 3 steady-state evaluations to begin in November 2020
Lessons Learned:	1. The initial observations of the Project have identified a variety of NLC technology benefits that provide opportunities to enhance outdoor lighting services and provide operating cost efficiencies. 2. The pandemic created disruptions to the Project as construction-related activities have been temporarily suspended. Further delays are likely due to potential supply chain issues and construction backlogs. 3. Continued involvement in the ANSI C136.50 NLC industry committee will build on the Company's meter testing experience for preliminary tests. The knowledge gained will enable the Company to formulate business models for various technology applications to provide customers with alternate service options and rate structures. 4. NLC metering accuracy specifications and industry accepted testing requirements are needed, and the metering needs to be accepted by the PSC, before NLC meter data can be used for billing purposes. In addition, integration of NLC meter data into the Company's billing system may require system upgrades.
Work Stream Coordination:	Coordination occurring among the Company's electric business unit, gas business unit, procurement, communications, marketing, customer organization, energy efficiency, grid & network communications, Metering and billing, and IT group for engineering design, review, and deployment.
Risks:	
Identified Risks:	Make-ready work for poles with the necessary clearances could increase deployment cost and impact the Project timeline. The public may not be fully aware of the benefits of a smart city.
Risk Mitigation Plan:	The Company will work closely with the City to identify low-cost make-ready installations to complete smart city sensor deployment in Zones A and B. The Company will explore additional public engagement opportunities during the Project to educate and inform stakeholders.
Finance:	

Quarterly Report Template	
Total Spend to Date:	$2,803,996
Target Budget Spend:	$3,455,000
Actual Incremental Spend:	$873,592
Variance:	$651,004
In-Kind and Grant Support (Specifically for REV Demo):	Estimated $150,000 from Phase 1 vendors.
Additional Notes:	

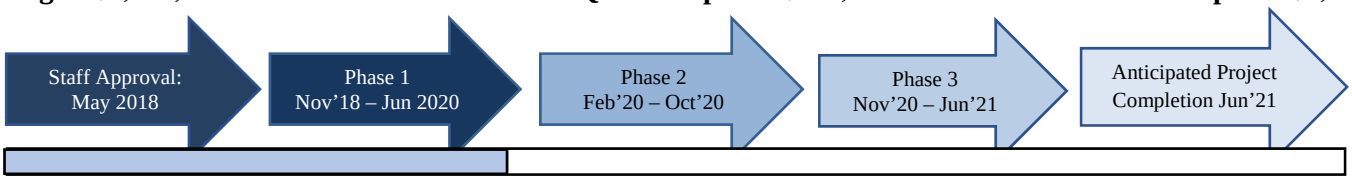
Appendix A – Updated Work Plan



Appendix B – Summary One Pager

nationalgrid **Smart city Schenectady REV Demo** **Q1 2020** **Overall Status (Active)**

Project Start Date: 05/24/2018 **Project End Date:** 06/30/2021
Budget: $7,585,000 **Current Quarter Spend:** $873,592 **Cumulative Spend**: $2,803,996



Project Summary: The Project is designed to test whether the Company's outdoor lighting infrastructure can serve as a platform for advanced services through the deployment of a multipurpose IoT network to enable smart-city technologies, and to develop viable business models to animate the advanced outdoor lighting and smart city markets.

Cumulative Lessons Learned		
The Customer	**Market Partners**	**Utility Operations**
• Cities want more than smart lighting alone. The City of Schenectady intends to improve public services, increase public safety, and find ways to save money in the process. • The City and the Company understand the need to continue to engage with stakeholders as the Project progress. A feedback loop is essential in creating a smart city that will benefit its citizens. • Conversion to smart LED street lights with NLC nodes provides greater control, convenience, and opportunity for additional GHG savings that help meet clean energy and CLCPA goals.	• Partners are customizing their solutions to meet the needs of both the City and the Company. • Standardization and market advancements would improve network interoperability between smart-city devices. • Upfront costs are high. However, the cost of future deployment may be lower as the Project expands into other zones. • New and disruptive smart-city technologies are emerging in the market. The Project can benefit from new market entrants offering additional choices and new products.	• Building a smart city entails a complex deployment of diverse smart technologies. Utility involvement consolidates smart cities into a packaged solution. • Installation costs are high. Therefore, deployment cost reductions can be achieved by combining smart city installation with LED upgrades. • Adequate time is needed to fully ensure the solution meets standard code compliance, data security, and data privacy requirements. Field surveys are also required before installation to ensure safety clearances are maintained on poles.

Application of lessons learned: The Company believes NLC nodes offer a range of customer benefits and provide opportunities to enhance outdoor lighting services. With sufficient lab testing results, the Company will review and make tariff proposals to offer NLCs as an offering. Experience gained on smart city attachments is being applied to other municipality attachment applications.

Issues Identified: Several Project timeline delays due to the COVID-19 pandemic. All field activities were suspended.

Solutions Identified: The Company will work closely with the City on non-field related tasks and planning tasks associated with Phase 2.

Recent Milestones/Targets Met: Deployment of all smart city sensors in Phase 1 Zone A. Phase 2 RFP was released to the market and generated eleven bid proposals.

Upcoming Milestones/Targets: Pursue make-ready services, complete smart city sensor deployment, and remaining Phase 1 tasks. Evaluate the deployed technologies for Phase 1 to inform Phase 2. Shortlist Phase 2 bids, host vendor presentations, and award contract. Complete lab testing of NLC nodes and report findings.