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September 12, 2023

VIA: ELECTRONIC MAIL

Mr. Adam J. Teitzman
Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

Re: Petition of Tampa Electric Company for approval of Direct Current Microgrid Pilot Program. Annual Status Report (Redacted)
Dkt. 20200234-EI

Dear Mr. Teitzman:

Enclosed for filing is Tampa Electric Company's Direct Current Microgrid Pilot Program Annual Status Report.

Thank you for your assistance in connection with this matter.

Sincerely,

Malcolm N. Means

Malcolm N. Means

MNM/bml
Enclosure
cc: All Parties of Record (w/attachment)
TECO Regulatory Department

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing Status Report, filed on behalf of Tampa Electric Company, has been furnished by electronic mail on this 12th day of September, 2023 to the following:

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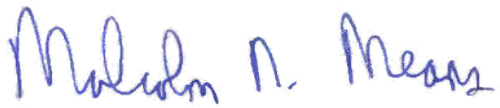

ATTORNEY

TAMPA ELECTRIC'S

MICROGRID PILOT ANNUAL REPORT

June 7, 2022 through May 31, 2023

September 6, 2023

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INTRODUCTION

On June 30, 2021, the Florida Public Service Commission ("PSC") approved Tampa Electric's Request for Approval of its microgrid pilot program ("Pilot") that involves the use of the Block Energy System ("BES") supplied, installed, and commissioned by BlockEnergy™ LLC (formerly Emera Technologies, LLC). The BES connects 37 homes in the Hillsborough County Community of Medley at Southshore Bay, built by Lennar Homes, LLC ("Lennar"). The BES is comprised of:

a) a buried DC loop;
b) a Community Energy Park ("CEP") containing a large battery, two natural gas fired generators, a control enclosure, and an interconnection to Tampa Electric's distribution grid; and
c) an average of 7.83 kW-DC of rooftop solar photovoltaic ("PV") panels and a BlockBox™ containing 17.75 kWh of battery storage and other equipment at each house. Each BlockBox™ has an inverter to convert direct current ("DC") microgrid power to alternating current ("AC") power for use inside the home. The BES is backed up by a traditional underground AC distribution system connected in parallel to the BES at each home for the purposes of the Pilot.

The overall objective of the Pilot is to test the capability of the BES to provide power to residential homes with a high level of renewable energy while providing superior reliability and resiliency. Tampa Electric expects that the BES will achieve the following objectives:

1) isolate homes from upstream AC distribution system disturbances with no interruption to the customer;
2) integrate high levels of renewable energy, with a target of more than 60 percent of the total energy used by the homes coming from the BES solar panels; and
3) eliminate impacts on the transmission and distribution system during peak demand periods from the addition of the 37 homes.

Tampa Electric expects to demonstrate the following benefits by the end of the Pilot:

1) increased renewable energy penetration;
2) reduced system losses;
3) reduced generation capacity costs;
4) reduced system transmission and distribution capacity costs;
5) reduced energy costs; and
6) increased reliability.

SUMMARY

Tampa Electric's BES Pilot went in-service on May 27, 2022 and has been operational for one year. Tampa Electric began collecting data on June 7, 2022 for monthly reporting. For purposes of this report, the operational period ("Reporting Period") is June 7, 2022 through May 31, 2023. Throughout year one, the BES Pilot has made substantial progress toward meeting the three primary objectives, while Tampa Electric has gained a better understanding of microgrid design and operational performance. The BES has proven to be resilient, meeting the primary objective of the pilot, and has demonstrated its ability to maintain electric service during Tampa Electric's AC system outage events, most notably during outages caused by Hurricane Ian. During the hurricane, Tampa Electric's AC system had an extended 42-hour outage to surrounding homes while the BES continued with uninterrupted service during this period.

Throughout the Reporting Period, Tampa Electric has intentionally maintained a high level of customer engagement, which required customer visits and transfers to the backup AC supply while adjustments were made to the BES equipment. Every effort has been made to ensure that service to the customer was not impacted. This resulted in decisions to proactively remove certain customers from the BES and use the AC backup for a period of time. These decisions were made to reduce the impact on customers while issues were resolved but also resulted in more hours spent on the AC grid.

A benefit of the BES architecture is its ability to integrate within Tampa Electric's AC distribution system while not depending on the grid for firm power during periods of peak loads. The BES Pilot control system was configured to zero tie line flows from the Tampa Electric's system during peak periods; and to date, the Pilot has met the objective of eliminating impacts from the 37 homes to Tampa Electric's transmission and distribution systems during periods of peak demand.

As might be expected during the first year of using a new technology, some start-up issues occurred during the Reporting Period. Many of these issues have been addressed and resolved through hardware or software modifications and have not reoccurred. There remains a short list of issues that we continue to work on collaboratively with BlockEnergy™. These are discussed throughout this report.

While the BES is beginning to meet the three primary objectives, its controls will be modified and tested to further optimize other fixed or dynamic operational functions, including making economic decisions on dispatch of its natural gas generation versus importing energy from the AC grid and the potential for the BES to become a resource for the broader Tampa Electric system during peak periods. This, and other potential benefits, will be further evaluated as the Pilot continues.

BES PERFORMANCE RESULTS, JUNE 7, 2022 TO MAY 31, 2023

The data and information presented below will demonstrate the achievements made in this reporting period as they relate to the Pilot objectives.

I. Energy Supply Reliability and Availability

The unique topology of the BES makes it difficult to assess the reliability of the energy supply to the homes in the Pilot using traditional AC reliability indices such as SAIDI, SAIFI and CEMI-5. Instead, the performance of the BES is evaluated against the "Availability" of the BES to provide energy to each of the homes.

Availability is defined as the ratio of total number of hours in a reporting period that all homes were supplied from the BES to the total number of hours for all homes in that same period.

$$Availability, BES = \frac{Total\ \#\ hours\ that\ all\ homes\ were\ connected\ to\ BlockEnergy}{Total\ \#\ hours\ per\ week\ for\ all\ homes\ (37\ homes\ x\ 24\frac{hrs}{day}x\ 7\ days)}$$

This metric was calculated weekly and was a valuable tool in identifying performance issues or trends and resolving them in a timely manner.

The results shown in Table 1 show an overall availability that includes issues that arose early in the Reporting Period (described later in this report under "***Operational Experiences For Year 1 (Reporting Period)"*** These issues were either resolved or had mitigation plans in place by the end of 2022; Table 2 shows the adjusted availability of the BES with these issues removed. The number of Automatic Transfer Switch ("ATS") Occurrences represents the frequency of switching the home energy source from the BES to Tampa Electric's AC grid.

As presented in these tables, the reliability of the BES has consistently improved once these "early-day" issues were addressed and as the Reporting Period progressed. Tampa Electric expects to see continued improvement on these metrics as the BES performance continues to mature.

Cumulative System Availability				
Item	**Total Time Spent AC Grid**	**Total Time Home Outage**	**Total Time Spent on BES (Availability)**	**# of ATS Occurrences**
Home-Hours	4,988.50	28.8	281,566.7	**365**
Percent	1.74%	0.01%	98.25%	

Table 1: Cumulative System Availability, June 7, 2022 to May 31, 2023

Cumulative System Availability (Jan-May 2023)				
Item	Total Time Spent AC Grid	Total Time Home Outage	Total Time Spent on BES (Availability)	# of ATS Occurrences
Home-Hours	1,090.5	0.5	133,254	75
Percent	0.82%	0.000%	99.18%	

Table 2: Cumulative System Availability, January 1 to May 31, 2023

II. Ability to Ride Through AC System Disturbances

Tampa Electric confirmed that none of the 37 homes connected to the BES experienced a power outage during any of the AC recorded outages listed in Table 3.

Circuit 13305 Pilot Lateral Outages (Underground AC Service to Homes)			
Date (month/day)	Duration (hh:mm:ss)	Duration (min)	Time
9/29/22	0:02:37	2.62	10:52 PM

Circuit 14146 Pilot Lateral Outages (Overhead Service to the CEP)			
Date (month/day)	Duration (hh:mm:ss)	Duration (min)	Time
9/13/22	0:19:25	19.42	9:09 AM
9/28/22	42:55:38	2,575.63	5:28 PM
9/30/22	1:20:22	80.37	4:12 PM
3/13/23	0:04:14	4.23	1:10 PM
3/27/23	0:44:26	44.43	11:45 AM

Table 3: List of Tampa Electric AC Circuit Outages on Circuits Connected to the BES, for the period June 7, 2022 to May 31, 2023

Comparison of the outage dates and times with the status of the main DC loop confirmed that the loop also was unaffected by these outages.

III. Reduction in System Losses

For this Reporting Period, the net energy reduction on Tampa Electric's AC network (including home energy reduction and net AC energy across the CEP grid tie) was 214,848 kWh with a corresponding reduction in AC system losses of 12,719 kWh. The reduction in energy losses with the BES in service should increase as economic dispatch of the BES natural gas generation is incorporated into the BES energy management optimization software. The implementation and testing of these controls is expected to occur during the first quarter of 2024.

The cumulative BES energy flows for the Reporting Period are provided in Table 4. The data shows a net difference between energy produced/supplied and energy consumed of approximately 179,000 kWh. Tampa Electric continues to work with BlockEnergy™ to resolve this deviation between energy sources and energy consumers to confirm the reduction in energy imported from the AC grid and determine the benefit of reduced AC grid system losses.

Energy Produced / Supplied (kWh)		
Rooftop Energy		
Energy Produced (PV)	Energy Dispatched to AC Grid	Net Energy Available to Home
380,043	99,590	280,453
Energy Supplied from Tampa Electric's AC Grid		289,711
Energy Supplied from BES NGG		13,754
Total Energy Produced /Supplied		583,918
Energy Consumed by Homes (kWh)		
Total Energy Consumption		404,969
Variance		178,949

Table 4: Cumulative Energy Metrics

IV. Integrate High Levels of Renewable Energy

Table 5 shows the actual household electrical load and rooftop PV generation for the Reporting Period.

	Actual Home Electrical Load (kWh)	Actual PV Energy Output - kWh	PV Energy as a % of Home Electrical Load
Total Reporting Period to Date	404,969	380,043	93.84%

Table 5: Actual Household Electrical Load, PV Energy Output

The tables above show that the rooftop PV solar arrays were able to produce the equivalent of approximately 93 percent of the electrical energy requirements of the homes in the Pilot.

V. Reduce TECO System Impacts During the Peak

The BES did not add load to Tampa Electric's AC system during peak load conditions. The BES is programmed to maintain zero energy flow from the AC grid tie at the CEP during Tampa Electric's identified peaks between 5:00 p.m. and 6:00 p.m. EST during June through August and between 7:00 a.m. and 8:00 a.m. EST during January through March to demonstrate compliance with this performance goal.

Table 4 shows the actual kWh energy imported into the BES from the AC Grid. The Energy produced from the Natural Gas Generators ("NGG") is shown in Table 6.

NG Energy Consumption Total Reporting Period to Date	
Forecasted NGG Output (kWh)	**Actual NGG Output (kWh)**
222,315	**13,754**

Table 6: Natural Gas ("NG") Energy Generation

Tampa Electric will be implementing controls in the Pilot energy management optimization software to make economic dispatch decisions on an hourly basis for up to 350 kW, of local natural gas generation versus importing energy from the AC grid. The implementation and testing of these controls is expected to occur during the first quarter of 2024.

OPERATIONAL EXPERIENCES FOR YEAR 1 (REPORTING PERIOD)

a) Early in the Reporting Period, after an Electric Vehicle ("EV") Level 2 charger was installed, Tampa Electric learned that the BlockBox™ was not designed with the capacity to support a Level 2 charger when operating at its maximum charge rate for extended periods of time. In those instances, the BlockBox™ would shut down and the supply to the home would be switched to Tampa Electric's AC supply.

   During those instances, the ATS from the BES supply to Tampa Electric's AC supply would operate, causing a short duration power interruption of less than one second, also known as a "momentary." The momentaries can be an inconvenience to the homeowners because it required resetting clocks and Wi-Fi modems; however, it did not represent any safety risks to the home or negatively affect the use and operation of the other appliances in the home.

   To avoid these potential momentaries, the homeowner chose to keep the home on Tampa Electric's AC supply until a solution could be found. During Hurricane Ian,

the homeowner agreed not to charge their EV during the storm so that they could be switched back to the BES supply. Being in the microgrid proved to be most beneficial to all homeowners as adjacent AC circuits experienced outages during the hurricane.

Tampa Electric and BlockEnergy™ determined that reducing the rate of charge in order to stay within the limit of the inverter could mitigate the issue. Tampa Electric was in the process of developing a testing program with BlockEnergy™ to better define the operating limits of the Level 2 charger while connected to the BES. However, the homeowner moved out of the community before this program could be implemented. Tampa Electric will proceed with this testing when another Level 2 charger is introduced into the Pilot community.

b) In the Fall of 2022, Tampa Electric noticed an increase in momentaries at two of the participating homes. An initial investigation revealed that the homes had recently equipped their pools with heat pump systems, and starting the pump was causing the BlockBox™ to switch to Tampa Electric's AC supply. More detailed investigation revealed that the inverter serving the home was not designed with the capacity to accommodate the short duration, inrush current that occurs with the starting of an AC motor, resulting in an inverter shutdown and ATS operation to connect the home to the AC grid.

Tampa Electric worked with the supplier of the heat pump systems to install a heat pump control system using "soft start" technology designed to reduce the magnitude of this pump-starting inrush current. While the soft start control technology has materially reduced the frequency of these momentaries, it has not eliminated them.

Three other homes that installed heat pump systems on their outdoor spas could not be modified with soft start controls. Tampa Electric continues to evaluate the possible solutions including collaboration with the homeowners to schedule their heating cycles and other controllable home electrical loads to avoid coincident load peaks in an effort to better understand the operating limits of these BlockBox™ inverters.

As Winter turned to Spring, the warmer temperatures seem to have influenced the frequency of pool and spa heat pump control usage as evidenced by a decrease in the number of ATS operations. We will continue to monitor these and other attributes of the BES through the Summer to gain a better understanding of the seasonal effects on the overall system performance.

c) The BES utilizes a distributed control system architecture with all resources interconnected within BES having their own controller. Individual controllers have experienced incidents where they have locked up and required a restart and can cause momentaries at the home. BlockEnergy™ and Tampa Electric are working collaboratively to identify and resolve the root causes for these interruptions. These issues recur infrequently but have not been eliminated. Work is ongoing to improve the controller design to harden the control system against these lock-up or restart events.

d) The microgrid has experienced instances where the renewable energy generated from the rooftop PV assets exceeds the required energy in the collective BlockBox™ battery energy storage. In such cases, the excess solar energy flows out to the Tampa Electric AC grid to support the broader distribution system energy supply. There are times when the broader microgrid cannot manage significant swings in these PV export flows in a stable fashion resulting in the loss of the DC buried loop supply; however, the homes continue to receive energy from the BlockBox™ during these microgrids outages, further demonstrating the built-in resilient features of the BES.

   Revisions to the control and response time of the BlockBox™ and CEP power converters addressing this instability are being developed. These revisions will allow the micro grid to manage these PV energy flows and will be tested in the fourth quarter of 2023.

Evaluation Period Extension

The technology period commenced on June 7, 2022 with the intended end date of June 7, 2023. Some issues arose during this first year which have resulted in extension of the end date; these issues are described below, in sequence:

a) Shortly after the June 7, 2022 start of the Evaluation Period, gaps were identified in the BES system grounding that made the system susceptible to lightning strikes. Until the grounding issue was resolved, all 37 homes were switched back to the traditional AC grid. This issue was resolved on August 17, 2022, and the homes were moved back to the BES. Accordingly, the end date of the evaluation period was extended to August 17, 2023
b) One of the features of the BES to be evaluated is the ability of the BES to be dispatched by Tampa Electric's Distribution System Operators. As of the date of this Report, this functionality was not ready for testing. Tampa Electric has advised BlockEnergy™ that the evaluation period end date will need to be further extended until the control system is updated and tested to confirm this functionality.

CUSTOMER ENGAGEMENT

Tampa Electric continues to engage with its Pilot customers as needed. These communications include any updates to the BlockBox™, maintenance, or other updates. During Hurricane Ian last year, approximately 295,000 Tampa Electric customers lost power; however, the 37 homes in the Pilot were not affected. Neighboring homes lost power, but the Pilot customers were islanded from the grid for a period of approximately 42 hours and did not experience a service interruption from the hurricane. This event received the attention of local and national news organizations prompting interviews with some customers to gain their perspectives.

Customers on the Pilot receive personalized 24-7 customer service from Tampa Electric. As a result of our "concierge" like services, customers can address concerns quickly and share plans such as building a pool or adding a Level 2 EV charger that would change the load profile and energy requirements of the home. Tampa Electric then uses this information to proactively monitor and anticipate any necessary adjustments.

On June 5, 2023, Tampa Electric sent out a survey to the 37 homes involved in the Pilot. The survey period was from June 5, 2023, through June 14, 2023. Sixteen customers responded to the survey. Figures 1 through 5 summarize the results of the survey.

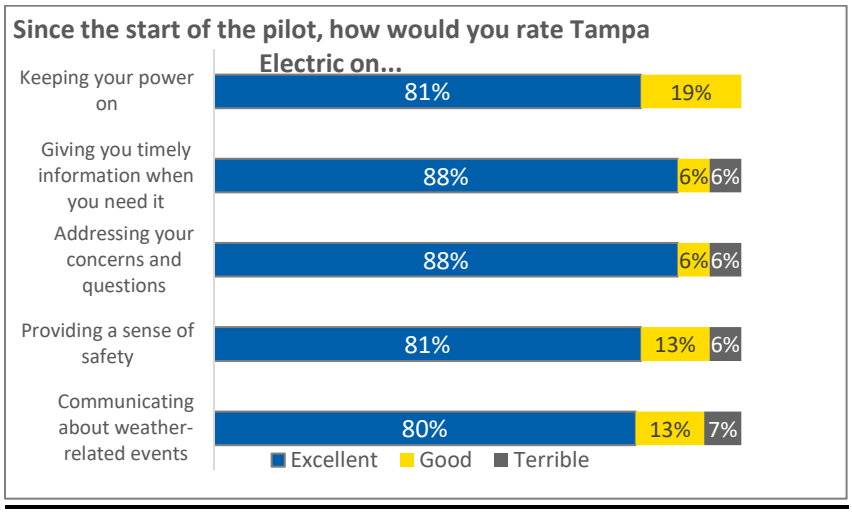

Figure 1

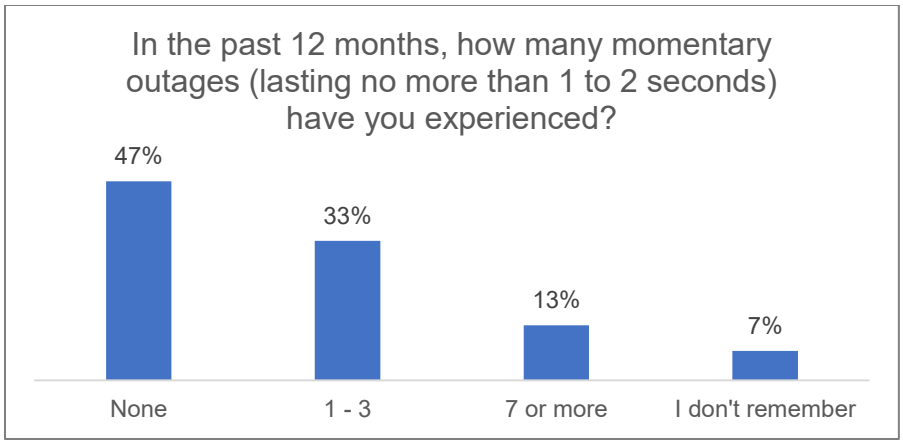

Figure 2

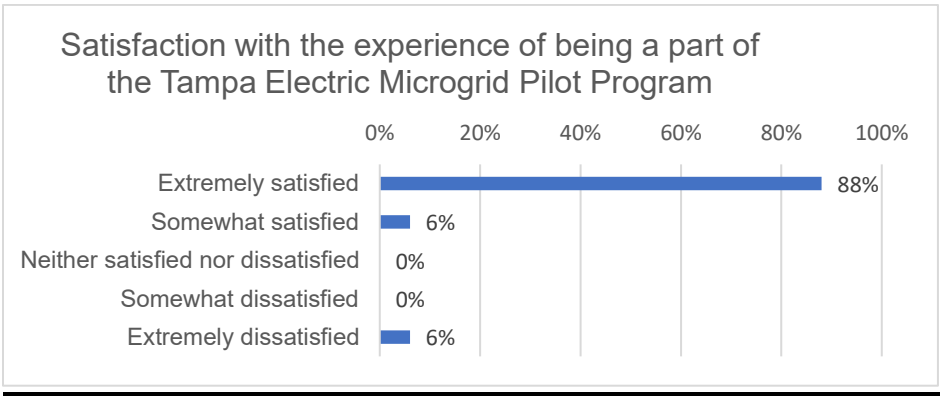

Figure 3

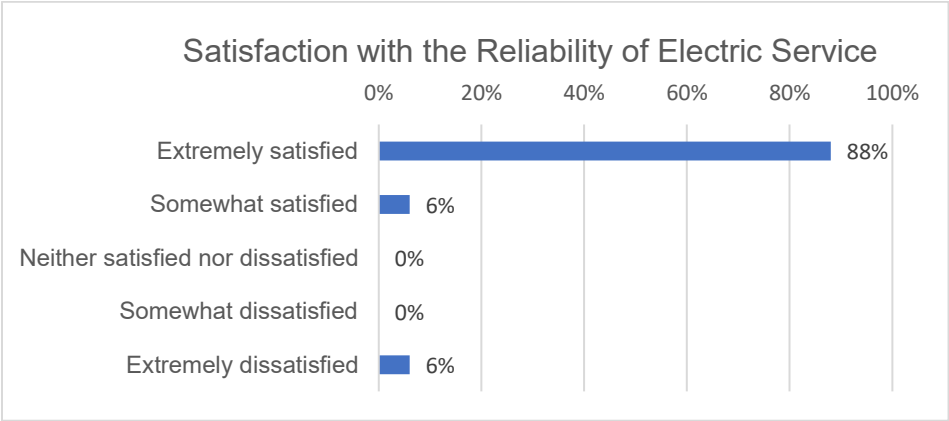

Figure 4

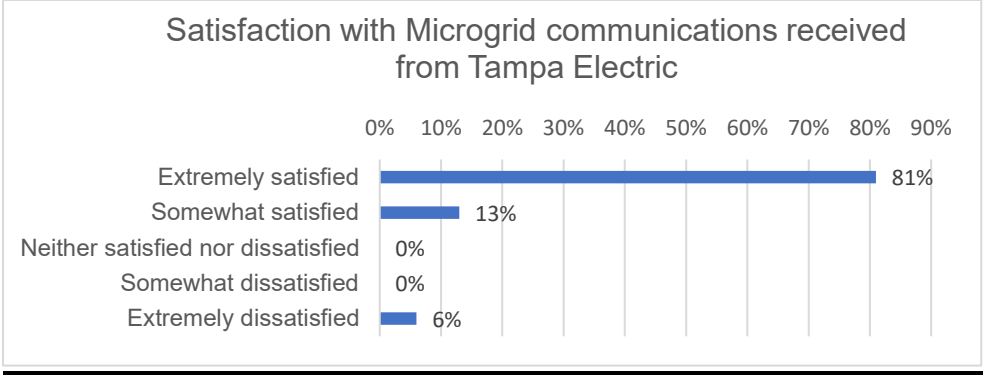

Figure 5

COSTS

Table 7 highlights the operating costs incurred by BlockEnergy™ during the first year of the Pilot. Tampa Electric incurred $0 in operating costs for the Pilot because the contract requires BlockEnergy™ to provide those services during the Pilot without payment.

	Costs through June 2022	July-Sept 2022	Oct -Dec 2022	Jan-Mar 2023	Apr -May 2023	Project Total
Operations and Maintenance						
Labor: Fixing an issue/outage	[redacted]					
Materials						
Operations and Maintenance						
Other Project Expenses						
Labor: System Requests/Enhancements	[redacted]					
Materials: System Requests/Enhancements						
Project Requests						
Total Operating Expenses						

Table 7: Year 1 Operating Costs

WRAP-UP AND NEXT STEPS

The Pilot has demonstrated its ability to maintain electric service during Tampa Electric's 42-hour AC system outage event during Hurricane Ian. During the outage, the BES maintained service while the surrounding homes experienced an extended outage. The Pilot's resiliency throughout Hurricane Ian has captured national attention.

The BES Pilot has made substantial progress toward meeting the three primary objectives. Tampa Electric is encouraged by the learnings gained in relation to microgrid design and operational performance and is looking forward to continued collaboration with BlockEnergy™ to advance the performance metrics and customer experience over the remainder of the Pilot.

As we proceed into the next operational year, Tampa Electric will continue to make progress with achieving the three primary objectives, testing the optimized controls for optimization of its operational functions, and evaluating the potential for the BES to become a resource for the broader Tampa Electric system during peak periods.