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Energy Innovation to Economic Growth and Competitiveness

Driven by service and inspired by innovation, North Carolina's electric cooperatives are building a brighter energy future for 2.5 million North Carolinians. Beyond providing electricity, each of the 26 not-for-profit cooperatives is investing in its community and delivering new energy solutions to improve quality of life for cooperative members in 93 of North Carolina's 100 counties.

North Carolina's electric cooperatives are serving members in new ways. We are pursuing and applying new technologies that give members options to not only understand and control their energy use, but also play an active role in reshaping our electric grid, the network of resources and technologies used to produce and deliver electricity.

Together, we are creating an industry future that allows us to continue our mission of powering and empowering the people and communities we serve. As leaders in the utility industry, it is our responsibility to champion an effort that we call a "Brighter Energy Future." The roots of this forward focused strategy grow from three values we believe in:

- Creating a low carbon emissions environment through sustainability and continued investment in low and zero emissions resources.
- Integrating technology to make distribution grids more resilient, robust and flexible for an energy future that includes consumer participation through demand response programs and new energy resources distributed across the grid
- Improving efficiency of the overall energy sector through beneficial electrification.

In 2014, the North Carolina Electric Membership Corporation (NCEMC) worked with its members to begin a community solar program that led to 11 cooperatives installing 18 community solar farms totaling 2 megawatts across our system. We have developed an internet-connected thermostat and water heater program that has over 3,000 devices deployed that can be called on for demand response. NCEMC continues to partner with its members to develop an Electric Vehicle Charging Network, bring broadband to rural parts of our state, and implement energy storage on the grid where appropriate.

Our two microgrids are examples of these energy storage projects. NCEMC placed these demonstration projects to benefit the two largest economic drivers in our state – tourism and agriculture. They demonstrate economic benefit throughout the year by offsetting power supply costs, deferring asset investments, and providing grid optimization opportunities. They also help support local resiliency and improve reliability with edge-of-grid resources distributed throughout the network.

Ocracoke Island Microgrid

Ocracoke Island is part of the string of barrier islands that make up North Carolina's Outer Banks. It is exposed to severe weather, and it is vulnerable during major weather events like hurricanes. Additionally, it is isolated from central generation sources, like power plants; if the transmission line feeding the island is without service due to storms or some other

circumstance, the island would be without power. This remote location allows us to learn and support a goal of better reliability for the island.

Tideland Electric Membership Corporation (EMC) serves Ocracoke Island and owns and maintains the distribution system on the island. Tideland EMC serves approximately 23,000 cooperative members in six eastern and coastal North Carolina counties.

The primary goal for developing a "utility microgrid" on Ocracoke Island is to avoid prolonged and/or rotating blackouts during and after storm events. Additional goals beyond reliability include learning from this integrated solution, increasing local demand-response, interaction with the PJM market and reducing power supply costs. Specifically, the microgrid will be used to:

- manage loads on the island when transmission service is unavailable due to storms or other planned or unplanned outages;
- gain an understanding of the interoperability of distributed energy resources (DER) on distribution systems as well as within structured markets;
- implement demand response to reduce peak capacity use;
- facilitate energy arbitrage, charging during low cost periods and discharging during higher cost periods; and
- participate in the ancillary service markets, particularly regulation.

This microgrid was built on Ocracoke Island, which currently has a 3 MW generator used to support the island during storms or other periods when transmission service has been interrupted. NCEMC is utilizing the existing island generator and distribution system with the new microgrid components to improve reliability to existing and future members. The additional resources NCEMC and Tideland EMC added to the existing system include:

- 500kW/1MWh (2 hour) Tesla Powerpack battery system;
- 19kW of roof mounted solar energy;
- Ecobee3 Wi-Fi enabled thermostats;
- intelligent water heater controls from Carina Technology for electric resistance water heaters; and
- a Microgrid Controller tying the existing and new resources together.

During peak seasons, power demand on the island can exceed the local generation. During transmission outages due to storms or other reasons, service to members can be interrupted due to lack of supply, leading to "Island Mode" operation. The combination of energy supply (generator, battery and solar) and demand reduction (thermostats and water heater controls), combined with a microgrid controller will work together to balance resources and load thereby reducing intermittent power outages.

The integrated microgrid equipment that assists the generator during Island Mode can also help reduce power supply costs under normal operating conditions in "Grid Connected Mode". The power supply costs to serve the island include energy, demand and ancillary services. The microgrid enables NCEMC to optimize the timing of load to save costs for all members; when

energy costs are low the battery can be charged and then it can discharge during higher cost periods. The thermostats and water heaters can shift demand when costs are high, further reducing load and improving member-consumer savings. Finally, the battery can be used to provide ancillary services to the PJM market, generating further revenue for the portfolio.

The integration of supply-side and demand-side resources, with community involvement from the residents and visitors to the island have made this a successful project. Economically, the demand response value funds this project throughout the year – minimizing peak demands and offsetting power supply and transmission costs.

This project has provided NCEMC staff and others with valuable lessons in the planning, development and testing of microgrids and the individual components that make up a microgrid. NCEMC studied demand response and energy arbitrage; ancillary services; capacity firming and smoothing of renewable resources; islanding and resiliency; asset deferment; and power quality improvement. NCEMC reviewed these "use cases" of the microgrid to demonstrate the lessons that have been learned; to recognize the value of building a microgrid; and to identify recommendations for others considering the development of a microgrid.

These lessons learned have already been applied to NCEMC's second microgrid at Butler Farms and will no doubt prove to be valuable to North Carolina's electric cooperatives and others as they endeavor to develop similar projects.

Butler Farms

In late 2016, NCEMC was looking for a home for its second microgrid. The goal of the project was to develop a microgrid that expanded on the knowledge gained from the Ocracoke project and to increase the complexity by merging utility-owned generation with customer-owned generation. NCEMC's desire was to find a project that would highlight the coordination between two of North Carolina's most important industries: agriculture and energy.

South River EMC, a distribution cooperative member, approached NCEMC with the idea of placing the microgrid at Butler Farms as it would be a natural fit with the farm's existing generation resources. Additionally, the owner, Tom Butler, was focused on environmental stewardship and energy conservation. After the first site visit, the parties knew this would be a natural fit and the concept of the Butler Farms Microgrid was born.

The goal of the Butler Farms microgrid is to provide enhanced electric service reliability for the customer and surrounding electrical power distribution infrastructure (distribution feeder) as well as to reduce peak electricity costs.

The project will also act as an educational pilot project to support greater understanding of microgrid techniques and technologies to provide an alternative to the deployment of standby or emergency diesel generators, and further NCEMC's development of microgrid controllers.

Butler Farms in Lillington, North Carolina, is a "finishing operation" pig farm where they raise the pigs to reach market weight. The farm has driven its own sustainability research for the last 10 years by implementing covered lagoons, 22.28kW of solar generation, and 185kW of methane powered electric generation.

To further advance its sustainability initiatives, Butler Farms partnered with South River EMC and NCEMC to implement this microgrid project that would not only benefit the farm, but the surrounding community as well. NCEMC installed a PowerSecure Energy Storage Systems utilizing two Samsung lithium-ion batteries each rated at 125kW / 372.5kWh, the microgrid controller, and reclosers to isolate the portion of the feeder to be powered by the microgrid.

The project is divided into three phases, where "Phase One" serves to supply the farm in case of outages, "Phase Two" incorporates the surrounding residences on the feeder to be powered by the batteries of the microgrid during outages or maintenance, and "Phase 3" integrates the swine waste methane generator as a resource of the microgrid.

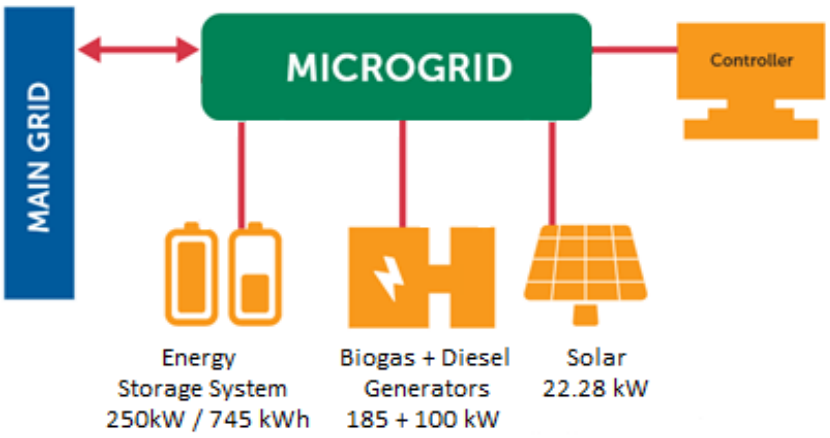
When the project is completed and power from the main grid is interrupted, components of the microgrid will work together to help supply the farm and feeder load. Components of the microgrid can be controlled remotely from the NCEMC Integrated Operations Center or South River EMC dispatch center, where several aspects of the system are monitored in real time.

The components of the existing generation on the site (owned by Butler Farms) are a 185kW Methane Powered Electric Generator; 22.28kW of solar energy; a 100kW diesel generator, which participates in the NCEMC Consumer-Owned Generation (COG) program.

Most of the generation at Butler Farms is based on the waste produced by the farm's swine population to produce electricity. With the use of a digester and covered lagoons, Butler Farms can capture the methane produced from the waste and use it to generate electricity. When running, all power produced is sent to the South River EMC distribution system under a Power Purchase Agreement (PPA). Similarly, the grid-tied solar energy array is under a separate PPA.

In case of outages, the farm uses the diesel generator as backup to keep essential loads operating. For a hog farm, its primary concern is air flow through the houses. During the summer, the temperature inside the houses can rise rapidly without proper air circulation.

NCEMC added a PowerSecure Energy Storage System with two Samsung lithium-ion batteries rated at 125 kW/372.5 kWh each; a microgrid controller; and reclosers on the distribution feeder to enable islanding and synchronization, completing the microgrid topology.



The microgrid is configured so that local resources can serve the farm and homes in the community during outage events. The controller balances local control with system optimization for power supply savings.

Future Programs

Battery storage is a game-changing technology that is impacting the distribution grid through distribution automation, resiliency, renewables integration, and generation investment. Microgrid pilots and projects provide resiliency and reliability, and at the same time, allow us to test these emerging technologies to understand better how we can integrate them into systems to benefit cooperative member-consumers. They also serve as a case studies for how cooperatives and the community can work together to promote sustainability and improve the quality of life. We are continuing to explore new solutions at the edge-of-the-grid that can meet the needs of our member-consumers such as building a neighborhood microgrid and developing larger, more complex microgrids.

Not every cooperative has to do everything - we share information, pilots, and research and development (R&D) results. We started with community solar, then added thermostats and water heaters and now have two functioning microgrids. This innovation depends upon infrastructure which includes not only traditional distribution lines and utility poles, but also includes communication through rural broadband initiatives. Infrastructure also includes investments at the edge-of-the-grid by member-consumers, like those on Ocracoke Island, and by farmers, like Mr. Butler who invested in his swine-waste energy facility. The success of these projects takes partnerships from the local community, business partners, and cooperatives. Together, we can see a Brighter Energy Future.

S. 1183, the Expanding Access to Sustainable Energy (EASE) Act of 2019

Senators Amy Klobuchar and Jerry Moran have introduced S. 1183, the EASE Act, which Senators Angus King and Cory Gardner have co-sponsored. By providing grants and technical assistance to rural electric cooperatives, this bill would significantly encourage the deployment of microgrid and energy storage technologies. Cooperatives that receive funding and assistance under this program would then participate in a public awareness campaign to educate other cooperatives with a focus to share the lessons that have been learned; to assist in developing successful energy storage and microgrid models; and to highlight that barriers can be overcome. The EASE Act replicates a tremendously successful partnership between cooperatives and the Department of Energy to deploy solar technology in rural America. I encourage the Members of the Senate Energy and Natural Resources Committee to take a closer look at this legislation and consider supporting it.