SPECIAL REPORT

Building Energy Resilience

How Electric Cooperatives Are Mitigating Extreme Weather Effects

CFC SPECIAL REPORT

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National Rural Utilities
Cooperative Finance Corporation

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OVERVIEW

The importance of energy resilience—the ability to prepare for and adapt to changing conditions and withstand and recover from disruptions—is hard to overstate. The financial toll associated with U.S. weather and climate-related disasters totaled $145 billion in 2021, according to the U.S. National Oceanic and Atmospheric Administration. And the human toll, while inestimable, includes the potential loss of life.

The aging nature of the grid—much of which was constructed over a period of more than one hundred years—has made electric systems more susceptible to outages caused by severe weather. In 2020, the average American home endured a power outage for more than eight hours, according to the U.S. Energy Information Administration—more than twice the outage time from five years prior.

Wall Street is paying attention to energy resilience as well. Mainstream investors have ramped up pressure on electric utilities and other companies to disclose, in financial terms, the risks associated with extreme weather. Investors want to know how vulnerable a company's physical assets are to severe weather events such as floods, hurricanes and wildfires, and what efforts are being taken to address these vulnerabilities.

One way to reduce long-term risk to people and property from extreme weather is to identify priority vulnerabilities and build out resilience efforts accordingly.

Global consulting firm ICF published a report that concluded U.S. investor-owned utilities face a $500 billion capital investment gap to build out resilience efforts and effectively address risks from extreme weather. Around 60 percent of the gap is driven by the need for investment in system hardening, while the need for adaptations to protect infrastructure during extreme storms represents around 13 percent.

Many electric cooperatives are already taking steps to build energy resilience through a combination of new and traditional approaches.

Some cooperatives, such as Poudre Valley Rural Electric Association in Colorado, are leveraging grid-connected distributed energy resources (DER). The cooperative has found that microgrids with long-duration energy storage can help strengthen reliability in remote parts of its service territory. Others, such as Great River Energy in Maple Grove, Minnesota, are embracing innovation to explore energy storage that can support load for several consecutive days.

Cooperatives are also developing member-connected DER programs to enhance resilience. Cherryland Electric Cooperative in Grawn, Michigan, allows commercial and industrial (C&I) members to take out a 10-year loan with a 2 percent interest rate for a commercial generator at below market cost. Shelby Electric Cooperative in Southeast Illinois combines technologies, including a residential generator and smart switch, to restore power for residential members within 30 seconds of an outage.

Photo courtesy of Poudre Valley Rural Electric Association, Colorado.

Photo courtesy of Rappahannock Electric Cooperative, Virginia.

Making home batteries more affordable is a key focus of Vermont Electric Cooperative. The distribution system has devised a program that offers a financial incentive to members in exchange for permission for the cooperative to draw power from member-owned batteries during peak demand periods.

Electric cooperatives are also utilizing a variety of strategies for distribution system hardening. When it comes to hardening utility pole infrastructure, approaches range from new technologies such as LifeJacket® enhancements and fire-resistant mesh to traditional pole relocations.

The frequency and severity of extreme weather events has prompted some electric cooperatives to convert portions of above-ground power lines to underground feeders. These systems have concluded that the long-term benefits of undergrounding lines often outweigh the short-term costs, even with some drawbacks.

Cooperatives are also taking steps to improve how they plan for resilience. These steps cover everything from enhancing existing emergency response plans and having the right technologies in place to workforce planning and, of course, having a strategy to pay for capital investments, including how to leverage funding opportunities through the federal government.

Regardless of the specific approach, electric cooperatives share a commitment to protecting their member-owners and communities while ensuring reliability of uninterrupted service—the ultimate measure of resilience.

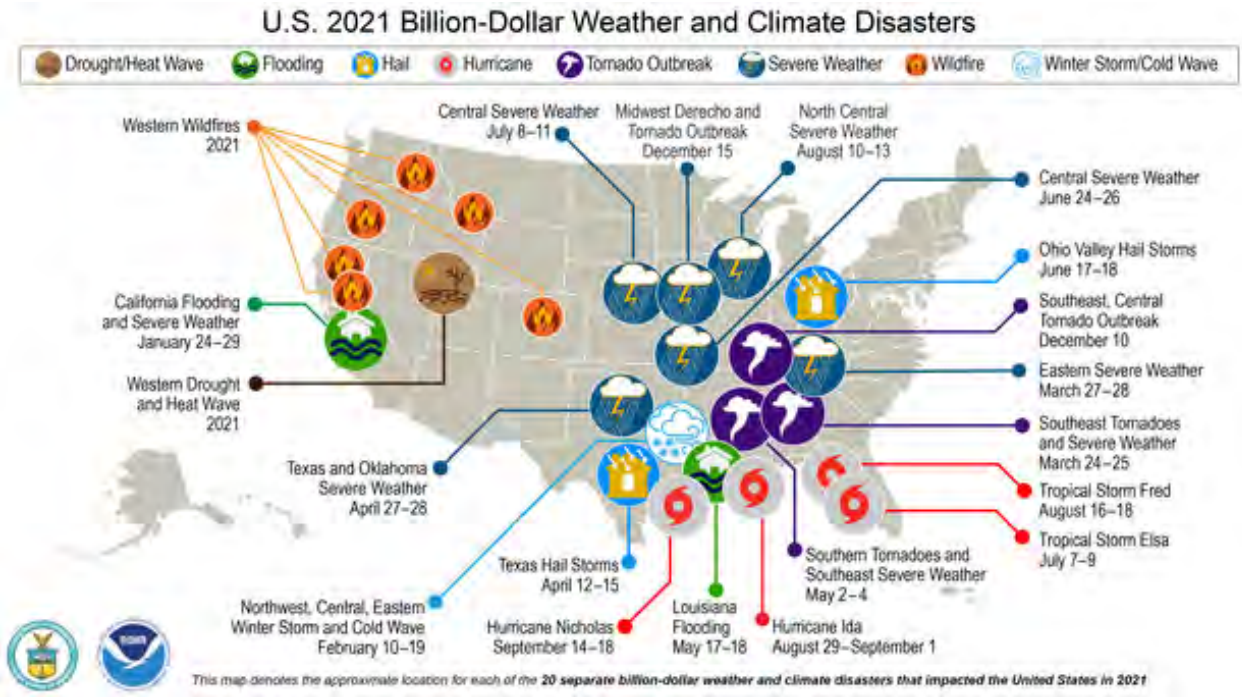
While electric cooperatives do not have the ability to receive a regulated rate of return on capital investments like their for-profit investor-owned counterparts, they have the advantage of being member-owned nonprofit organizations that exist for the benefit of the communities that formed them.

Photo courtesy of Northwestern Electric Cooperative, Oklahoma.

As members of CFC, a member-owned financial cooperative, electric cooperatives also have the advantage of tapping the global financial markets to make the capital-intensive investments that energy resilience requires. A prime example is the first-of-its-kind $400 million sustainability bond that CFC issued in 2020 to finance renewable energy and broadband initiatives benefiting rural communities.

The demonstrated commitment of electric cooperatives to energy resilience is a renewal of their founding mission of providing affordable, reliable energy to communities throughout America. For more than half a century, CFC has mirrored that commitment by serving as an essential resource to electric cooperatives.

Photo courtesy of West Florida Electric Cooperative, Florida.



GRID-CONNECTED DER

Long-Duration Energy Storage

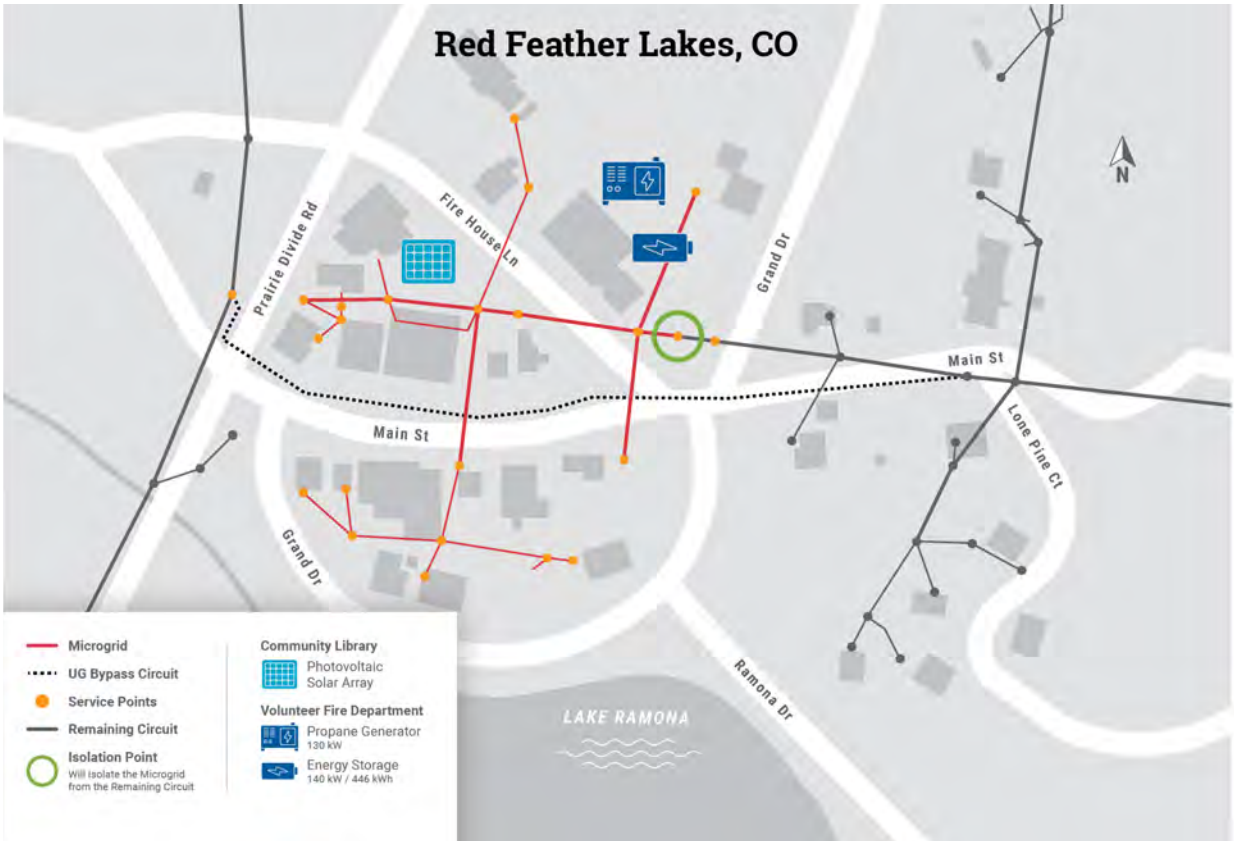
Some cooperatives have found that grid-connected distributed energy resources (DER) like microgrids with long-duration energy storage can enhance resilience in areas vulnerable to extreme weather events.

PVREA Brings Microgrid with Storage to Remote Community

Poudre Valley Rural Electric Association (PVREA)—a distribution cooperative that provides electricity to 50,000 homes and businesses in northern Colorado—debuted a new microgrid in October 2021 for the Red Feather Lakes community. Located in the remote Rocky Mountains, the community faces frequent challenges from wildfires, winter storms and even tornadoes.

PVREA Energy Resources Specialist Tony Francone said Red Feather Lakes was selected as the site for the microgrid because the community can encounter extended outages during these events. "We thought the microgrid was a great way to partner with the community to provide some resilience," he said.

The microgrid's energy resources include three main components: an 8-kW photovoltaic that sits atop the Red Feather Lakes community library; a 130-kW propane generator; and a 140-kW/446-kWh Tesla Powerpack battery. The generator and battery are located at the fire department, across the street from the library.



An overview of the microgrid service territory at Red Feather Lakes, a remote community in the Rocky Mountains.

> **We thought the microgrid was a great way to partner with the community to provide some resilience."**
>
> — ***Tony Francone**, PVREA Energy Resources Specialist*

During extended outages, PVREA controls the microgrid to support nearly 20 metering locations with a combined load of approximately 90 kW. The cooperative owns the battery, which is large enough to serve the Red Feather Lakes downtown area, according to Francone. "The solar array handles the library's load when needed, then anything left over is sent back to the grid," he said.

PVREA estimates the microgrid system can maintain power for up to eight hours when other parts of the grid are temporarily unavailable, though Francone is quick to point out the generator will extend the duration time considerably. "Not only can the propane generator carry some of the load, it can recharge the battery," Francone said. "In theory, the system can function indefinitely as long as there is propane in the tank."

This is especially important considering the microgrid's lines are connected to essential services that sustain the town in extreme conditions.

According to PVREA President and CEO Jeff Wadsworth, what's just as exciting as the microgrid technology is the cooperative spirit that made the project possible.

"Here was a situation where a community recognized a need and came together to meet it—with support from local, regional and national partners," Wadsworth said.

Members of the Red Feather Lakes community initiated the project with PVREA. Local equipment manufacturer Encorp LLC in Fort Collins engineered the microgrid controller. Tri-State Generation and Transmission Association Inc. provided funding. NRECA connected the project with the U.S. Department of Energy for funding and support.

"By working together and sharing our resources, we were able to design a system that adds resiliency to emergency services during an extended outage situation," Wadsworth said. "That's the essence of any cooperative."

In addition to helping the community of Red Feather Lakes, Wadsworth believes the project could benefit electric cooperatives in other ways. "We believe microgrid technology offers a lot of potential in supporting not only our members, but improving system performance," he said. "We anticipate being able to apply what we learn to other projects."

PVREA's microgrid system can maintain power for up to eight hours.

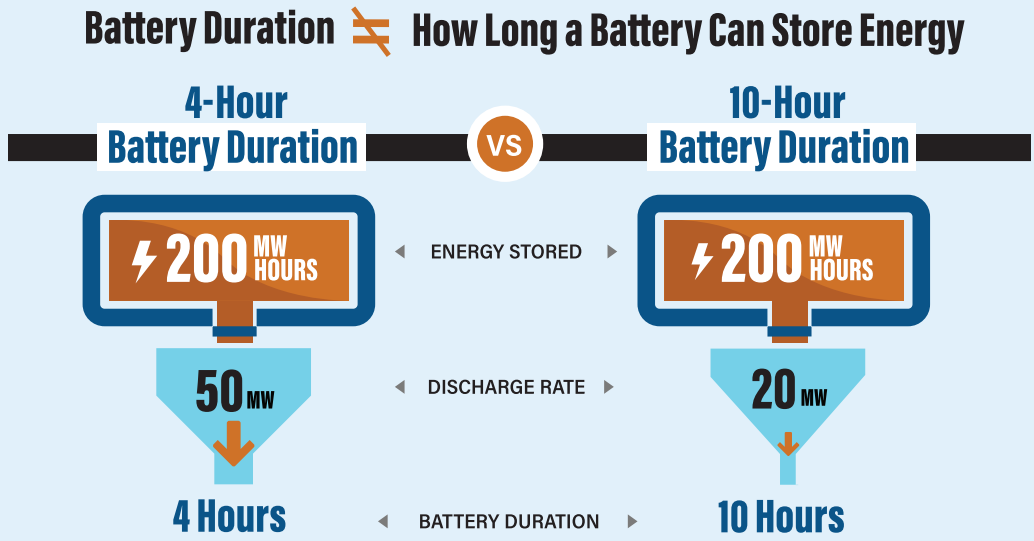
DEFINING ENERGY STORAGE DURATION

An energy storage system's duration is the length of time it can discharge continuously at its rated output power. For example, a large-scale battery storage system that stores 200 MW-hours of energy and has a discharge rate of 50 MW of power would have a duration of approximately four hours. If the same system discharged at 20 MW of power, it would have a duration of 10 hours.

Applications for different energy storage projects:

- **Short duration**, less than four hours: Peak shaving/demand management/energy arbitrage, substation or distribution feeder upgrade deferral, frequency regulation, voltage support and black start.
- **Long duration**, about 10 hours: All short duration applications plus firming of renewables such as solar to make those resources more like dispatchable generators and microgrid resilience applications.
- **Multiday duration**, more than 24 hours: All short- and long-term duration applications plus larger-scale resilience/reliability improvements in the face of weather events or other acute impacts on power supply.

FIGURE 1: **Understanding Energy Storage Duration**



KEY TAKEAWAYS

- PVREA's microgrid system leverages multiple resources to provide resilience for a remote community, including an 8-kW photovoltaic, a 130-kW propane generator and a 140-kW/446-kWh Tesla battery.
- The microgrid system can maintain power for up to eight hours during extended outages, and potentially longer as the generator recharges the battery.
- The project was a true collaborative effort, with PVREA working closely with the Red Feather Lakes community as well as local, regional and national partners.

Multiday Energy Storage

As extreme weather events become more common, there is a growing need for new cost-effective technologies capable of storing electricity for several days.

GRE's Multiday Storage Project Leverages Iron, Air

Great River Energy (GRE), a Minnesota-based generation and transmission cooperative, recently partnered with Massachusetts startup Form Energy on a first-of-its-kind, multiday storage project that uses a different kind of battery technology: one that relies on iron and air as its core components.

"Innovation will be critical in the transformation of the grid, and we believe this project represents a promising new way to serve our member-owners in the future," said GRE President and CEO David Saggau. "Multiday storage has the potential to transform energy from wind and solar facilities into dispatchable resources that can ensure electricity remains reliable at all times."

According to Form Energy, the battery uses an electrochemistry process in which oxygen from the air turns metallic iron into rust as the battery discharges. During the charging period, the rust is converted back into iron through an electrical current.

GRE plans to leverage the technology for a 1.5-MW, grid-connected storage system that is expected to come online in late 2023. The system will be capable of delivering its rated power continuously for 100 hours. This contrasts with the shorter-duration energy storage solutions currently available with utility-scale lithium-ion battery technology.

> **"Innovation will be critical in the transformation of the grid, and we believe this project represents a promising new way to serve our member-owners in the future."**
>
> — ***David Saggau**, GRE President and CEO*

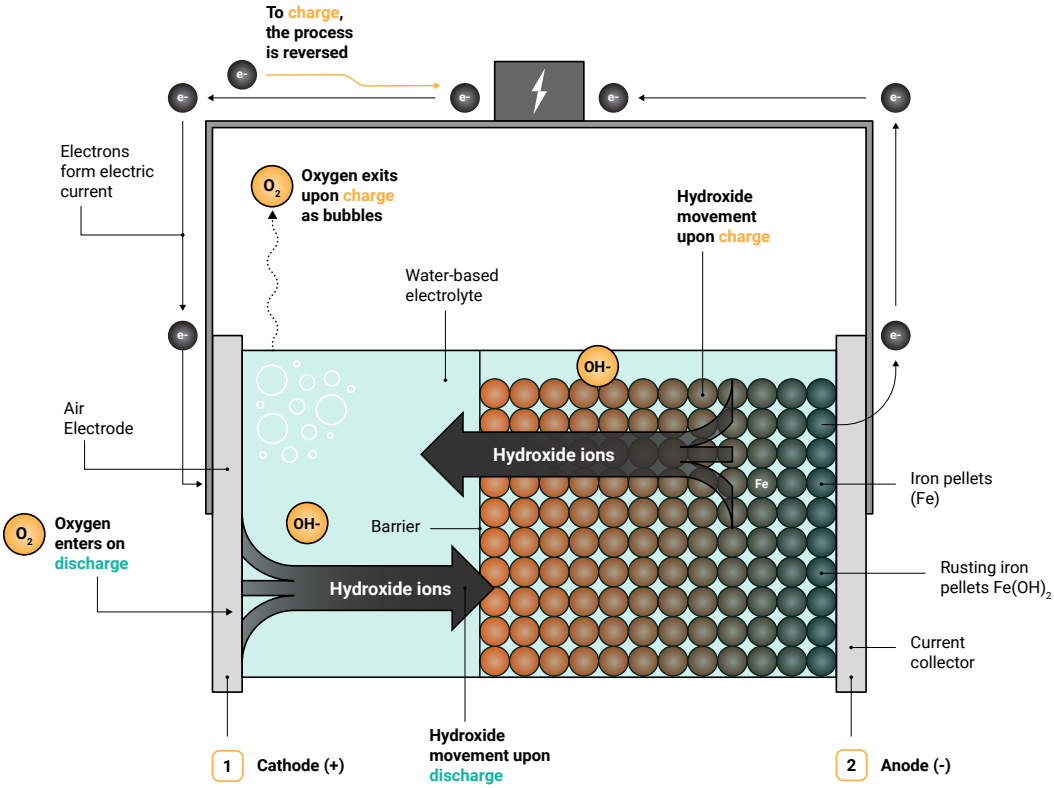
Ensuring the safe delivery of electricity during multiple days of extreme weather events is a key priority for GRE. The cooperative provides power to 28 member-owner distribution systems in the Upper Midwest—a part of the country that faces challenges from cold snaps, such as the polar vortex in January 2019, which caused wind generation to decrease significantly and outages at coal and gas plants.

Having a reliable, long-term energy storage solution that can solve challenges posed by the variable nature of renewable energy is just one of the benefits that GRE hopes to achieve from the project. It also dovetails with the cooperative's support of a low-carbon future for the electric grid.

GRE has stated that it intends to more than double the renewable energy in its portfolio by 2025 and reach 50 percent renewables by 2030.

"With increased dependence on renewables, a reliable backup electric power source is essential," said GRE Vice President and Chief Power Supply Officer Jon Brekke. "Multiday energy storage could help provide that service in the future."

FIGURE 2: **A Rendering of the Iron-air Battery**



1 Cathode (+)

Discharge: When the battery discharges, oxygen enters the battery through the air electrode, and reacts with water and electrons to create hydroxide ions. those hydroxide ions then migrate through the liquid electrolyte to the iron in the anode.

Charge: The process is reversed, and hydroxide ions travel from the anode to the cathode, where they react to form oxygen bubbles, water, and electrons that flow through the circuit.

2 Anode (-)

Discharge: Hydroxide ions from the liquid electrolye react with the iron pellets to produce rust and send electrons into the circuit.

Charge: The process is reversed, and electrons from the circuit react with the rust to convert it back to iron metal and liberate bydroxide ions into the liquid electrolyte.

A rendering shows how the battery technology will work once constructed and in operation.

KEY TAKEAWAYS

- GRE's multiday storage project leverages an innovative technology designed by Massachusetts company Form Energy that relies on iron and air as its core components.
- The technology will be used for a 1.5-MW, grid-connected storage system that will be capable of delivering the battery's rated power continuously for 100 hours.
- The cooperative hopes the technology will enhance resilience during multiple days of extreme weather and support a low-carbon future.

MEMBER-CONNECTED DER

Standby Power Systems for Business Continuity

Some cooperatives are offering specific programs to enhance resilience for commercial and industrial (C&I) members, while providing new ways to serve residential members and communities.

Cherryland C&I Generator Loan Program Enhances Resilience

When it comes to addressing challenges from derecho wind bursts, thunderstorms and other extreme weather events, Cherryland Electric Cooperative (CEC) pays special attention to supporting its C&I member-owners with enhanced resilience.

"The local businesses in our service territory are more than just commercial enterprises," said Cherryland EC Tony Anderson. "They are part of the fabric of our community. Many of the business owners know their customers on a first-name basis."

The close connection between the local business community and residents informs CEC's approach to resilience. Since 2017, the Grawn, Michigan-based distribution cooperative has made it easier for C&I members to have a backup power source through a commercial generator loan program. The program allows C&I members to take out a 10-year loan with a 2 percent interest rate for a Generac commercial generator at below-market cost, giving them much needed peace of mind during storms.

"The next time the power goes out, the local business is prepared to keep the lights on to continue serving customers," Anderson said.

Ensuring businesses can continue to operate when a backup power source is needed is a major goal of the program, but Anderson notes it is equally about supporting the broader membership and community during extended power outages.

A Cherryland service crew approaches a downed tree on a power line following a storm.

> **“The next time the power goes out, the local business is prepared to keep the lights on to continue serving customers.”**
>
> — ***Tony Anderson**, CEC General Manager*

Rather than marketing the program publicly, the cooperative targets specific C&I members that are well-positioned to offer public services to the community, such as food, shelter and other forms of assistance in the event of a storm or natural disaster.

“This program is a way for the co-op to demonstrate the seventh cooperative principle, Concern for Community,” Anderson said. “Members of the local business community share that concern. We feel fortunate to have so many C&I members who are ready, willing and able to support local residents and community members.”

The response to the program from participating C&I members has been positive, according to Anderson. “Thankfully, none of the participants have experienced any widespread outage events, but they are very appreciative of the program and strong advocates of the cooperative in the community,” he said.

“RESELLER” STATUS COMES AT A COST

Until recently, CEC’s agreement with Generac, the company that supplies the generators, required the cooperative to serve as an authorized reseller. This arrangement proved to be very “resource intensive,” admitted CEC Engineering & Operations Manager Frank Siepker.

“Being the generator ‘dealer’ situated the co-op staff between the members and the local Generac dealer installer for site evaluation, sizing, quoting, ordering, delivery coordination, installation, commissioning, training, and potential future maintenance, warranty and repair needs,” he said.

The cumulative cost has prompted CEC to shift its role to “just the planning and loan aspects,” without continuing on as an authorized reseller of Generac generators, Siepker said. “Cherryland will continue to have an instrumental role in helping our C&I members obtain a generator, but we will leave the ordering and installation process to the local dealers. This will also open up opportunities for other generator providers, whether that’s Kohler, Cummins or some other company.”

KEY TAKEAWAYS

- **CEC supports its C&I members with enhanced resilience through a commercial generator loan program.**
- **The program allows C&I members to take out a 10-year loan with a 2 percent interest rate for a commercial generator at below-market cost.**
- **Cherryland sees the program as a demonstration of the seventh cooperative principle, “Concern for Community.”**

Residential Member Resilience Programs

As member-owned and controlled noneprofit organizations, electric cooperatives are uniquely positioned to offer specific programs to enhance resilience for residential property owners.

SEC Combines Technologies to Offer Emergency Power

When Winter Storm Landon brought heavy snow and blustery winds across the Midwest in early February 2022, millions of residents lost power. But not everyone was unprepared.

Shelby Electric Cooperative
Your Touchstone Energy® Cooperative

In southeast Illinois, Shelby Electric Cooperative (SEC) members didn't have to wait too long for the lights to come back on. That's because the distribution cooperative offers a program that incentivizes members to own distributed generation units through its subsidiary, Shelby Energy.

The residential generator units range in size from 7 kW to 150 kW, giving SEC plenty of options to meet members' specific needs. Shelby Energy sells the units on behalf of the cooperative.

"Members who take advantage of the program typically have their power restored within 30 seconds of an outage," said Shelby Energy Propane Operations Manager Jason Nohren.

> **"Emergency power and peace of mind are often the main reasons our members buy the generators, not the discounted energy rate."**
>
> — ***Josh Shallenberger****, SEC President and CEO*

The speed and efficiency of the power restoration is a result of the different technologies involved. The residential generator units are connected to a smart switch that uses Aclara's Two-Way Automatic Communication System (TWACS) technology.

When an outage occurs, the smart switch disconnects the home from the grid and sends a signal to the generator causing it to turn on.

"Once power comes back to the grid, the smart switch will disconnect from the generator," he explained. "The transfer to the grid is seamless. The customer doesn't even notice."

SEC uses smart-switch technology to control the generating units.

The TWACS technology enables the cooperative to control the generator units, which opens up a range of possibilities. "From a reliability standpoint, the member doesn't have to figure out how to start up the generator unit when the power goes out," Nohren said. "The technology makes it automatic."

It also enables SEC to dispatch cooperative resources more efficiently during storms. "Since we don't have to worry about the members with the generating units, we can focus our attention on the parts of our service territory that need the most support," said SEC President and CEO Josh Shallenberger.

This is particularly important, Shallenberger noted, because when a storm prompts an extended outage, the cooperative must deploy resources as quickly and efficiently as possible.

SEC President and CEO Josh Shallenberger, left, and Shelby Energy Propane Operations Manager Jason Nohren with a residential generator.

While the primary benefit of the program is offering peace of mind to the 300 to 325 members currently using the generators, it also provides a means for SEC to reduce peak demand, which helps the cooperative lower its transmission cost allocation and reduce demand charges.

"This program is a great example of a cooperative 'win-win-win,'" Shallenberger said. "SEC is able to apply the widespread system benefits that come from reducing demand during peak periods, and the cooperative member benefits from lower electric costs, while simultaneously becoming more resilient."

All of these benefits are possible because the program was designed with more than just resilience in mind. Participating members who allow SEC to switch them from the grid to the generator during peak demand periods receive a $200 bill credit up front, an 8 percent discount on the energy portion of their monthly bill and free annual maintenance of the generator, valued at $140. The incentive program runs from May through October—the six months of the year when SEC experiences its biggest peak demand periods.

"Historically, we are a summer peaking system," Shallenberger said. "There is some benefit when it comes to the power bill, where we save on transmission charges during peak interruption periods. However, the greater benefit is with the consumer. Emergency power and peace of mind are often the main reasons our members buy the generators, not the discounted energy rate."

Shallenberger added that demand for the generators is so strong, the cooperative has a waiting list. "I should know," he said. "I'm one of the people on the list!"

KEY TAKEAWAYS

- **SEC enhances resilience by offering residential generators through its subsidiary, Shelby Energy, which installs the units.**
- **Members typically have their power restored within 30 seconds of an outage, thanks to a smart switch that automatically disconnects the home from the grid and sends a signal to the generator.**
- **The primary benefit of the program is offering backup power to members, but it also provides a means for SEC to more efficiently allocate resources during an extended outage and reduce peak demand.**

VEC Program Offers Potential for Backup Power, Peak Shaving

As more residents look to home batteries to have back-up power during extended outages, affordability has become a key concern. The cost of a typical 5-kW Tesla Powerwall system is around $10,500. Recognizing the financial barriers involved, Vermont Electric Cooperative (VEC) has devised a program that makes home batteries more affordable for its residential members.

In exchange for allowing the cooperative to draw power from member-owned batteries during peak demand periods, participating members receive a financial incentive in monthly bill credits of $6.40 per kW a month for 10 years or an upfront payment of $268 per kW, with the remainder paid as a monthly bill credit of $3.20 per kW.

VEC's BYOB pilot program leverages residential battery power.

"The bill credits can help defray the cost of a home battery purchase," VEC Manager of Power Planning Craig Kieny said. "Our hope is this program will result in more members deciding to purchase a battery to be more resilient, while helping the entire membership save money during peak events."

In designing its "Bring Your Own Battery" (BYOB) program, VEC emphasized flexibility. VEC invites members to BYOB from any energy storage manufacturer and installer. The only requirement is the storage unit be compatible with VEC's communications platforms. Members can enroll as little as 2 kW of storage, and up to the full rating of their energy storage unit—typically 5 kW for a residential battery.

VEC allows members to opt out of peak events if they are concerned about a potential outage due to weather. Members who do so forego their monthly bill credit.

To honor the intent of residential member resilience, VEC will not draw power from the batteries if weather forecasts suggest a reasonable likelihood of widespread outages either systemwide or locally.

"If your cooperative doesn't find a way to work with its members on residential energy storage, then the vendors will offer solutions that may benefit the individual member, but may harm the rest of the membership," Kieny said.

KEY TAKEAWAYS

- **VEC sees potential to build resilience for members and shave peak demand with its residential bring-your-own-battery program.**
- **The BYOB program offers a financial incentive to members in exchange for allowing VEC to draw power from the member-owned batteries—up to 40 hours a month, but not to exceed four hours in any single day.**
- **Members can BYOB from any energy storage manufacturer and any installer, with the only requirement that the energy storage unit be compatible VEC's communications platforms.**

DISTRIBUTION SYSTEM HARDENING

Utility Poles

Wildfire Mitigation Measures

To protect poles and other parts of utility infrastructure from fire damage, electric cooperatives are employing different strategies.

PSREC Protects Poles from Wildfires with Multipronged Approach

Blazing wildfires are a persistent threat to the communities served by Plumas-Sierra Rural Electric Cooperative (PSREC) in Portola, California.

The distribution cooperative, which provides electric and telecom service to Plumas, Sierra and Lassen counties in California and Washoe County in Nevada, has pursued an aggressive hazard tree removal program for the past 25 years to reduce wildfire spread. While this program has paid dividends, PSREC has enhanced its wildfire mitigation approach in recent years with a number of new measures such as mastication, fire-resistant mesh and flame retardant.

MASTICATION

Mastication, a process that involves grinding woody vegetation and unwanted trees into mulch with machines, has become the cooperative's first order of business to protect utility poles from wildfires. "The process of clearing a utility line typically requires four-man hand crews," PSREC Engineering & Operations Manager Jason Harston said. "We do our own mastication in-house with two Bobcat forestry cutters as well as using contractors."

PSREC is particularly focused on clearing right-of-way areas near poles that carry its fiber optic and transmission lines. "The transmission line keeps the lights on, of course, but the fiber line is just as important," Harston noted. "It's our communication lifeline to our substations and radio network that keeps our guys safe and helps ensure basic public health and safety."

PSREC reduces wildfire risk by using Bobcat forestry cutters to clear right-of-way areas near utility poles.

FIRE-RESISTANT MESH

In addition to masticating, the cooperative protects wood utility poles by wrapping them in fire-resistant mesh from Genics. The mesh is designed with polymers and fire-resistant compounds that form a barrier of protection, preventing flames from spreading.

Harston noted the wildfires in PSREC's service territory are so intense the cooperative doesn't bother wrapping most of the length of the utility pole. Instead, it focuses on the bottom six feet. "With most fires, if we have that bottom section wrapped by the time the fire flashes through, the pole will still stand," he said. "If you have a fire that's crowned out around the top of the pole at 20 feet, it doesn't matter what mitigation measure you have in place—that pole will be compromised."

Durability and a long-life span are two advantages of the fire mesh. PSREC likes using the fire mesh "because it works well and has a long lifespan," Harston said. He also pointed out that the fire mesh is durable. "Once it's up, it's up. If you have multiple guys climbing the pole, it won't ruin the mesh. If a bear tears some of it off, it's easy enough to stitch back together."

One drawback to the fire mesh, however, is cost. "We can't afford to apply fire mesh to every utility pole, so we pick certain ones that could affect a large portion of our electric membership and our fiber lines," he explained.

PSREC relies on fire mesh to mitigate fire spread.

PSREC BATTLES DIXIE FIRE

The monstrous Dixie Fire ravaged nearly 1 million acres in northern California from July 13 to October 25, 2021. It was the second-largest wildfire in California's history.

The Dixie Fire threatened and damaged PSREC's system in multiple locations, including its primary transmission service from investor-owned utility PG&E. After more than four months, PSREC was able to return to a normal transmission supply from PG&E. PSREC kept its system up and running by using a mix of local generation, emergency back-up generators and alternate transmission service.

When the Dixie Fire advanced toward PSREC service territory in the summer of 2021, the cooperative applied all three of its wildfire mitigation measures to protect poles and wires. PSREC wrapped more than 150 poles in critical locations with fire-resistant mesh and pretreated the poles with Phos-Chek. The cooperative also tapped crews to go "pole by pole" to masticate nearby vegetation that could easily ignite. Harston said it was an "all-hands-on-deck moment" that required "a monumental level of coordination" between electric operations and telecom crews.

In the end, the fire never advanced to any of the poles where the preventive treatment was applied. While some of PSREC's poles caught fire, the cooperative had removed so much vegetation it was able to quickly extinguish many of the ones that ignited. This meant some poles were still structurally sound once the fire had stopped, which aided in the rapid power restoration for PSREC's members.

> **“It always come back to what works. We will use whatever tool it takes to stop these fires from destroying our poles and wires.”**
>
> *— **Bob Marshall**, PSREC General Manager*

FLAME RETARDANT

A less-expensive wildfire mitigation tool to protect poles that PSREC uses is Phos-Chek flame retardant. The name Phos-Chek comes from ammonium phosphate, its main ingredient. It functions as a much-needed “check” on fires by reducing the flammability of fuels.

Phos-Chek consists of a concentrate that easily mixes with water and can then be sprayed on any combustible substance. PSREC sprays it from backpack pumps and a small water trailer it hauls behind trucks.

While the cooperative has found that pretreating wood utility poles with Phos-Chek ahead of a spreading wildfire can increase the odds of their survival, the retardant does have limitations. “Rain can deteriorate the retardant,” Harston noted. “It’s something we tend to use along with other measures like the mesh.”

LESSONS LEARNED

Having battled one wildfire after another using multiple approaches, what lessons has PSREC learned? According to PSREC General Manager Bob Marshall, the most important lesson is to always “be relentless, but also pragmatic.” This sums up PSREC’s philosophy on wildfire mitigation.

“It always comes back to what works,” Marshall said. “We know that mastication works. We know that the fire mesh and flame retardant work. We will use whatever tool it takes to stop these fires from destroying our poles and wires.”

Another lesson the cooperative has learned is to take advantage of supervisory control and data acquisition (SCADA) technology. Marshall noted PSREC has recently increased its use of SCADA, which has helped the cooperative gain a better understanding of what’s going on in its service territory. “Since we integrated SCADA into all our substations, we get much better data,” he said. “We’re learning faster.”

While new technologies can help cooperatives in ways previously unimagined just a few years ago, it’s important to be persistent about the basics, Harston noted. “Sticking to your mitigation program is critical, even if you run into a customer who objects to the co-op masticating a right of way,” he said. “Be sure the person understands this isn’t about them—it’s a public safety issue.”

KEY TAKEAWAYS

- **PSREC leverages a combination of approaches to protect poles from wildfires, including mastication, fire-resistant mesh and flame retardant.**
- **The cooperative is particularly focused on protecting poles that carry its fiber optic and transmission lines, which connect to its substations and radio network.**
- **PSREC used all three approaches when the Dixie fire advanced toward its service territory in the summer of 2021.**

Novel Pole Materials

Electric cooperatives with service territories near coastal waters face particular challenges in protecting utility poles. Thankfully, these cooperatives can mitigate damage and enhance resilience by leveraging novel pole materials.

JEC Leverages Steel Structures, Fiberglass Pin Insulators

For Jackson Electric Cooperative (JEC) in Ganado, Texas, a key part of energy resilience is using the right combination of materials for utility pole infrastructure.

Jackson Electric Cooperative, Inc.
A Touchstone Energy® Cooperative

JEC's service territory—which includes five counties in south Texas near the Gulf of Mexico—is susceptible to strong winds, hailstorms, hurricanes and tornadoes. These conditions frequently stress utility infrastructure.

Part of the cooperative's resilience strategy is using direct, burial steel poles in locations that require extra support. JEC replaced traditional wood cross arms that have higher failure rates during storms and natural disasters with composite cross arms.

"While I believe the traditional wood poles still play a critical role in our infrastructure and will for many years, being able to utilize steel structures and composite cross arms in areas of high failure rates increases our resilience and reduces outage times," said JEC General Manager Jim Coleman.

With JEC's service territory being so close to the Gulf of Mexico, the cooperative's wood utility poles are exposed to many different conditions and elements. "If salt-laden air builds up and there's not enough rain to wash it off, the salt can conduct when there is fog or high humidity, and the pole can catch fire," Coleman noted.

To avoid this, JEC works with its local fire departments on an as-needed basis to spray the salt off the poles and equipment. In light of these unusual environmental conditions, the cooperative looks for opportunities to change the structure of the poles to track less salt.

JEC uses fiberglass pole-top pin insulators to extend the life of its poles.

> **While I believe the traditional wood poles still play a critical role in our infrastructure and will for many years, being able to utilize steel structures and composite cross arms in areas of high failure rates increases our system reliability and reduces outage times."**
>
> — ***Jim Coleman**, JEC General Manager*

JEC uses direct, burial steel poles in locations that need extra support.

When lines demonstrate a high failure rate, the cooperative will replace traditional metal pole-top pins on the utility poles, which rust off prematurely, with 25-kilovolt (kV) fiberglass pin insulators. "The use of fiberglass and composite materials has shown promise for less buildup of salt," Coleman said.

The fiberglass pole-top pins are also taller, thicker and less susceptible to rust than their traditional metal counterparts, Coleman noted. "They can last 15 to 20 years instead of the usual five years of traditional pins," he said.

While Coleman acknowledged these pole materials come at a cost, he pointed out they help extend the life of the poles and reduce the cost of maintenance. "The total operation cost can be the same or lower," he said.

KEY TAKEAWAYS

- JEC's service territory is susceptible to strong winds, hailstorms, hurricanes and tornadoes—extreme conditions that frequently stress utility infrastructure.
- Part of the cooperative's energy resilience strategy is using direct, burial steel poles in locations that require extra support.
- The cooperative leverages 25-kV fiberglass pin insulators on utility poles when lines demonstrate a high failure rate.

Technology Enhancements and Relocations

Electric cooperatives now have more options than ever to strengthen utility pole infrastructure, including LifeJacket® technology enhancements and pole relocations.

FKEC Employs LifeJackets and Relocations

In the aftermath of Hurricane Irma, which knocked out power to more than 6.8 million people in September 2017, Florida Keys Electric Cooperative (FKEC) looked at ways it could mitigate the effects of future storms.

One of the key decisions the cooperative made was to leverage funding opportunities through the Federal Emergency Management Agency's (FEMA's) Hazard Mitigation Grant Program (HMGP). The program allocates funds to state, local, tribal and territorial governments to help communities rebuild after a presidentially declared disaster *(to learn more about FKEC's HMGP experience, turn to page 34).*

POLE LIFEJACKETS

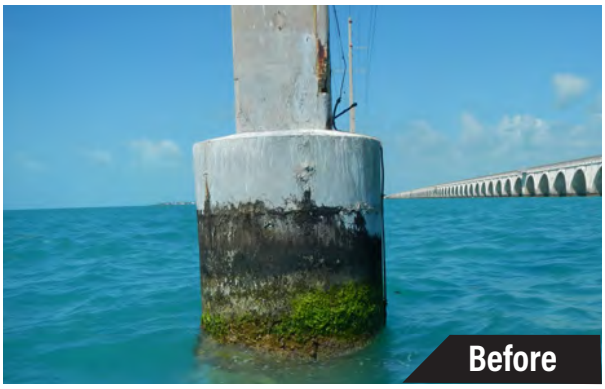
Among the hazard mitigation projects that FKEC proposed for HMGP funding was LifeJacket technology to protect the structural steel inside 114 water crossing concrete transmission poles in southern Monroe County. The poles showed signs of concrete cracking, spalling and corrosion—evidence of exposure to extreme environmental conditions.

The LifeJacket technology consists of two 50-pound zinc anodes and newly poured concrete.

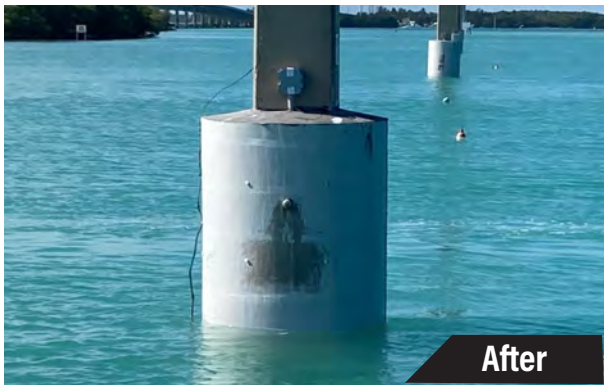
The LifeJacket technology consists of two 50-pound zinc anodes that significantly reduce corrosion and concrete spalling in future years and newly poured concrete to strengthen the foundation of each pole. The steel in the pole is connected to the new concrete foundation and zinc anodes.

"The LifeJacket technology provided a way to eliminate most of the corrosion and concrete spalling, while strengthening the pole in the process," said FKEC Planning, Rate and Budget Analyst Ray Rhash. "The end result is a longer life for the transmission water crossing structures and a more resilient grid for southern Monroe County."

(At the time of publication, this project is about 50 percent complete.)



Corrosion and concrete spalling was clearly visible on the transmission pole prior to treatment.



Following the treatment, the transmission pole shows no visible signs of corrosion or concrete spalling.

> **"The LifeJacket technology provided a way to eliminate most of the corrosion and concrete spalling, while strengthening the pole in the process."**
>
> — ***Ray Rhash**, FKEC Planning, Rate and Budget Analyst*

POLE RELOCATIONS

Erosion from Irma around one of the transmission structures at Sea Oats Beach in Islamorada required FKEC to make emergency repairs. The cooperative was keen to avoid additional costly repairs from future storm damage.

HMGP funding presented an opportunity to address this. FKEC opted to relocate 37 poles that make up a section of transmission line along Sea Oats Beach to the other side of U.S. Highway 1—the only highway connecting the Florida Keys to mainland Florida. The 37 poles are critical because they provide power to the entire Florida Keys.

Beach erosion from Hurricane Irma prompted FKEC to relocate 37 transmission poles along Sea Oats Beach to the other side of U.S. Highway 1.

"Failure of one of the transmission poles along Sea Oats Beach means a significant power outage for Florida Keys residents and closure of U.S. Highway 1," noted FKEC Director of Power Supply and Delivery Tom Anthony. "Relocating these poles decreases the likelihood of failure due to a storm surge."

Anthony added that it was not only a cost-effective solution, but environmentally friendly.

(At the time of publication, the cooperative has applied for and been approved by the Florida Department of Emergency Management and FEMA to relocate these transmission structures.)

KEY TAKEAWAYS

- **FKEC tapped FEMA's HMGP to help pay for several projects to mitigate the effects of future extreme weather events on utility infrastructure.**
- **LifeJacket technology was deployed to protect the structural steel inside 114 water crossing concrete transmission poles in southern Monroe County.**
- **FKEC relocated a section of transmission line along Sea Oats Beach in Islamorada to the other side of U.S. Highway 1—the only highway connecting the Florida Keys to mainland Florida.**

DISTRIBUTION SYSTEM HARDENING

Underground Lines

Undergrounding Distribution Lines

While switching from overhead to underground distribution lines isn't simple or cheap, some electric cooperatives have concluded there are long-term benefits of undergrounding lines.

Baldwin EMC Improves Restoration Efforts with Line Conversion

While replacing overhead lines with underground lines to improve resilience is nothing new, Baldwin EMC's experience is a little different. For starters, the move to replace above-ground power lines with underground feeders at two beach resort areas wasn't prompted by the Alabama-based co-op.

In Alabama, municipalities can request their electric utility to replace overhead lines with underground lines. The state has a provision that allows the utility to recover the costs through a surcharge on members' bills within the requesting municipality.

"Converting the beach areas to underground lines was a sizable investment made possible through the underground surcharge," pointed out Baldwin EMC CEO Karen Moore.

> "Our lines are less exposed to storm winds that impact the beach and our resilience has improved in these areas."
>
> — ***Karen Moore**, Baldwin EMC CEO*

Coastal erosion, which can wash away underground lines, has proved to be an occasional challenge. Moore recalled the aftermath of Hurricane Ivan in 2004 when she witnessed a "spaghetti of underground cables sitting on top of the sand and pad-mounted equipment flipped over and destroyed."

In certain areas, Baldwin EMC replaced all the conduits and conductors to restore service. Since that experience, the cooperative has required more heavy-duty concrete pads and stainless steel bolts to secure the equipment to the pad. It has helped significantly.

Ultimately, switching to underground lines using surcharge dollars was a win-win. "In most cases, it helped improve our restoration efforts," she said. "Our lines are less exposed to storm winds that impact the beach and our resilience has improved in these areas."

KEY TAKEAWAYS

- Baldwin EMC has long relied on the protection that comes from having buried portions of its distribution line that would otherwise face increased risk of damage from storms.
- Placing lines at beach areas underground improved the cooperative's restoration efforts in most cases, but it hasn't solved every problem, such as coastal erosion.
- The cooperative requires heavy-duty concrete pads and stainless steel bolts to secure parts of its underground line infrastructure.

CEC Protects Most Vulnerable Lines with Undergrounding

As a noneprofit distribution cooperative focused on keeping costs down for its members, Cherryland Electric Cooperative (CEC) is not in a position where it can replace every overhead line it wants to with underground distribution feeders. Instead, the Michigan-based distribution system uses a strategy that emphasizes moving its most vulnerable lines underground in phases.

CEC Engineering & Operations Manager Frank Siepker noted: "It is cost prohibitive to underground all areas of the system that we'd like to underground, but we underground portions of our system every year. Approximately 20 percent of the last two construction work plans have been dedicated to undergrounding our facilities."

Siepker said the cooperative targets areas of the system susceptible to tree damage, such as areas with hillsides and cliffs, where maintaining a 30-foot right of way offers little to no protection to outside lines from falling trees. "These are areas where uphill trees could fall on the line from much farther than the edge of the right of way," he said. "In some cases, it is literally hundreds of feet."

According to Siepker, one of the smartest decisions the cooperative made in recent years was replacing overhead lines with underground feeders on a peninsula between two lakes.

CEC linemen clear tree debris and prepare to pull conductors up from a river bed, while a bucket truck is used to reach a damaged overhead line.

> **"The decision to move the lines underground meant greater protection for about 100 residences."**
>
> — ***Frank Siepker**, CEC Engineering & Operations Manager*

"This was part of our service territory that was guaranteed to have outages every time a strong wind came out of the west," Siepker explained. "The decision to move the lines underground meant greater protection for about 100 residences."

The timing of the move could not have been better. CEC completed undergrounding the peninsula in 2014. One year later, a storm with 100 mph winds struck the peninsula, leaving a large portion of the area flattened.

"The underground section didn't have any line damage despite the fact that large areas did not have a single tree left standing," Siepker noted. "It would have been several days of work to replace poles and get the line back in the air if it had not been underground."

A CLOSER LOOK AT COST

While discussions about moving lines underground frequently center around cost, Siepker pointed out undergrounding is not always a more expensive option.

"Sometimes undergrounding lines can be done for little or no incremental cost compared to overhead line rebuilding, especially in very rural areas with a minimal number of transformers, and minimal road and paved driveway crossings," he said. "Direct burying by plowing cable into the ground is very labor efficient compared to setting poles, anchors and guy wires."

Siepker added that the cost of undergrounding ranges from less than overhead to 3 or 4 times the overhead cost. "But don't forget to factor in reduced annual operational costs of underground without right-of-way tree maintenance, pole testing, storm restoration expenses, etc.," he said.

While undergrounding portions of Cherryland's lines has been beneficial, it has come with some drawbacks, he said. "Underground cable can have a shorter life than an overhead line that you can essentially maintain forever with incremental pole replacements," Siepker said. "However, if overhead conductors are susceptible to extreme weather events, they will likely have a shorter life than the underground alternatives."

KEY TAKEAWAYS

- CEC uses a strategy that emphasizes moving its most vulnerable lines underground in phases.
- The cooperative targets areas of the system that are particularly susceptible to tree damage—such as areas with hillsides and cliffs, where even maintaining a 30-foot right of way offers little to no protection.
- Undergrounding is not always a more expensive option, particularly in situations where overhead lines must be rebuilt.

PLANNING FOR RESILIENCE

ERPs and Technology Planning

Emergency response plans (ERPs) have been a mainstay for electric cooperatives for years, but are now seeing a renewed focus in light of the increasing number of extreme weather events.

Baldwin EMC Emphasizes Continual Improvement with ERP

Some cooperatives that are exposed to high frequency extreme weather events have taken ERPs to the next level. One such cooperative is Baldwin EMC. Located in coastal Alabama, the distribution cooperative must contend with hurricanes, devastating winds, storm surges and flooding.

Against this backdrop, the cooperative takes a strategic approach to its ERP, particularly how it plans for and responds to large-scale events such as hurricanes. "The key is having a plan for the storm response process," said Baldwin EMC Senior Vice President for Finance and Accounting Alan Schott. "We learn a lot from every storm that comes through and apply what we learn to improve the process."

When Hurricane Zeta hit the northern part of Baldwin EMC's service territory in October 2020, the cooperative learned how to successfully and quickly redeploy resources within hours of the start of its restoration effort.

"The emergency response plan is really good at getting people into position quickly at the start of the storm response," Schott said. "We learned that we can reposition crews on different parts of the system within hours to get everything restored quickly."

> **"The emergency response plan is really good at getting people into position quickly at the start of the storm response."**
>
> — ***Alan Schott**, Baldwin EMC Senior VP for Finance and Accounting*

In addition to conducting an annual review and update of its ERP, Baldwin EMC holds debrief meetings with key staff following storms to assess which aspects of the storm response process worked well and what opportunities there are for improvement.

Following the response to Hurricane Sally, Baldwin EMC held a debrief session that was attended by 30 staff members from the cooperative's storm response team, including employees from senior leadership, field staff, member services and communications. The outside consultant who facilitated the session had an excellent process to draw out opportunities for improvement from all participants, Schott noted.

"We were organized into small groups to answer specific questions created by the consultant, then all groups reported out to the entire room," he said. "As a result, we developed consensus around 30 areas of improvement to strengthen our plan going forward."

STORM RESPONSE WORKFORCE PLANNING

One of the lessons Baldwin EMC learned from prior storms was the importance of having a plan to quickly expand the workforce. In a matter of days following Hurricane Sally, Baldwin's workforce of 200 regular employees swelled to more than 1,600 workers to repair storm damage throughout its service territory.

"We had a FEMA compliant contract in place for a logistics team to house, feed and fuel the contractors," Schott explained. "It worked very well, especially considering we had to operate in the COVID-19 environment where housing occupancy rates were capped at 50 percent."

Hurricane Sally was a particularly strong test of Baldwin's ERP because it combined the impacts of sustained winds of 110 mph with the complications of a global pandemic. During the hurricane response, Baldwin EMC "really cashed in on investments we made and lessons we learned from other storms," Schott said.

Baldwin operated two base camps for contractors: one at an office facility and the other in the parking lot of a local amusement park. Continuing the tradition of improving its ERP after each storm event, the cooperative has since concluded that it needs to own and control the land for both contractor base camps. It subsequently purchased and cleared land for that purpose.

TECHNOLOGY PLANNING TO ENHANCE RESILIENCE

While many of the logistics involved with Baldwin's storm response efforts are behind the scenes and not directly visible, members know immediately if technologies that enable member communications become inoperable during storm recovery—a time when member communications volume and criticality peak.

Baldwin's technology plan heading into Hurricane Sally left nothing to chance when it came to preserving communications channels with members and between employees. Each of the following pieces of technology infrastructure had redundant measures in place prior to Hurricane Sally:

- Electric service to Baldwin's headquarters was backed up with a primary and secondary generator.
- Fiber communications between Baldwin's offices were backed up with a microwave radio network.
- Internet service from Baldwin's offices was backed up by a second internet service provider.
- Phone connections into Baldwin's offices were backed up by a second telephone company.

When Sandy hit, every one of the power and communications backups were called into service. Members lost the ability to call Baldwin's outage center for one hour during the response, but Schott estimated members would have been incommunicado for over 18 hours without the backup telephone service.

All of these logistics and technology plans have meant slightly higher costs for Baldwin's members, but the benefits speak for themselves. "We've been very fortunate that our members have been willing to support these investments," Schott said. "They saw a return on that investment after Hurricane Sally in 2020 and will continue to see returns when future storms come."

KEY TAKEAWAYS

- **Baldwin EMC holds debrief meetings with key staff following storms to assess which aspects of the storm response process worked well and what opportunities there are for improvement.**
- **In a matter of days following Hurricane Sally, Baldwin's workforce of 200 regular employees swelled to more than 1,600 workers to repair damage.**
- **Every one of Baldwin EMC's power and communications backups were called into service when Sally hit.**

Funding

Some electric cooperatives are taking advantage of funding opportunities through FEMA to help pay for new investments relating to resilience and hazard mitigation.

FKEC Leverages FEMA's HMGP to Fund Key Investments

The initial cost of Florida Keys Electric Cooperative's (FKEC) four hazard mitigation projects *(see "FKEC Employs LifeJackets and Relocations" on page 25 to read about two of these projects)* was $26 million—an amount that would have been hard to justify on its own.

Thanks to careful planning, however, the cooperative was able to leverage funding through FEMA's Hazard Mitigation Grant Program (HMGP). Combined with the share paid by Key Energy Services, the public power utility for the Lower Florida Keys, FKEC's total cost for the four projects was $3.25 million.

PLANNING FOR PATIENCE

Electric cooperatives interested in leveraging funding opportunities through FEMA's HMGP should plan for the application and approval process to take time.

"With this being a national program, the application process itself can be quite protracted, especially when you also take into account what is required at the state level," said consultant Ferguson.

All HMGP funding projects in Florida must be approved by both the Florida Department of Emergency Management (FDEM) and FEMA, which can take a year or longer per project, according to Ferguson. "It took two years for the co-op (Florida Keys Electric) to win approval for its first mitigation project and three years by the time we received a recommendation from the state of Florida with pre-approval," he said.

One particular factor that affects how long the process takes, Ferguson notes, is personnel at the state level. "There's not really a lot of experts out there when it comes to things like the cost/benefit analysis and some of the FEMA policies," Ferguson said. "It's a lot of people who have done a little bit of it, but not a lot of it. Fortunately, FDEM does have several experts, which is instrumental in helping applicants in the state of Florida."

The bottom line, Ferguson said, is that patience is key. "It's likely going to take a while," he said. "If you are not in a position to wait on FEMA, I recommend not submitting a project proposal."

"FEMA's HMGP program is a great funding source for expensive mitigation projects," said FKEC CEO Scott Newberry. "Once a project is approved for funding, FEMA reimburses up to 75 percent of the total project cost."

Adam Ferguson, a disaster recovery and mitigation consultant with Tidal Basin Government Consulting, was hired by FKEC to assist with the application process. "Adam has a nuanced understanding of how FEMA works and all the legal aspects involved," said FKEC Planning, Rate and Budget Analyst Ray Rhash. "We could not have done this without him."

Ferguson's expertise came in especially handy during the pre-application phase, where proposed projects must be reviewed and scored by the county's Local Mitigation Strategy committee members before a formal application for funding approval is submitted to the Florida Department of Emergency

Management (FDEM) and FEMA. One particular challenge that Ferguson faced: FKEC's proposed projects did not look like the kind of hazard mitigation projects that were being approved.

> **"With each of FKEC's four projects, we really had to push the committee and FDEM outside their comfort zone."**
>
> — ***Adam Ferguson**, Disaster Recovery and Mitigation Consultant*

"Elevating homes, acquiring generators, making small drainage improvements, improving storm water capacity —these are the kind of projects that committee members associate with hazard mitigation," Ferguson said. "With each of FKEC's four projects, we really had to push the committee and FDEM outside their comfort zone."

A critical factor in determining whether a proposed project may proceed to the formal application stage is how well it scores based on a cost/benefit analysis conducted by the state of Florida. In this case, however, state officials worked collaboratively with Ferguson and FKEC.

"Due to the fact that these projects were so unique relative to what the committee normally reviews, the process turned out to be more collaborative," Ferguson said. "I give the state a lot of credit. They allowed us to be part of the process and present our case why we believed these projects were eligible."

In presenting to the state, Ferguson emphasized each project's connection to hazard mitigation, the cost effectiveness involved and the overall impact on county residents. "We had to demonstrate that these projects weren't simply capital improvements," he said.

In the end, all four of FKEC's proposed projects won approval. "It took quite a bit of time, but we batted four for four in getting funding approval for each of these projects," Ferguson said.

All approved projects are capitalized up front by applicants, then reimbursed by FEMA. While coming up with the capital can pose challenges for some applicants, Rhash says electric cooperatives have an advantage in this area.

"Co-ops have access to the capital markets through CFC," he said. "We can borrow the money to pay the amount that we're responsible for where other organizations in the county can't do that. That's another plus for co-ops in this program."

KEY TAKEAWAYS

- **FEMA's HMGP program helped FKEC pay only $3.25 million for projects that cost $26 million.**
- **With each of FKEC's four projects, an effort was made to push the committee and FDEM outside their comfort zone.**
- **In the case of Florida, a critical factor in determining whether a proposed project may proceed to the formal application stage is how well it scores based on a cost/benefit analysis.**

Funding Opportunities Available to Electric Cooperatives

For electric cooperatives, a key component of any plan to enhance resilience and natural disaster mitigation is knowing how to pay for new investments. With that in mind, it is important electric cooperatives are aware of the funding opportunities available through the Department of Energy (DOE), FEMA, as well as the federal tax credit opportunities for financing microgrid projects.

The $1.2 trillion Infrastructure Investment and Jobs Act, which was signed into law on November 15, 2021, allocates a considerable amount of funding to DOE for financing resilience projects, including: $5 billion over five years to states, utilities and power system companies for activities to enhance power system resilience; $5 billion over five years to state and local governments to undertake research, development and demonstration projects to enhance power system resilience; and $1 billion over five years for power system resilience improvements in rural areas. For more information about these infrastructure funds, contact NRECA.

In addition to federal mitigation and resilience funding, states may offer their own resilience or mitigation funding programs. Electric cooperatives are encouraged to contact their state's office of emergency management to learn more.

FEMA offers a number of funding opportunities through the Hazard Mitigation Grant Program (HMGP) to state, local, tribal and territorial governments to help communities rebuild after a presidentially declared disaster *(see "FKEC Leverages FEMA's HMGP to Fund Key Investments" on page 34)*. The specific types of grants awarded through the program depend on the mitigation activities that need to be implemented.

To support wildfire hazard mitigation measures, HMGP allocates funds for Post Fire grants. FEMA's Flood Mitigation Assistance Program provides grant funding for projects that reduce or eliminate the risk of repetitive flood damage to buildings and structures insured by the National Flood Insurance Program. FEMA also makes grants available through the Building Resilient Infrastructure and Communities program to support investments that enhance resilience for communities. The agency also offers funding through the Resilience Grant Program to support those located in high-risk earthquake areas.

Electric cooperatives cannot apply for these grants themselves. However, a state or local municipality can apply for FEMA funding on behalf of a cooperative. Visit www.fema.org or contact your local emergency management office for more information.

Federal tax credit opportunities are also available to finance microgrid projects. Microgrids can significantly improve a community's energy resilience by ensuring hospitals, transit centers, emergency shelters, businesses and other essential services have access to electricity during an outage.

Federal tax credits for microgrids include the production tax credit, which covers utility-scale renewable energy installations, and the investment tax credit, which supports smaller renewable energy and cogeneration installations. However, tax credits can only benefit for-profit microgrid projects and cannot be used directly by tax-exempt organizations. A tax-exempt organization can access the tax credits by partnering with a for-profit entity.

We hope you find this and other CFC publications as useful and interesting as we find the process of creating them. As always, please share your thoughts, suggestions and questions with us. If your co-op has a resilience story to share, CFC would love to hear about it. Contact **Jan Ahlen**, VP, Utility Research & Policy at: jan.ahlen@nrucfc.coop and **Rick Taylor**, Strategic Communications Specialist at: rick.taylor@nrucfc.coop.

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National Rural Utilities Cooperative Finance Corporation
800-424-2954

National Rural Utilities
Cooperative Finance Corporation

20701 Cooperative Way
Dulles, Virginia 20166
703-467-1800
www.nrucfc.coop