CFC ISSUE BRIEF

Co-ops See Movement Toward Virtual Power Plants

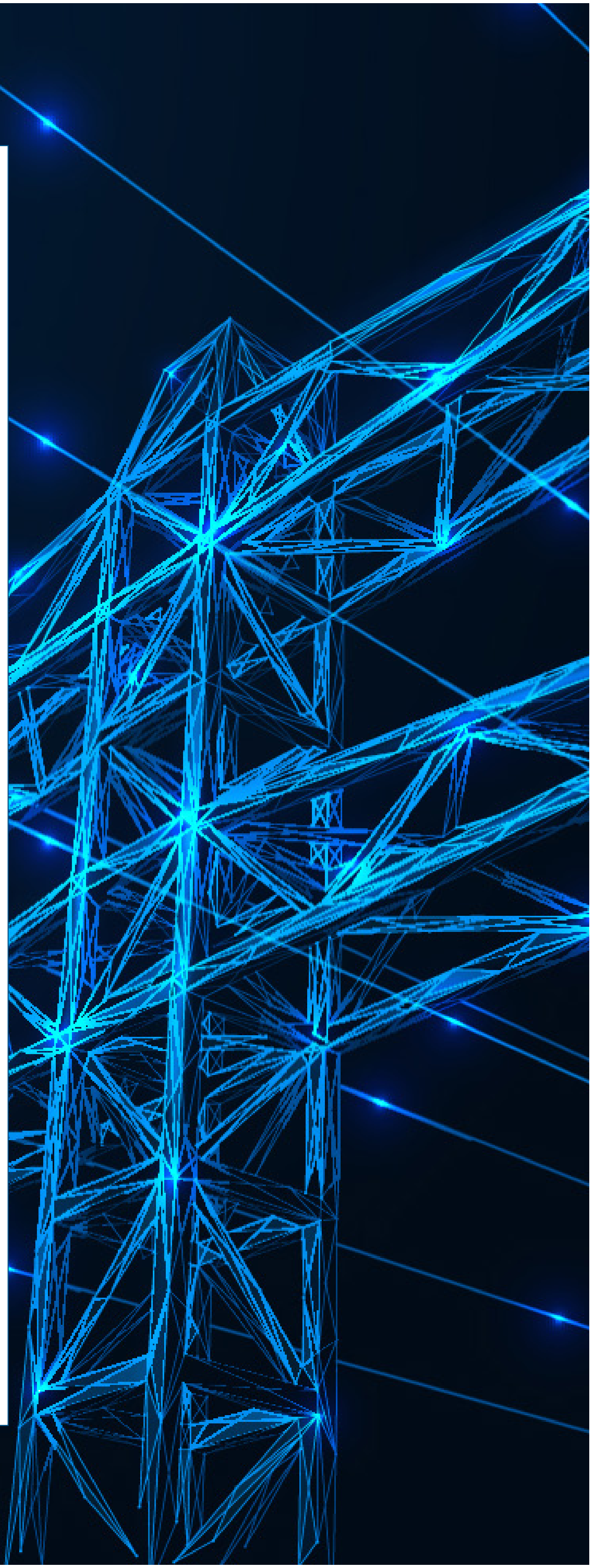
National Rural Utilities Cooperative Finance Corporation

Introduction

“Virtual” is a term that is often overused in today’s world. In the electric utility industry, it is being used more frequently as interest grows in the concept of a virtual power plant (VPP). At first glance, it may be tempting to dismiss this term as an attempt to attach a new label to the same demand-response programs that G&T and distribution cooperatives have operated for years. However, what sets VPPs apart from previous programs is that they incorporate key elements of traditional demand response with various types of resources—including distributed generation units, batteries and controllable end-use devices, such as water-heater controllers, smart thermostats and electric vehicle (EV) chargers.

VPPs offer greater flexibility and use cases than traditional demand-response programs. G&T and distribution co-op operated VPPs can be dispatched to meet local grid needs or sold as resources to the wholesale power market. A VPP can address a variety of needs, including peak-load reduction, voltage regulation, local grid stability or revenue generation.

VPP components will often be owned by individuals or commercial companies that can work in partnership with their local co-op. Components can be mixed and matched to achieve the necessary outcome. G&T and distribution co-ops will be in the best position to determine how to maximize the value of a VPP to improve grid reliability and resiliency.



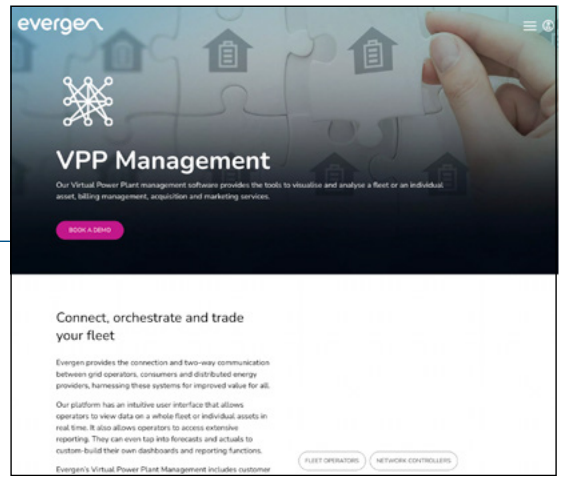
VPP Technologies

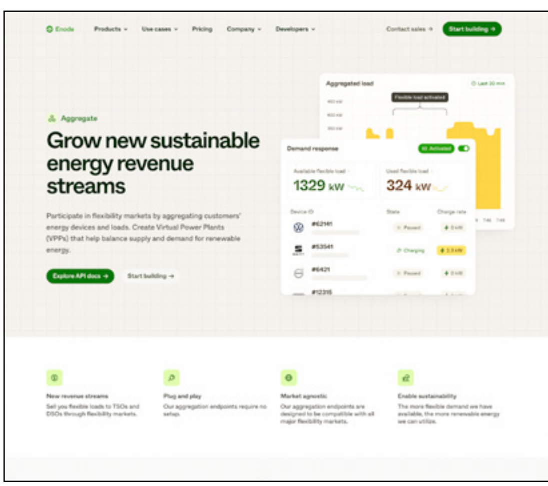
Some of the resources that are used for VPPs include:

- Rooftop solar
- Behind-the-meter energy storage
- Smart thermostats and HVAC equipment
- EVs and EV chargers
- Smart appliances

Control Systems

In addition to having the appropriate mix of resources, VPPs require a control system for the operator. For many utilities, this control system will include a distributed energy resource management system (DERMS). These platforms manage groups of DERs to meet the needs of the utility. This is currently done through the traditional use of demand response where devices such as water heaters, HVAC and EV chargers see reduced usage during peak load periods. Utility DERMS platforms will have to adapt to the specific needs of utilities to add VPP functionality. There may be use cases that require additional software.





Possible Virtual Power Plant Use Cases

An electric cooperative can use a VPP to improve the management and optimization of DERs located within its service territory. The system or its members can own the DERs. Here are a few ways that a cooperative might use a VPP:

Aggregation of DERs

A VPP allows a cooperative to aggregate and coordinate the output of DERs located on the system. Solar panels, wind turbines and battery storage systems can be coordinated to function as a single, centralized power plant. This enables the cooperative to better manage and optimize the use of resources to help ensure grid reliability. Energy storage could be the key enabling technology.

Grid Integration

A VPP could help a cooperative integrate DERs into the grid. The VPP can monitor the grid and adjust the output of the DERs to match the changing demand for power. For example, EV chargers can receive a signal to charge or water heaters can be activated during periods of excess generation at the local feeder level. This can help improve the stability of the grid and reduce the need for expensive grid upgrades. Advanced software controls are critical for this use case. Pilot tests and further understanding of the cost and benefits are still needed.

Ancillary Services

A VPP can be utilized to provide ancillary services to the grid, such as frequency regulation and voltage support. This can help to reduce costs for the system and its members and provide additional revenue streams for the cooperative and/or DER owners.

Demand Response

A VPP could manage demand from the cooperative's members. In many ways, these are the traditional demand-response programs that cooperatives have operated for years. The key difference is the use of smart devices such as smart thermostats, EV chargers and smart water-heater controllers instead of traditional load-control switches.

Member Engagement

A VPP could be used to engage members in the cooperative's energy management, helping members and the organization realize cost savings. For example, the VPP can provide members with information about their energy usage and allow them to participate in utility programs designed to meet the changing needs of the grid. This can help to increase member satisfaction and engagement with the cooperative. Individual members would enroll smart devices or their generation resources and receive compensation in a prearranged manner.

VPP Technologies

A key difference between a VPP and past demand-response programs is frequency of use. Traditional demand-response and curtailment programs are used sparingly. Many utilities use demand response on peak power days or use the program during grid emergencies to prevent larger disruptions.

The variety of resources that can be deployed with a VPP gives electric utilities more options. For example, programs can rely on behind-the-meter energy storage owned by individual consumers to meet everyday needs.

One area of potential concern is reliability. For a VPP to be successful, the resource must always be there when the utility calls upon it.

Having the right software is also essential to the success of any VPP. The software needs to be able to not only properly communicate and dispatch the different resources but also ensure that consumers are not inconvenienced. For example, batteries will need to retain sufficient charge in the event the owner experiences an outage and needs the system for backup power.

Flexibility and adaptability are key attributes of a VPP. The way one electric utility implements a VPP could be very different from another implementation. The flexibility allows for the system to potentially meet the unique needs of the local or regional grid.

Select Pilot Program Results

VPP pilots are a mix of utility and 3rd party controlled small scale pilots. Results may not be transferable to all areas of the country as demographics and local conditions will play a large role in a projects outcome. G&T and distribution co-op staff will be in the best position to understand how a VPP could benefit the local grid.

During the summer of 2022, a multi-state VPP was operated by Sunrun. The pilot took place in Massachusetts, New Hampshire, Rhode Island and Vermont. Sunrun coordinated the output of 5,000 small solar energy systems with energy storage systems. Over the three months of the pilot program, Sunrun claims its VPP shared 1.8 GW hours of energy with the grid. Sunrun designed the system to produce energy for the grid between 1 and 5 p.m. (Source: EnergyWire)

Tesla operates VPP pilot programs in several markets. Tesla's California Powerwall users can opt into a Tesla VPP through its mobile app. Tesla will discharge users' Powerwalls during grid emergencies. Users are instructed to set their Powerwall's backup reserve level to a minimum that the individual is comfortable with. Tesla advises that rolling outages could be 90 minutes in duration. Tesla does not compensate its users for their participation. Pacific Gas and Electric Company (PG&E) customers that are part of the Emergency Load Reduction Program pilot test receive $2 for every kWh delivered during called events. Tesla has activated up to 4,500 Powerwalls in PG&E's territory. This contributed 30 to 32 MW of peak power. (Source: Teslarati)

Green Mountain Power, an investor-owned utility in Vermont, has incentivized behind-the-meter energy storage since 2015. On July 20, 2022, Green Mountain Power dispatched 20 MW of capacity in response to rising costs from a heat wave. The effort saved the utility and its customers $1.2 million in peak demand charges. The utility realizes typical annual savings of around $3 million from its program. (Source: Canary Media)

Role of Third Parties

Existing pilot tests have mostly focused on discharging energy storage systems. VPP proponents envision greater coordination among all of the resources behind the meter. The trend toward a more distributed grid using variable resources has increased interest in the VPP format. Federal Energy Regulatory Commission Order 2222 allows third-party organizations to control DERs and place them into wholesale markets. The order does have a small utility exemption that allows most cooperatives to retain control over resources within their service territory. The rulemaking process at the regional transmission organization and independent system operator level has been slow to implement rules allowing third-party coordination.

The impact that a third-party operated VPP would have to a cooperative is unknown at this point. It is reasonable to assume that multiple VPP providers operating within a cooperative's service territory will require coordination to ensure reliability is not negatively impacted. Cooperatives may also be concerned about the effect third-party providers would have on the cooperative-member relationship.

Next Steps

Interest in VPPs is expected to grow as more residential and commercial members install DERs and smart devices, traditional baseload generation is retired, extreme weather events impact grid operations and non-utility providers see an opportunity to enter new businesses.

G&T and distribution co-op staff may investigate and increase their understanding of the amount and type of behind-the-meter smart devices installed within the service territory and the value these devices could provide existing demand-response programs.

Additional pilots focused on deploying VPPs to assist in grid reliability and resiliency are needed to further the understanding of how these resources can be deployed and to convince individual members that their devices can be used by the cooperative without inconvenience.

CFC CASE STUDY ▶

Texas' Bandera Electric Employs Member-Centric Approach to VPP Concept

BANDERA ELECTRIC COOPERATIVE

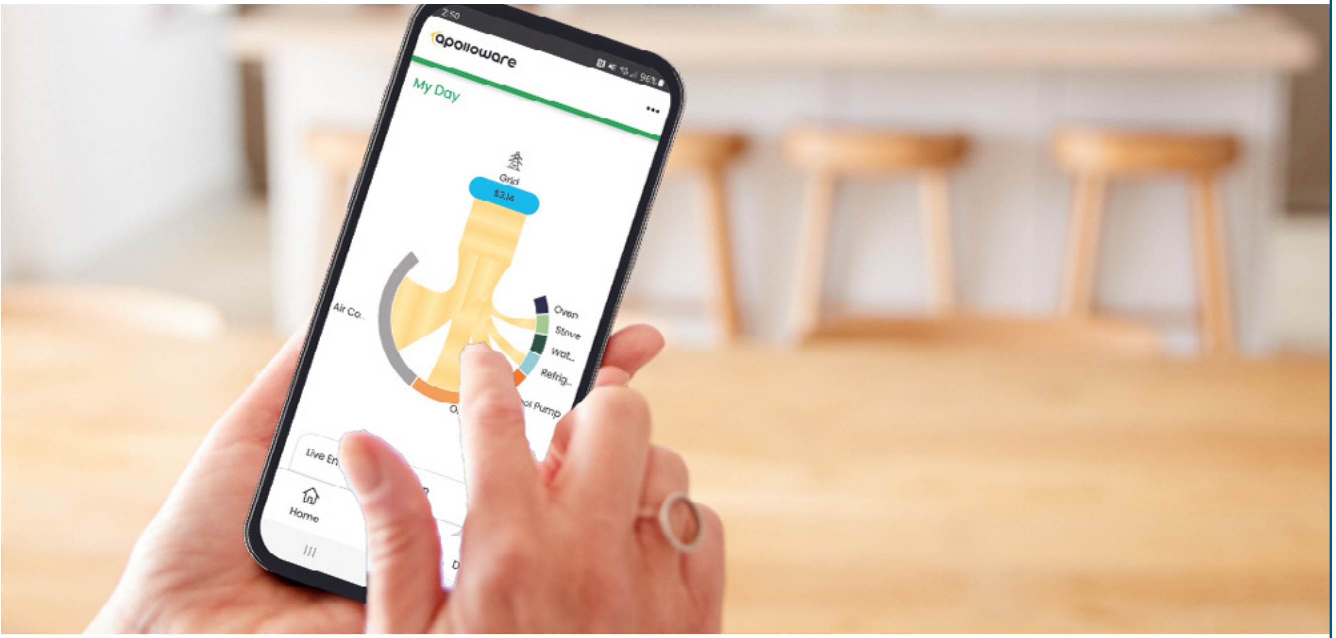
BANDERA ELECTRIC COOPERATIVE

CFC CASE STUDY:

Texas' Bandera Electric Employs Member-Centric Approach to VPP Concept

Bandera Electric Cooperative (BEC) is a Texas-based distribution system with 28,000 members and more than 41,000 active meters across seven counties in Central Texas. The cooperative employs 130 people, and operates and maintains more than 4,800 miles of distribution lines, 106 miles of transmission lines and 2,500 miles of fiber. BEC's broadband business serves 12,000 subscribers.

BEC has developed a member-centric approach to energy management and the application of the VPP concept. BEC staff sought to create a program that focused on education and empowerment to meet members' needs. The cooperative also focuses on the "sovereignty of the interconnection." This ensures that BEC is able to obtain the necessary aggregate data to maintain grid reliability rather than relying on third-party vendors to obtain aggregate data on behind-the-meter devices.



Members join the program and receive access to the Apolloware software and an energy audit.

Apolloware is a tool to educate and empower members. It is a secure, cloud-based energy management system that helps members visualize and have greater control of their energy usage.

The Apolloware Control Module (ACM) can be installed on residential and commercial buildings, where it monitors various appliances, solar panel power and inverters and electric service circuits. The ACM transmits these data to a secure Apolloware cloud using the local internet connection. Homeowners can view the data from any device through the Apolloware mobile app or website.

BEC staff do not believe their members would be willing to give complete control of devices—such as thermostats, energy storage and distributed generation—to the cooperative or a third party. Instead, BEC focuses on using the technology to enhance its position as the local trusted energy adviser to make recommendations to members. This member-centric approach is vastly different from the approach that third-party providers often take—a command-and-control philosophy with payments to the end-use consumer.

The cost for a member to sign up for the Energy Saver Program is $16 a month for 120 months. Participants are seeing average savings on their electricity bills of $22 to $25 a month.

In August 2022, the Public Utility Commission of Texas (PUCT) established the Aggregated Distributed Energy Resources Pilot Project (ADER Pilot Project). The ADER Pilot Project and a 20-member task force were established by PUCT. BEC's General Counsel, John Padalino, has been a task force member since its inception. The task force assists PUCT and ERCOT by ensuring public transparency, providing subject matter expertise and facilitating stakeholder collaboration with ERCOT. The ADR Pilot Project will continue to collaboratively develop solutions until permanent rules are developed for ADER participation in the market or until PUCT and ERCOT deem the lessons learned from the pilot project are complete. According to the PUCT, "the pilot will answer how aggregated distributed generation can support reliability, enhance the wholesale market, incentivize investment, potentially reduce transmission and distribution investments and support better load management during emergencies." **(Source txses.org)**

During Winter Storm Uri in February 2021, BEC advised its members on steps they could take to help maintain grid stability. Because of the accuracy of Apolloware and the actions of its members, the cooperative was able to identify line faults and better engage with its members. The system received a 92% member satisfaction rating for its response to market volatility.

BEC currently has 1,500 members participating in the Energy Saver Program. Across the country, many electric cooperatives and municipal utilities are in the process of deploying systems in their own service territories.

apolloware

Apolloware's one-second telemetry provides several grid benefits to BEC. The cooperative uses the tool for:

- Behind-the-meter device aggregation—which provides enhanced distribution planning.
- End-of-line monitoring—54% of feeder installations provide real-time data of voltage anomalies and outages (blinks).
- Rural Energy Savings Program (RESP)—this USDA-certified energy measurement and verification device has allowed BEC to obtain RESP 0% financing for energy improvements over the last 20 years.
- Energy analytics to balance loads on feeders—which reduces losses and delays system upgrades.
- In-line monitoring—which provides real-time data on line segment overloads prior to an outage.

For more information about VPPs for cooperatives, contact your regional vice president or Jan Ahlen, CFC vice president of Utility Research & Policy, at jan.ahlen@nrucfc.coop.

Systems with questions about Bandera Electric Cooperative's VPP pilot program may contact BEC CEO Bill Hetherington at b.hetherington@banderaelectric.com.

National Rural Utilities
Cooperative Finance Corporation

www.nrucfc.coop