Business & Technology Report

**February 2020**

# Turning Numbers Into Action:

## Analytics Brings Visibility To Utility Operations, Clarity To Decision-Making

**(Part 1 of 2)**

NRECA

America's Electric Cooperatives

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## Analytics Brings Visibility To Utility Operations, Clarity To Decision-Making
### (Part 1 of 2)


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NRECA
America's Electric Cooperatives

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# 1. Executive Summary

### What Has Changed?

Electric cooperatives are collecting enormous amounts of consumer and operational data every hour. The data collected from advanced meters can be used for much more than preparing monthly consumer bills. Applying analytics to this data reveals a broad range of actions that can save money and improve service. Analytics can be applied to all aspects of the cooperative business, from better detection of line losses, to staying ahead of the impact of changing weather patterns and consumer preferences.

### What Is The Impact On Electric Cooperatives?

In an era of declining power sales and increased competition, the application of analytics – turning raw data into actionable programs – can mark the difference between struggle or success. Analytics empowers decision-making, allowing staff to better see and react to what is occurring on the utility system. In advanced applications, analytics can help cooperatives anticipate change, leading to accurate and timely investment in resources and programs.

### What Do Co-ops Need To Know/ Do About It?

The sheer volume of data pouring into the databases of the average electric cooperative can be intimidating. Cooperatives need employees who are comfortable with data and software, and capable of running queries that sift and sort for the information essential for effective action. The expanding suite of information software available through trusted partners makes basic analytics accessible to cooperatives of all sizes and consumer demographics.

# 1. Introduction

The consumer usage and operational data received by electric cooperatives that began as a small stream a decade ago has accelerated into a torrent. The majority of this data is delivered by the advanced metering infrastructure (AMI) that as many as 70 percent of the nation's cooperatives have installed. AMI replaces automated meter reading (AMR), and its monthly reads of consumer energy demand, with meters that provide a detailed suite of information updated in 15-minute intervals. A cooperative with AMR collects 12 meter reads a year for every consumer. A cooperative with AMI takes in 34,944 reads a year from each consumer meter.

One of the key challenges facing electric cooperatives is how to use even a portion of this new data for more than the preparation of a monthly power bill. Cooperatives are just starting the transition to a more complex – and potentially highly rewarding – practice of applying analytics to this data repository. Analytics can extract information from "big data" and turn it into actionable reporting that can impact critical business decisions at the cooperative.

This data, which also comes from sensors on power lines and in substations (and from other elements of what are now termed Advanced Distribution Management Systems), has the potential to provide significantly more information than ever before about the operating status and characteristics of utility infrastructure, as well as how and when consumer-members are using energy. This two-part Business and Technology Report explores how electric cooperatives are beginning to use analytics to make productive use of at least a portion of the data now accessible to improve service, save money, and more effectively plan for the future.

The use of data analytics is well-established in traditional competitive product marketing. Technology giants like Amazon and Google are entirely driven by analytics. Electric utilities may not – yet – depend upon analytics for market share and business viability. But, it is a tool that cooperatives are using to optimize performance and efficiency.

The use cases and case studies presented here are chosen to demonstrate lessons learned in a variety of applications that are especially relevant to and accessible by small- to medium-sized distribution cooperatives. The primary research for these reports included in-depth interviews with more than 15 distribution cooperatives with an average of 29,000 meters. These cooperatives are exploring and using a diverse set of analytics tools, from early stage to advanced.

## Data Analytics? We Can't Afford Not To

Tim Lindahl, CEO of Wheat Belt Public Power, a 5,016-member utility in western Nebraska, is convinced that for many utilities like his, data analytics will spell the difference between thriving and struggling. He says that for a small, rural cooperative, especially one in an area without a lot of load growth to offset rising costs, "the only way to survive is to become more efficient. Data – managing and using the data we've become inundated with - is a key to increasing efficiency."

Two years ago, Lindahl created a position at Wheat Belt for a data scientist. He relates that a CEO from another co-op asked him how a co-op of his size could afford the hire. "My response was, 'how can you afford not to?'," Lindahl says. "I believe a lot of utilities are missing the boat when it comes to analyzing data – they are not looking at the return that you can get from the investment."

Wheat Belt's data scientist was tasked to help the cooperative reduce overall technical losses by one percent. Lindahl says that the initial effort focused on low-hanging fruit – the problems that may have been hidden for years that could be unearthed by analyzing system data in new ways. The effort paid off quickly. For example, through data forensics Wheat Belt discovered that one of its substations, in a system that overall averages technical losses of six percent, was registering losses of 21 percent. Use of data analysis revealed the source to be changes in how power was being used – in this case, the conversion by farm operations to irrigation motors that were different and more powerful than those in place when the substation was designed 20 years earlier.

Lindahl believes that the development of effective and easy-to-use analytical tools presents a significant opportunity to cooperatives of all sizes to reduce costs today. The next and potentially more dynamic phase of utility analytics he says will be a shift in emphasis from reactive to predictive analysis. This will help cooperatives do everything from minimizing the impact of weather events to staying ahead of changes on the consumer side of the meter.

# 2. How Analytics is Evolving into a Core Cooperative Practice

The use of data analytics can be viewed as a three-stage process, with each stage overlapping the next.

The first stage is to use a software program to create reports from cooperative databases on past and current conditions within the utility system. With the use of graphics, these reports can make the information visually appealing and easy-to-digest. These reports are a useful way to inform other departments and senior decision makers on the state of the cooperative in a variety of areas. Ideally, this information will more precisely measure the impact of system upgrades and investments, and the performance of utility programs.

The second stage produces actionable information – leading to better-informed decisions about where to next spend time and resources to address present and near-term issues.

The third stage, one a smaller number of cooperatives have reached, uses data in predictive fashion, identifying patterns that can lead to partially- or fully-automated changes in how the grid adjusts to changing conditions. Examples include hardening the grid in advance of a weather event, to getting ahead of changing loads and consumer behavior. This includes the use of sequential learning software, and eventually the use of artificial intelligence and machine learning, to automate changes without the need for human intervention at every step.

Several of the cooperatives interviewed questioned whether what they are currently doing with data can accurately be termed ‘analytics,’ rather than simply a different way of information gathering. The use of analytics is in its early stages – “just the tip of the iceberg” is how one cooperative employee termed it. Also new is simply the ability to collect data. Consumer meters are at the heart of data available to cooperatives. But, the transition from AMR to AMI is still underway, with perhaps 30 percent of co-ops still without the “smart” meters of AMI. Even within the AMI-enabled cooperatives, those utilizing data beyond the calculation of monthly energy charges are a small minority.

Still, change is evolving quickly – and one striking conclusion is that progress and leadership in analytics does not necessarily correlate to numbers of consumers, the size of staff, or the depth of financial resources. Research for these reports reveals several small- and medium-sized cooperatives with limited staff and financial resources are doing creative and highly-effective things with data.

## Barriers To Making The Most of Data Analytics – Insights From Cooperative Staff

- *"If you are the only person at your cooperative analyzing data – it can be overwhelming."*
- *"It needs to be a co-op wide initiative – and this requires getting someone at a higher level to buy in to the value."*
- *"Why aren't co-ops doing more with the sources of data they already have? In many cases, it is a lack of awareness or a lack of staff resources – people are already wearing multiple hats."*
- *"We need to be able to show that using data can make your job easier and allow you to work smarter. Instead of waiting until we get a call from a member to discover that we have a voltage issue, we can use data analytics to prevent the problem in the first place."*

## Growing Pains – One Cooperative's Experience with the Challenges and Opportunities Surrounding Analytics

Wake Electric Membership Corporation, a 46,000-meter cooperative in Youngsville, North Carolina, is a good example of how data analytics is changing operations and expectations at a medium-sized cooperative. Kelly Fritz, Wake EMC's manager of information systems, was hired 11 years ago to lead the Geographical Information System (GIS) team and pursue new integration opportunities at the cooperative. At that time, he says, there was no AMI and no SCADA at Wake EMC. The co-op's outage management system was "still in its infancy." Fast forward to today and he says, "The difference is night and day."

Fritz notes that a key tool to making data actionable is its National Information Solutions Cooperative (NISC) meter data management (MDM) software. With the MDM, Wake EMC can validate, edit and estimate meter data, resulting in better reports. This led to the roll-out of money-saving initiatives, like its conservation voltage reduction (CVR) program which leverages the capabilities of its Sensus AMI meters to provide feeder-level voltage levels readings at five-minute intervals. The successful integration of core systems with the CVR application

"helped open the eyes of people in other departments, "says Fritz, and he and his small team welcome inquiries for data analysis from staff throughout the cooperative. "They realize that we have resources and capabilities that can be of real value to them in their everyday work."

However, Wake EMC has had to work through challenges to achieve success with data analytics. The first is the quality of the data. "We really focus on the accuracy of the foundational data. If the information at the foundation is not accurate, it skews the analysis results. An error in the data that flows into an engineering model, into an outage management model, that affects our people in the field. If it's incorrect, they won't feel confident in the decisions they need to make." Fritz says that the pursuit of data accuracy involves checks and balances and procedures to keep things on track. "It's an ongoing process that is never done," he says.

Another issue is integration. "There are so many discrete systems and not all applications play well together," says Fritz. "This is where a lot of co-ops are struggling." Wake EMC relies on MultiSpeak® wherever possible for software integration. But, he says, "many vendors may claim to be MultiSpeak-compliant. If it's an older version, the integration can be sloppy – and some vendors prefer to use their proprietary integration."

# 3. Three Case Studies: Working with Technology Partners to Increase Visibility and Solve Problems Through Data

A cooperative's enterprise IT vendor – for the clear majority of electric cooperatives, this will be either NISC or SEDC (Southeastern Data Cooperative) – can provide many of the tools needed for data analysis and report generation. The following case studies look at how three cooperatives are working with their IT partners to use data analytics to improve a variety of core operational and consumer-facing functions at the utility.

- ***Case study #1 – Noble REMC, Indiana***

Noble REMC
A Touchstone Energy® Cooperative

Noble REMC in Albion, Indiana provides an excellent example of how a smaller electric cooperative (11,161 consumers) can leverage the advantages of an advanced metering infrastructure (AMI) and work with its enterprise IT provider to use analytics to reduce outages and save money for its consumer-members and better manage its distribution system.

The changes at Noble REMC center on the granularity and timeliness of consumer information delivered by its radio frequency (RF) AMI, and the willingness of the Noble REMC staff to work through the learning curve of applying analytics to the data. The metering system from Elster (now Honeywell) replaced an aging power line carrier automated meter reading (AMR) system in 2014.

"We didn't have a lot of choice," says Kenny Kill, who joined the staff at Noble REMC as system engineer shortly before the conversion. The meter reads from the old mechanical devices came on a 26-hour interval and inaccuracies increased the number of manual readings by the week.

"Once in place, the AMI has proven to be more valuable than anyone could have anticipated," says Kill. The new AMI provides readings at 15-minute intervals. Right away, the cooperative began saving money by reducing static line losses, eliminating disruptions of meter readings with the power line carrier system when equipment changes were made at substations, and by the ability to ping the meter to check for voltage when a consumer called with a problem, reducing truck rolls.

"I did not arrive at Noble [from a position at a municipal utility] thinking about analytics," says Kill. But, the availability of accurate and timely data triggered a

change. From an emphasis on hardware and physical infrastructure, Noble REMC's engineer began to see his job in terms of how the interval data could help the cooperative not only manage the system more efficiently, but also perform engineering analyses that identify issues before they become costly problems.

The biggest gains came in system visibility. Kill first focused on transformer health, producing system models accessed from the meter data management (MDM) software provided by the co-op's enterprise IT provider, the National Information Solutions Cooperative (NISC). The MDM exports data to a system modeling and analysis software named the Distribution Engineering Workstation (DEW). The DEW ties in interval data, outage management software (OMS) reports, and geographical information system (GIS) mapping to provide Kill with close to a real-time window on the health of the Noble REMC system.

The first application of the software at Noble REMC was to flag transformer loading anomalies on the distribution system. Two years ago, in the middle of winter, Kill received a report through the DEW that a transformer serving one residence was critically overloaded. Driving to the residence, Kill found that the heat from the pad-mounted transformer had melted the snow in a one-foot radius. Unbeknownst to the cooperative, the homeowner had replaced a propane heating system with a geothermal heat pump, and due to insulation issues, the heat pump's resistive heating elements were working overtime. In addition to alerting the homeowner to the efficiency issue, Noble REMC replaced the transformer with one capable of handling the larger [electric heating] load.

"Before using analytics, we would only have known about the problem after the transformer burned up and caused an outage," says Kill. He and his team are now able to alert consumers to a range of problems on their side of the meter. "Not only can we detect and resolve outages before a homeowner returns home from work, but we can tell them if they are suddenly using more power than usual and help trace the issue to things like a failed well pump. The member reaction has been very positive – they feel that we are really on top of things now."

Noble REMC is a summer peaking utility, and in the past its peak load analysis stopped there. Now the cooperative crunches data for every season, and as a result, tracks the types and timing of demand that contributes to peak loads throughout the year. With this information, Noble REMC can take steps to increase efficiency and reduce costs, from targeting its plans for line reconductoring to developing peak shaving incentives.

Thanks to the capabilities of its smart meters and its analytics software, Noble REMC can track voltage levels and initiate demand response programs like

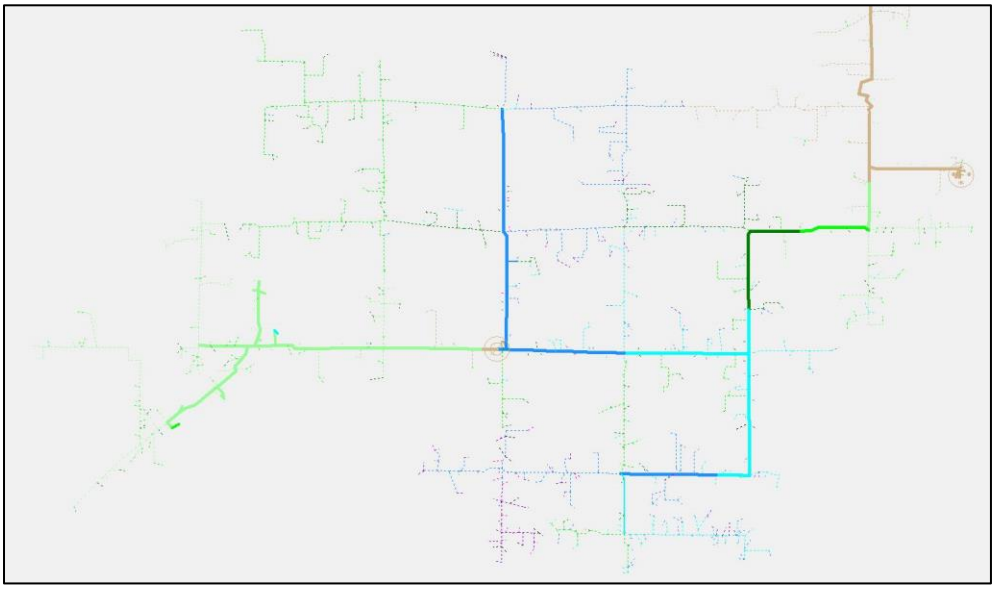
thermostat control, with visibility to every device on the system, not just the transformer.

The capability of the DEW software to model changes to the delivery of power throughout the distribution system in the interests of resiliency and rapid outage response was put to the test one evening in February of 2019. An airplane hit a nearby transmission line, knocking out service to two of the cooperative's larger substations. Noble was able to quickly run scenarios on the safest and most effective means to switch power delivery to work around the affected equipment and restore service quickly. Initially, 2,500 cooperative consumers were out of power, but service was restored to all within four hours (the neighboring investor-owned utility experienced an outage of 16 hours because of the same accident).

"Without the analytical tool, we wouldn't have been sure of having good voltage support at the end of the line," says Kill. And once the system was stable and service restored, Noble REMC ran a validation check and found that the amperages as calculated by the DEW software were very close to the actual measurements recorded by the SCADA system.

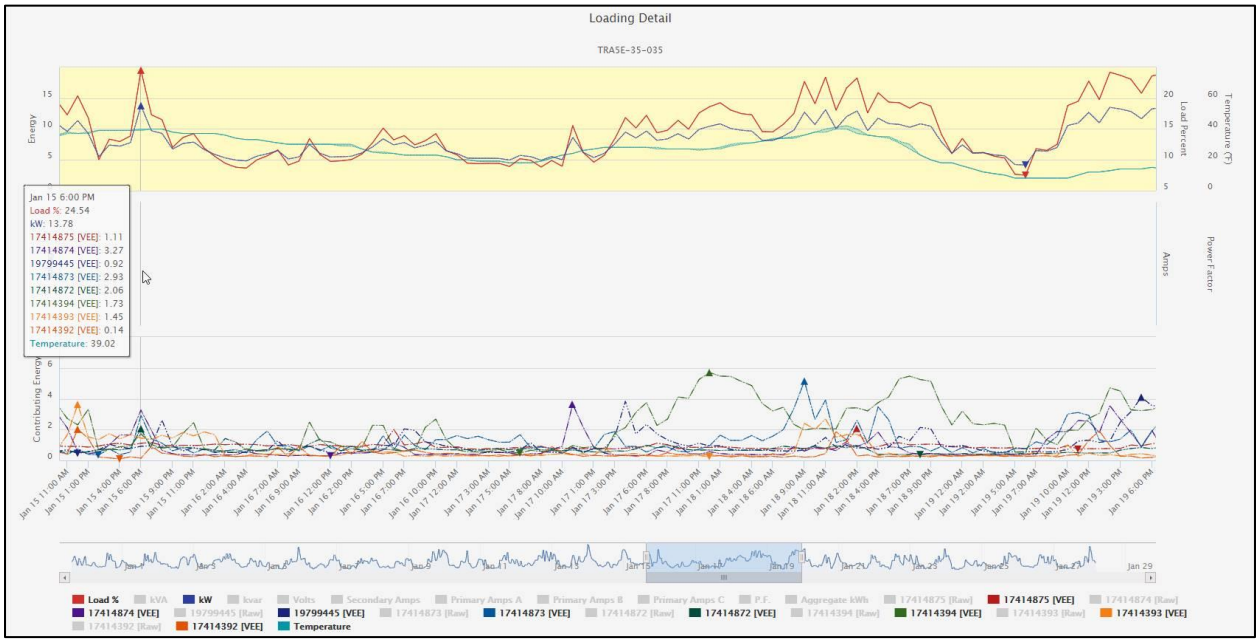
"That was when we really knew that we could trust the calculations," says Kill. "And now we know just what to do in the future."

**Noble REMC Figure 1.**



Noble REMC system model overlaid with calculated voltage data on a hot day in June. The feeder head is at the right of the picture denoted by an encircled F. A downline voltage regulator can be seen in the lower center actively raising the line voltage. The blue colors are feeders slightly below normal range, green colors are normal, and brown is slightly above normal.

**Noble REMC Figure 2**




Detail screen of Noble REMC transformer loading tool, with a focus on one 50 kVA transformer in a subdivision with 8 homes connected to it.

- ***Case study #2 – Central Georgia EMC***

Central Georgia EMC, a 58,000-meter cooperative in Jackson, Georgia, is using data analytics to tackle complex engineering issues, such as optimizing system loss and maximizing load shed capabilities under peaking conditions, as well as the non-technical, such as helping with staffing decisions and monitoring accounts to minimize bad debt.

Ben Thomason, the cooperative's chief operating officer, notes that with "billions of data points coming in to our system every year" from the Landis and Gyr radio frequency AMI system installed in 2017, along with other sources, "the traditional ways of managing data using Microsoft Excel or Access don't cut it anymore". This has prompted the cooperative to use an analytics data management tool called ReportIQ, a software platform available from its IT enterprise provider SEDC (Southeastern Data Cooperative). Users can customize reports from a variety of data sources and deliver results in dashboard visual display formats that simplify results for decision-makers.

Thomason says that the software is sufficiently user-friendly to allow employees in different departments to independently create and run customized reports without needing further support from SEDC. “Now we’re able to use data to make tremendous improvements,” he says.

Prior to installing the ReportIQ platform, Central Georgia tackled a major distribution automation project through the implementation of a fault location, isolation and system restoration (FLISR) program. The FLISR system utilizes automated switching to quickly pinpoint and isolate faults, minimizing disruption to consumers in the event of an outage. Central Georgia’s System Average Interruption Duration Index (SAIDI) improved as outage minutes were cut in half from 2009 to 2018.

Upon implementing ReportIQ, Central Georgia was able to further capitalize on its FLISR investment. Thomason explains that as the cooperative processed meter data at a much more granular level, it was able to divide the distribution system into zones by using the automated reclosers to provide downline metrology. ReportIQ provided the insight needed to see how much energy was entering and leaving each section of line, enabling the cooperative to zero-in on system losses. The dynamically managed data provided unprecedented visibility to system operations, says Thomason. This led to a reduction in line losses over the past three years of 0.5 percent. “That number may not seem eye-popping until you understand that the improvement equates to an annual savings of more than $550,000,” he says.

On the billing side of operations, Central Georgia used ReportIQ to analyze a very different data set: when, where and how often people came to pay bills in person. The reports helped the cooperative more efficiently schedule cashiers to meet periods of high-volume and shift human resources away from low-use hours. It also fed data into its marketing efforts to steer more consumer-members to cost-saving measures, such as the use of a kiosk in the lobby for payments, or to gravitate from paper to electronic billing.

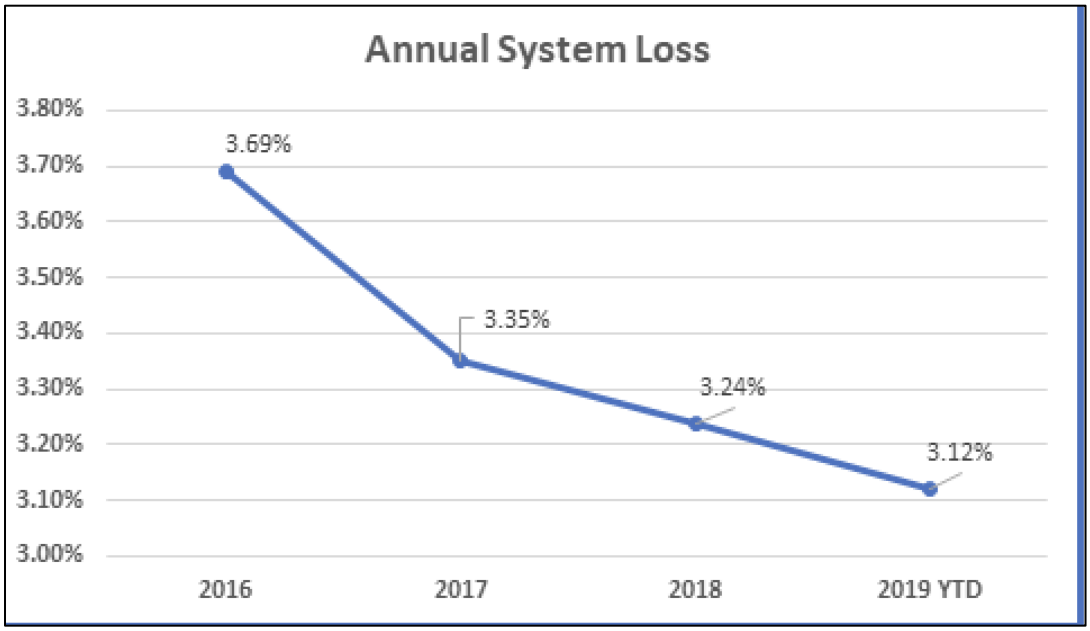
In 2019, the cooperative began to use data to proactively identify issues on the consumer side of the meter before those problems became expensive. “Using the ReportIQ platform, we wrote an algorithm that singled out consumers whose consumption deviated from the expected norm in terms of energy use,” says Thomason. The information was turned into outreach to those members and an active search for a triggering event, such as a burst water pipe or a malfunctioning HVAC system. “When we started alerting consumers to problems they weren’t even aware of, it was a big hit,” he says. “To our slight surprise, there was no negative reaction on the grounds that the use of this kind of information from the meters at their homes was an invasion of privacy. Our members were happy when we helped them avoid a high bill.” The cooperative was able to proactively

identify 164 issues on the consumer side of the meter in 2019, providing a savings of more than $57,000 to its members.

Central Georgia continues to explore ways to use data analytics to improve service and reduce costs. Applications under examination include:

- Integrating safety incident data into a tool that, based upon previous events, can identify high risk conditions for employees to be cognizant of;
- Integrating vehicle fleet data to more precisely track and predict maintenance needs and vehicle replacement times, and
- Expanding the value of consumer satisfaction surveys.

**Central Georgia Figure 1**




Central Georgia EMC reduction in line losses over the past three years.

- ***Case Study #3 – Powder River Energy Corporation***

Powder River Energy Corporation,
a cooperative of 27,000 meters headquartered in Sundance, Wyoming, has for decades ridden the boom and bust economy of mining and mineral extraction. Quentin Rogers, vice president of engineering, has worked at Powder River Energy for 13 years. “With 80 percent of our load linked to coal, oil and natural gas, we take a very strategic approach to mitigating risk,” he says. “One of our key strategies today is in how we can leverage the use of technology, and how we leverage data, to manage our risks and operate as efficiently as possible.”

With this growing emphasis on utilizing data to improve its operations, Powder River Energy measures progress differently than it might have in years past. Previously, strategic planning centered on installations of hardware. Now, the focus has moved to what Rogers terms realization goals. “You install equipment, but did you get the benefit you expected?” he asks. “Now, we’ve set up our metrics to track whether or not we realized the outcome we were trying to achieve.”

Ten years ago, the cooperative won a U.S. Department of Energy smart grid grant, the first step towards opening access to data. With the grant, Powder River Energy built a microwave system as its communications backbone. A SCADA system followed, providing breakthrough visibility to the real-time status of the grid – and an important tool in responding to operational issues. In 2019, the cooperative began upgrading its meter reading with the installation of a radio frequency AMI from Itron. The AMI delivers detailed information on how consumer-members use electricity, and data from the AMI supports increased visibility into how the utility system is performing.

Although choices in data utilization software have been growing, the cooperative finds that even with improved connectivity through MultiSpeak®, integration remains an issue. Powder River Energy elected to lean on the tools available from NISC (National Information Solutions Cooperative), its enterprise IT vendor, to efficiently manage all the streams of data from its meters and other devices on the grid, and to begin to use that data to better inform decision-making by senior staff. “We’ve long relied on our very experienced engineers and foremen in operations to make very good decisions,” says Rogers. “Now, we are harnessing data to expand our understanding. Our focus is on making data actionable. Gut checks are still important, but now we will be able to marry the two, and with that, we’re driving gains in efficiency and driving costs down.”

Rogers says that at Powder River Energy today, the use of data analytics is "just the tip of the iceberg of what is possible." He cites three examples of how data analysis is making a measurable difference in co-op success:

- **Pole testing**. Powder River Energy long kept paper records of utility pole testing, and the depth of that information was significantly upgraded in 2016 when the cooperative began using the IML Resistograph device in conjunction with SpidaCalc software to objectively determine the remaining strength of poles that exhibit some form of decay. But, the impact of that information, along with pole maintenance and replacement records, grew exponentially once digitized. Now, cooperative crews in the field enter information into an NISC software program. The current state of the cooperative's poles can be easily tracked and shared through Geographical Information System (GIS) mapping, leading to accurate preventative maintenance and more resilient physical infrastructure.

- **Avian protection.** The cooperative places a priority on protecting birds that make contact with its structures, in part due to the federal protection of some species. But, birds also cause a lot of outages. The use of analytics has helped Powder River Energy reduce wildlife-caused outages on its distribution feeders by 80 percent since 2013 by helping identify the types of structures and locations where avian contact occurs. The cooperative created hot spot mapping of incidents through GIS and concentrated preventative measures in those locations initially. Continued analysis of the data led to other process and procedural changes in methods and types of structures addressed. Improvements include retrofitting structures to increase clearances in both phase-to-phase and phase-to-ground, by ensuring that bushing covers on overhead transformer banks are in place and making other changes to assemblies to render them avian-safe.

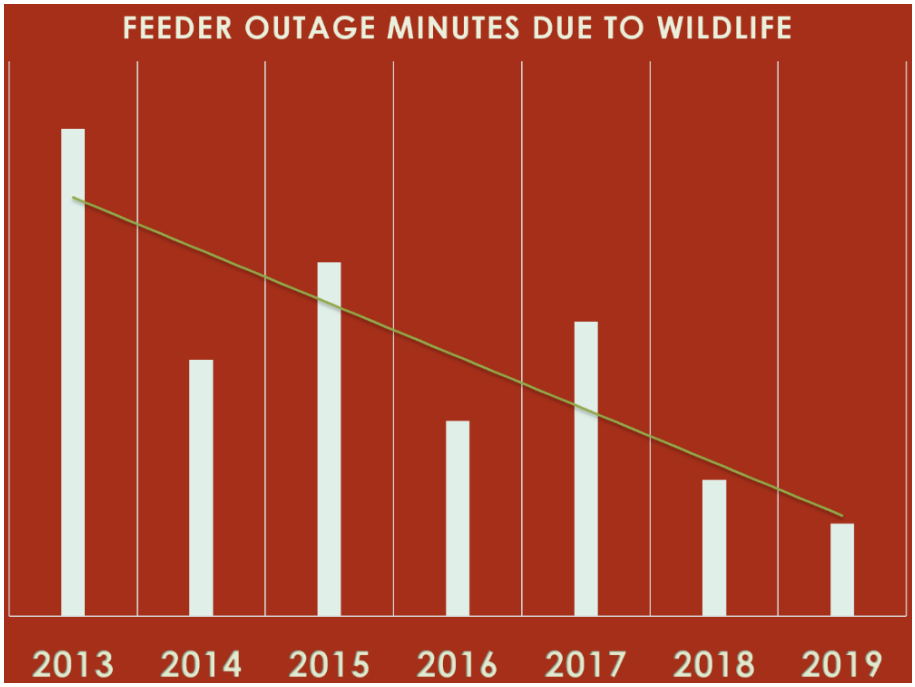
- **Improved reliability.** The cooperative inputs data from its Outage Management Software (OMS) to run a reliability analysis, identifying the worst-performing feeders and focusing maintenance schedules to address those problem areas. It also uses its software to produce fault current maps, which allow dispatch of crews to exact locations in times of an outage, rather than driving power lines, searching for the problem. This has helped earn "total buy-in" from the cooperative's line crews, says Rogers. "They see clearly how technology helps them do their jobs better and faster."

A related element of its strategic planning is the introduction of a ten-year digital strategy map. "It is a work in progress, but it should help us understand where we need to invest in education as well as in the use of data-driven technology," says

Rogers. The map will break down expectations for digital investments into ten, four, and one-year outlooks. "Technology is moving so fast, we will have to review the map on an annual basis."

In terms of where Powder River Energy stands today in its use of data analytics, Rogers says that "GIS has become the hub," a place where several data sources come together to produce visual maps and reporting that aids every department. In terms of where Powder River Energy thinks data will be leveraged in the future, Rogers says "Machine learning and artificial intelligence are just around the corner." This will include features such as anomaly detection, deep learning, and meter data disaggregation. "Software will provide flags and automated insights into the massive amounts of data we harvest," he says. "We'll be able to leverage that data into action for cooperative members without the need for a ton of internal resources."

**Powder River Figure 1**



**Power River Figure 2**

Powder River Energy line crews install avian protection devices on power lines.

# 4. What's Next

In Part Two of this Business and Technology Report (scheduled for release in March 2020), we will continue our report on the electric cooperative experience with data analytics. Topics in the next report will include:

- How small cooperatives can develop in-house expertise to use data analytics to address problems and improve efficiency;
- Case studies of innovation and use of advanced analytics at electric cooperatives; and
- What are the next opportunities for transformative change at electric cooperatives through data analysis?