Business & Technology Report

March 2019

Electric Cooperatives Bring High-Speed Communications to Underserved Areas

Insights from NRECA's 2018 Twelve Broadband Case Studies

NRECA

America's Electric Cooperatives

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NRECA
America's Electric Cooperatives

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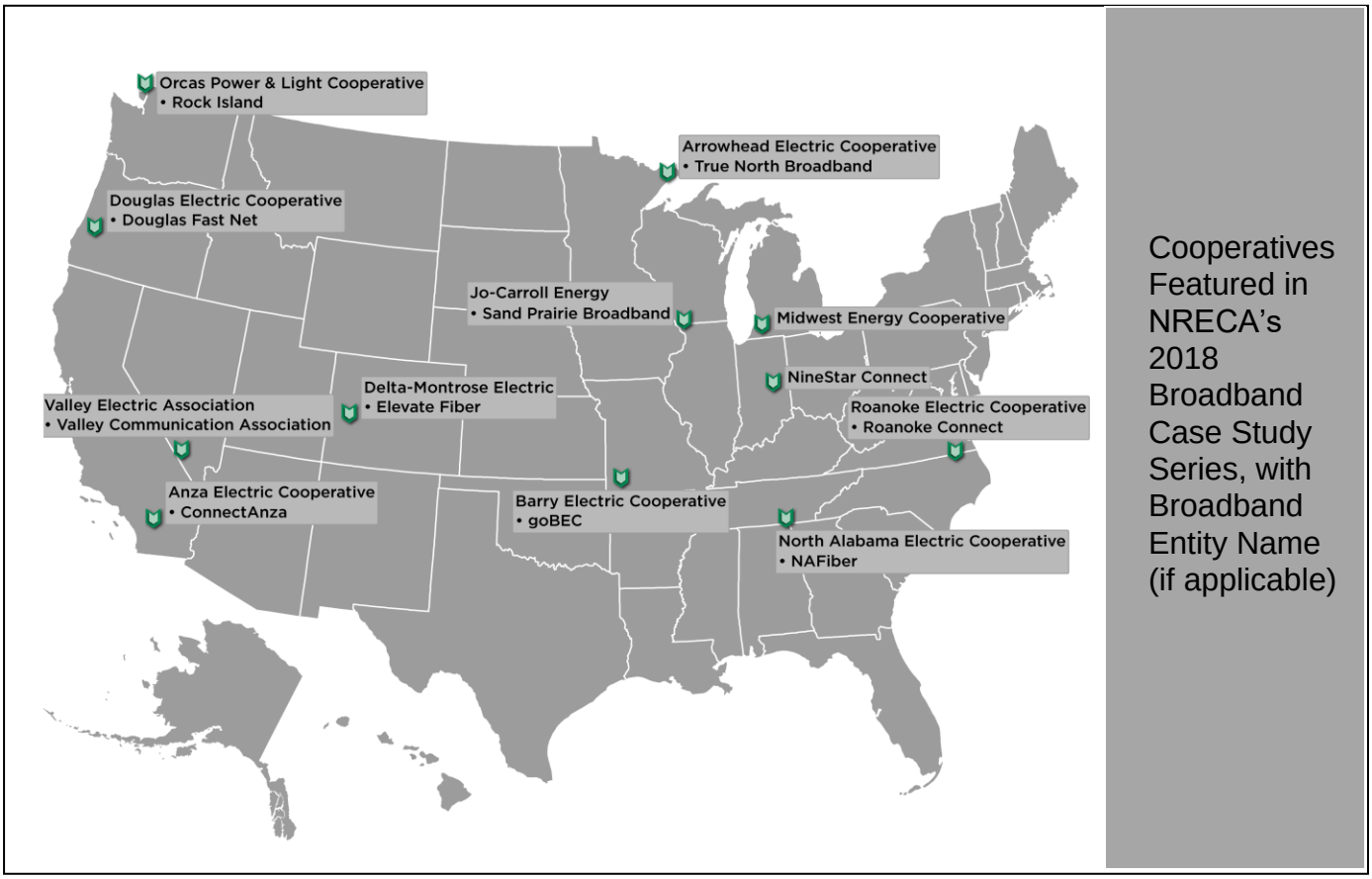
Overview

Electric cooperatives of all sizes and in many regions across the United States are building broadband communication networks, a focus seemingly beyond their traditional mandate. These networks enhance electric grid operations and member services, and just as significantly bring much-needed, high-speed Internet access to their communities. For many co-op CEOs, extending true broadband communications into rural areas is the current-day equivalent of rural electrification in the 1930s. The stakes are exceptionally high. Internet access is the great equalizer — enabling a virtual workforce, distance learning, telemedicine, and economic opportunities across the spectrum. However, high-speed communication networks are expensive to build and operate, and entry into a new business as different as broadband services often brings unexpected challenges to an electric utility organization.



Numerous lessons can be learned by carefully examining experiences of electric cooperatives that have entered the broadband business. This report looks at twelve electric cooperatives profiled by NRECA during 2018 to learn from their bellwether successes (and challenges) in broadband.[1] Together, these co-ops have invested or plan to invest just over $500 million in broadband communication networks, deploying some 17,700 miles of fiber. Some may spend as much for their broadband network buildout over a few, short years as they have invested in electric infrastructure over the lifetime of their cooperative. Investment in broadband, for the featured cooperatives and perhaps many more, is a defining moment with lasting consequences.

[1] The twelve case studies can be found at: https://www.cooperative.com/programs-services/bts/Pages/Broadband-Co-op-Case-Studies.aspx.

Purpose of This Summary Report

This report reviews data from the work NRECA undertook in 2018 to capture the experiences of electric cooperatives that have launched a retail broadband services business, either through the electric cooperative itself, through a subsidiary entity, or through an affiliate.

In this summary report, NRECA creates additional value for its members by:

- Developing a set of data tables that summarize key aspects of the 2018 broadband case studies. These tables enable cooperative planners and decision makers to look across the first twelve cases and identify those experiences that are most directly relevant to their own, specific business situation. The tables also highlight common themes, challenges, and approaches that flow through the cases.
- Providing accompanying discussion points that identify strategic findings, common threads, innovations, and approaches from these bellwether cooperatives' experiences.
- Offering the wider electric co-op community the convenience of a consolidated, all-under-one-cover report containing the case studies themselves, high-level findings and data tables in a PDF or hard copy for easy reference.

Cooperative Profiles

Introduction and Overview

The twelve electric cooperatives selected by NRECA in 2018 as case studies operate in many different regions of the U.S. and are a reasonable, but not necessarily representative, cross-section of the larger cooperative community. They share one important attribute — each featured cooperative has taken a bold step into the world of broadband communications. The entry cost to build a high-speed communications network is high, and the need for due diligence of any such investment cannot be overstated.[2]

Communications services are a competitive business, even in areas where businesses and households have had only limited options from which to choose in the past. Capturing market share is critical for recovering upfront capital investment dollars and covering ongoing, operating costs. However, even competitors who have a small market share and might otherwise appear disinterested can take pre-emptive steps to hamper the success of new market entrants, as is reported in several of the case studies. Some of the featured case study co-ops also note that retail marketing was not previously a competency that their co-op possessed, and that the learning curve should not be underestimated. But, the insights, data tables, and broadband case studies in this report suggest these challenges are, in fact, not insurmountable.

Key Insights from the Case Studies

- **Diverse Group –** The twelve electric cooperatives profiled by NRECA range in size from 3,900 to 36,000 members and operate in a dozen states. While not a statistically representative sample of the overall NRECA member universe, this group is nonetheless highly diverse.
- **Low Density Areas –** The cooperatives profiled serve an average of 8.0 members per mile of electric line. This is highly consistent with the average of 7.4 consumers per mile of line for NRECA members as a whole (2017).
- **Recent Development –** Three quarters of these cooperatives only began deployment of their broadband networks within the past five years.
- **Population Served –** Together, the electric co-ops profiled by NRECA serve 182,800 members. In spite of the relative newness of their broadband service offerings, some 53,000 members (and a small number of non-members) already subscribe to their broadband services, a 29 percent overall take-rate. Co-ops with a greater head start report gradual increases in take-rates over time.
- **Target Markets for Broadband –** The target market for broadband services typically includes the entire electric membership area; however, one-third of the twelve co-ops profiled already serve broadband customers beyond their traditional electric membership areas. Several more are planning for this possibility.

[2] NRECA's Due Diligence Report can be found at: https://www.cooperative.com/programs-services/bts/documents/reports/broadband-due-diligence.pdf

Tables 1 and 2 on the following pages contain cooperative profile data from the 2018 broadband case studies. This glossary of terms defines the abbreviations used in the data tables.

Abbreviations Used in the Data Tables

CAFII: Connect America Fund Phase II, part of the Federal Communications Commission's (FCC) reform and modernization of its universal service support programs.

CASF: California Advanced Services Fund, a broadband infrastructure grant program.

CDBG: Community Development Block Grant, a program of the U.S. Department of Housing and Urban Development which funds local community development activities and infrastructure development.

CLEC: Competitive Local Exchange Carrier, a company providing local telephone services that compete with the incumbent local services provider (see ILEC).

EBITDA: Earnings before interest, tax, depreciation and amortization, a measure of a company's operating performance.

FTTP / FTTH: Fiber-to-the-Premises / Fiber-to-the-Home.

Gbps: Gigabits per second, a measure of communication speed.

GPON: Gigabit Passive Optical Network, a way of providing fiber to the home.

ILEC: Incumbent Local Exchange Carrier, a company providing local telephone services.

LTE: Long Term Evolution, a 4G wireless mobile communications standard designed to provide up to 10x the speeds of 3G networks.

Mbps: Megabits per second, a measure of communication speed.

MPLS: Multiprotocol Label Switching, a routing technique in telecommunications networks that directs data from one node to the next, based on short path labels rather than long network addresses.

OLT: Optical Line Terminal, the endpoint device in a passive optical network.

ROI: Return on Investment, a measure of profitability.

SCADA: Supervisory Control and Data Acquisition system.

TVIP: Internet-Protocol-based TV.

VoIP: Voice over Internet Protocol, an Internet-based telephony approach.

Table 1. Cooperative Profile — Electric Operations (continued on next page)

Cooperative Name	Broadband Entity Name	Location	2018 Member Size (Electric)	Electric Line Density (Members per Mile)	Electric Membership Area	Physical Terrain
Anza Electric Cooperative	*ConnectAnza*	Southwest of Palm Springs, California	3,900	5.6	550 square miles in Anza Valley, Southwest Riverside County, California	Varying, coastal slopes and mountains ranging from 2,000' elevation to 5,000'
Arrowhead Electric Cooperative	*True North Broadband*	Northeastern tip of Minnesota, bordered by Ontario, national forest and Lake Superior	4,200	7.0	Cook County and part of Lake County, in far northeastern Minnesota	Rough, rocky terrain with tall trees; mountains on one side and Lake Superior on the other. Ground extremely hard with shallow line depths. Includes national forest and wilderness areas.
Barry Electric Cooperative	*goBEC Fiber Network*	Southwestern Missouri	6,700	6.1	Southern part of Barry County, Missouri	Peaks and valleys — running fiber overhead on poles is the "*de facto* choice." Cellular coverage poor due to terrain.
Delta-Montrose Electric Association	*Elevate Fiber*	Western Slope of Colorado	27,900	8.5	Delta and Montrose Counties, and part of Gunnison County, Colorado	Colorado valley lands with rolling hills and mountain foothill terrain. Rocky for a large marjority of our territory.
Douglas Electric Cooperative	*Douglas Fast Net*	Southwest Oregon	10,000	6.0	2,200 square miles in western and northern Douglas County, with small portions in northeast and southeast Coos County and south Lane County.	Mountains and valleys.

Table 1. Cooperative Profile — Electric Operations (continued from previous page)

Cooperative Name	Broadband Entity Name	Location	2018 Member Size (Electric)	Electric Line Density (Members per Mile)	Electric Membership Area	Physical Terrain
Jo-Carroll Energy	*Sand Prairie Broadband*	Northwestern Illinois, near Wisconsin and Iowa borders	16,000	8.4	Four northwestern Illinois counties	River bluffs and ridges used for siting wireless towers connected to fiber backbone to enable FTTH/FTTP.
Midwest Energy & Communications	*[Same name]*	Southwestern and southeastern Michigan	36,000	9.0	Twelve counties in Michigan, plus adjacent areas in Indiana and Ohio	(Not Available)
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	Central Indiana	14,700	9.5	Four Indiana counties	(Not Available)
North Alabama Electric Cooperative	*NA Fiber*	Northern Alabama	18,200	8.5	Jackson & Marshall Counties, Alabama	Rivers and mountains.
Orcas Power and Light Cooperative	*Rock Island Communications*	Twenty islands off northwestern Washington state	12,000	11.0	San Juan County, Washington	Islands off Washington coast; rocky terrain.
Roanoke Electric Cooperative	*Roanoke Connect*	Northeastern North Carolina	14,500	7.3	Parts of seven North Carolina counties.	Coastal plain.
Valley Electric Association (VEA)	*Valley Communications Association (VCA)*	Western Nevada	18,700	8.5	Approximately 6,800 square miles in western Nevada with a sliver in California.	Mountains and valleys.

Table 2. Cooperative Profile — Broadband Operations and Plans (continued on next page)

Cooperative Name	Broadband Entity Name	Broadband Service Area (Actual or Planned)	Broadband Deployment Timeline	2018 Active Broadband Subscribers
Anza Electric Cooperative	*ConnectAnza*	Coincident with electric service area	Began deployment in late 2015; Full deployment expected by mid-2020	1,300 active; 1,200 additionally signed up. Target of 4,000 subscribers.
Arrowhead Electric Cooperative	*True North Broadband*	Cook County membership area plus City of Grand Marais (non-membership).	Fall 2011 – June 2015	Approximately 2,600 active subscribers of either Internet or telephone service, or both.
Barry Electric Cooperative	*goBEC Fiber Network*	100% of electric service territory (planned)	Construction began August 2016 and is now 50% complete. Full completion expected in 2020.	Approximately 1,500. Approximately 50% of members have main line fiber access.
Delta-Montrose Electric Association	*Elevate Fiber*	Plan is to extend fiber network to 100% of electric members by 2021. May extend to non-membership areas in the future.	First customer connected in June 2016.	5,000+ active subscribers
Douglas Electric Cooperative	*Douglas Fast Net*	Roseburg and surrounding Douglas County. Currently, one-third of DFN's fiber network lies within DEC's electric service area while two-thirds of the network is in the rest of Douglas County and surrounding areas. Broadband service started initially outside DEC's electric membership area.	DFN was created in 2001 and began operating in Douglas County in 2002. Residential telecommunications services were first offered in 2003, relying on a fixed wireless network.	~8,550 Internet subscribers and ~400 ethernet connections to city halls, police departments, and schools.

Table 2. Cooperative Profile — Broadband Operations and Plans (continued from previous page)

Cooperative Name	Broadband Entity Name	Broadband Service Area (Actual or Planned)	Broadband Deployment Timeline	2018 Active Broadband Subscribers
Jo-Carroll Energy	*Sand Prairie Broadband*	100% of electric and natural gas membership area. JCE has no definate plans to extend its broadband network beyond its own service territory. Fiber backbone is exclusively for electric and gas operations.	Sand Prairie officially created in late 2008 and began offering wireless broadband services to memb ers in 2009. Fiber-optic network buildout commenced 2016-17 as the ultimate broadband solution.	2,000
Midwest Energy & Communications	*[Same name]*	Primarily MEC service territory; about 3% of current subscribers are non-electric members.	Launched in 2014, expected to take five years.	8,700 Internet, telephone and TV subscribers
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	Electric membership area and beyond. Communications business currently operates on a for-profit basis in ten Indiana counties.	Original plan was for every electric member to have a smart meter installed by mid-2015 and fiber-to-the-home (FTTH) within a few years after that, building on the fiber ring that already connected the co-op's substations. 100 percent FTTH coverage was reached by the end of 2018.	5,500
North Alabama Electric Cooperative	*NA Fiber*	(Not Available)	(Not Available)	4,300 active "fiber members" as of mid-2018
Orcas Power and Light Cooperative	*Rock Island Communications*	100% of electric membership area.	Network buildout began in early 2015.	4,700

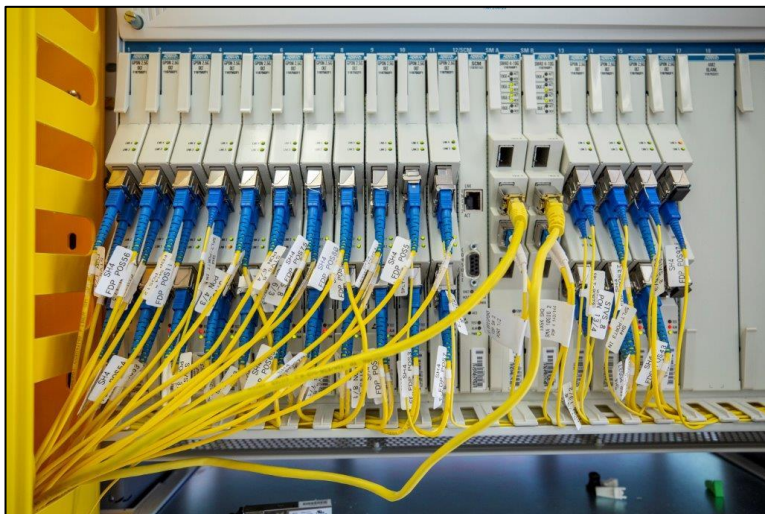
Table 2. Cooperative Profile — Broadband Operations and Plans (continued from previous page)

Cooperative Name	Broadband Entity Name	Broadband Service Area (Actual or Planned)	Broadband Deployment Timeline	2018 Active Broadband Subscribers
Roanoke Electric Cooperative	*Roanoke Connect*	100% of electric membership area, initially.	January 2018 launch. Full deployment expected in 24-48 months.	Fiber broadband deployment underway.
Valley Electric Association (VEA)	*Valley Communications Association (VCA)*	Wireless broadband currently covers approximately 95% of Pahrump and five other Nevada towns, as well as a small penetration in two towns outside VEA's service area. FTTH is being constructed in the Pahrump area.VCA owns and operates the broadband network and has the capability to provide wireless broadband services beyond VEA's traditional electric service territory, although this aspect of broadband operations is minimal to date.	VCA was launched in 2015. Wireless (WiMAX) tower construction (with fiber backhaul) began at the end of 2015 with subscriber installations beginning in July of 2016. By the end of 2018 approximately 95% of the electric service territory has wireless service available.	8,800

Business Decision-Making Factors

Introduction and Overview: No One-Size-Fits-All Approach

The business decision to expand from electricity distribution into broadband communication services is complicated, far-reaching, and strategic. What drives the business decision? What are the underpinnings of the business case justifying the large capital commitment required? And, how must the traditional electric co-op business model change? Detailed data conveying insights into all three of these questions have been provided by the co-ops featured in NRECA's 2018 broadband series. The picture that emerges is highly informative. There is no one-size-fits-all approach. Each case study describes an experience that is unique in some ways. As such, these early successes are not necessarily transferrable to other cooperatives looking for the best path to follow. Nonetheless, the case study co-ops' experiences can be highly instructive.



Key Insights from the Case Studies

- **Drivers of Broadband Investment –** The primary driver of cooperatives' broadband investments has been to meet internal business requirements, such as electric grid optimization, external requirements such as regional economic development, or both. In virtually all cases, broadband investment has produced significant benefits both internally and externally.

- **Addressing Underserved Populations –** Population densities served by the cooperatives studied are typical by NRECA standards (7.4 customers per mile of electric line on average). The high cost associated with serving such low densities has been an impediment to commercial broadband service providers extending their network reach, leaving many rural households and businesses unserved or underserved.

- **Rate of Investment –** Electric cooperatives' rate of investment in broadband communications is rapidly outstripping the historical rate of investment in electrical infrastructure witnessed over the

past century. Together, the twelve featured co-ops have invested, or are planning to invest, some $500 million in broadband communications infrastructure, mainly in fiber-optic networks.

- **Importance of Grant Funding –** More than $60 million in grants and low-interest loans have been awarded to the twelve co-ops thus far. These funds subsidize the broadband investment, and in some cases, have dramatically accelerated the return on investment.

- **High Take-rates –** Broadband services offered by these electric cooperatives are in high demand. In spite of the fact that some of the featured broadband deployments are not yet complete, more than 53,000 (29%) of the 182,800 electric members collectively served have subscribed to the new broadband service offerings. Local communities' high levels of trust in their local cooperative appear to be a contributing factor.

- **Crowd-source Funding –** Crowd-source funding platforms on the Internet have been used by a number of the featured co-ops to reduce financial risk. This enables construction planning to be prioritized according to areas or zones, which in essence, can pay their own way. One co-op has even pioneered an approach that has neighborhoods ("fiberhoods") contributing toward middle-mile, network construction costs.

- **Organizational Decisions –** A wide variety of organizational approaches has been adopted. Some of the new broadband services entities are operating divisions of the cooperative, others are non-profit or for-profit subsidiaries with resource sharing arrangements, and still others are fully independent, for-profit units.

- **Network Ownership –** Ownership of broadband network assets also varies widely. In some cases, the electric cooperative owns the entire network; in others, ownership of the network assets is split between the electric and broadband entities; and in still others, the broadband entity has financed and built the network and leases bandwidth back to its parent cooperative for electric operations.

- **TV or No TV –** Several of the new broadband co-ops have forgone providing local TV channels and programming content over their networks in anticipation of a full shift to Internet-based TV (IPTV) over time. This has important ramifications for investment planning, as the need for expensive video head-end facilities is eliminated under this approach.

Tables 3 through 5 on the following pages contain business decision factor data from the 2018 broadband case studies.

Table 3. Business Decision Making — Drivers of the Investment (continued on next page)

Cooperative Name	Broadband Entity Name	Drivers of the Business Decision	
		Internal / Business Requirements	**External / Community Requirements**
Anza Electric Cooperative	*ConnectAnza*	Significant improvements expected in system operating efficiency and annual operating cost. Elimination of leased T-1 lines; internal telephone system was extremely expensive to operate. Grid modernization is also a key driver.	Level of local economic activity is low and a large percentage of the working population commutes out of the area. Median household income lags behind the statewide average. The area has traditionally been underserved by telecommunications service providers.
Arrowhead Electric Cooperative	*True North Broadband*	AEC did not have fiber connections to its substations before this project. In process of evaluating SCADA and conservation voltage reduction. AMI mesh network is now using fiber backhaul from data collection points.	A 2006-7 study ranked Cook County last among Minnesota counties for Internet connectivity and rated the county "underserved" insofar as broadband telecommunications is concerned.
Barry Electric Cooperative	*goBEC Fiber Network*	By 2015, BEC had developed a construction work plan to deploy SCADA and Smart Grid applications, such as AMI data backhaul, time-of-use metering, voltage control data acquisition, prepaid metering, and remote connect/disconnect. BEC sees revenue stability as a major benefit of entering the broadband services business. "Fiber revenues are predictable."	BEC's B2B broadband service, in partnership with KAMO Power, had existed since 2000. BEC members became aware of broadband services being offered by other Missouri co-ops and began pressuring BEC. BEC's 2015 work plan envisioned FTTP for its electric members.
Delta-Montrose Electric Association	*Elevate Fiber*	Electric operations are significantly enhanced by DMEA's advanced metering infrastructure (AMI) — 34,000 advanced meters coupled with high-speed communications. The broadband network enables meter data backhaul. AMI also used for outage monitoring and theft detection.	Regional economic development a key driver — promoting remote workforce; support 'aging in place' for elderly residents (55% of area residents are retirees); connect students; employ former coal miners building fiber network. Telemedicine also seen as a critical community service.

Table 3. Business Decision Making — Drivers of the Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Drivers of the Business Decision	
		Internal / Business Requirements	External / Community Requirements
Douglas Electric Cooperative	*Douglas Fast Net*	With DFN's expansion into DEC's service area, DEC capital costs to extend fiber to its substations were only $470,000 for 158 miles of fiber-optic line. The total cost to connect fiber to all the substations was just under $2.4 million. DEC's SCADA system runs off the fiber network as does corporate data storage and IT backups between offices. DFN also installed fiber to 71 cell towers across Douglas County, which enables DEC's line trucks and crews working in the field to communicate via cell towers and back to the co-op's operational hub.	The county's Incumbent Local Exchange Carrier (ILEC) operated an analog telephone switch that had reached capacity; the infrastructure was largely comprised of aging, copper utility plant. Local businesses such as medical imaging facilities were forced to operate a "sneaker net," with couriers running images back and forth between imaging centers, doctors' offices, and hospitals. The situation became dire when ER physicians at the local hospital were unable to call out for a consult.
Jo-Carroll Energy	*Sand Prairie Broadband*	The primary driver of JCE's broadband initiative was enhanced utility operations, in particular its implementation of advanced monitoring and control systems on its electric distribution system (SCADA and AMI). 44 miles of JCE's backbone fiber connects the cooperative's main office to one of two outpost offices and to a remote disaster recovery building housing redundant IT equipment to support business continuity.	Members also needed a better communication system. Fast, high quality access to the Internet was severely lacking in JCE's area. Regional economic development initiatives have also been hampered by the lack of an advanced communication infrastructure. As many as 20,000 of the co-op's members lacked robust, high-speed Internet access.
Midwest Energy & Communications	*[Same name]*	MEC was considering revamping its communication system to address legacy copper wire, satellite, powerline carrier and wireless systems it had in place. Plans to upgrade from automated meter reading (AMR) and Supervisory Control and Data Acquisition (SCADA) systems to an advanced metering infrastructure (AMI) demanded broadband communications. Among new capabilities planned are fault location and automated service restoration/downline automation.	MEC members demanded better Internet access. In addition to homeowners and businesses, professors at area universities live in MEC's service territory and needed the same level of broadband access they had on campus. The number of people working from home was unexpectedly high. MEC came to view fiber broadband as a powerful tool for local economic development and jobs retention.

Table 3. Business Decision Making — Drivers of the Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Drivers of the Business Decision	
		Internal / Business Requirements	External / Community Requirements
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	Automated feeder switching is enabled by the fiber backbone that connects substations. Moreover, data from the co-op's smart meters are backhauled over a combination of wireless and fiber paths to the fiber backbone. The network also enables security cameras at substations and provides the foundation for WiFi coverage serving engineering technicians and line crews working in the field. In addition, SCADA system deployment is planned along with automated reclosers for improved system reliability.	The goal was to bring fiber broadband to unserved areas to create economic, educational, and retail service opportunities for residents. High-speed Internet access in many local homes was so sparse prior to 2011 that schools had to remain open late to meet the community's needs.
North Alabama Electric Cooperative	*NA Fiber*	Because NAEC receives its electricity from TVA, its distribution rates have trended toward being time-differentiated. An advanced metering infrastructure (AMI) was needed to enable time-of-use (TOU) rates and load management programs. 100% of NAEC members now have advanced meters in place. The recently installed fiber network provides the data communication system for NAEC's AMI system. NAEC lacks a SCADA system; however, AMI with fiber backhaul of feeder and substation data gives operations staff vastly improved visibility over what is taking place across the system in near-real-time.	Regional economic development: schools, hospitals and out-of-work residents. Within the two counties served by NAEC, 75% of electric load was industrial as recently as 2002. However, most of the area's industrial base was lost in the last decade. Also, a large part of NAEC territory was previously unserved by broadband ISPs.
Orcas Power and Light Cooperative	*Rock Island Communications*	OPALCO's need to better communicate with its crews, electrical substations and submarine terminals was the main driver behind its investment in an expanded broadband telecommunications infrastructure.	Reliability of telecommunications to/from the islands had long been a major issue. A 2013 break in the islands' sole telecom provider's undersea fiber cable interrupted landline, data and cellular telephone communications, including 911 emergency service, for ten days.

Table 3. Business Decision Making — Drivers of the Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Drivers of the Business Decision	
		Internal / Business Requirements	External / Community Requirements
Roanoke Electric Cooperative	*Roanoke Connect*	REC recognizes the convergence of telecommunictions into the utility business model and is intent upon building the smart grid infrastructure and deploying the robust, high-speed communication system necessary to operate the utility of the future. The co-op is actively pursuing demand response, system automation, conservation voltage reduction, line-loss reduction, and energy efficiency programs as part of its long-term business strategy of wholesale cost avoidance.	Prior to Roanoke Connect, REC's service territory had very limited broadband access. Considering that all of the counties served by REC are deemed to be "distressed counties" by the state of North Carolina and have low population densities, it is unlikely that expansion of existing telecom services or upgrades to broadband speeds would have been viewed as an attractive business investment by incumbent service providers.
Valley Electric Association (VEA)	*Valley Communications Association (VCA)*	As part of a 230-kilovolt transmission line VEA was building in 2012, a fiber-optic communication system was deployed in the static wire (Optical Ground Wire or OPGW) for the purpose of substation and protection system communications. VEA's fiber network is now being used for SCADA (Supervisory Control and Data Acquisition) system communications and the cooperative is looking at realizing new Smart Grid capabilities.	Demand for quality broadband service was very high in the area. VEA employees initiated the idea of broadband service in response to a lack of competition.

Table 4. Business Decision Making — the Business Case for Broadband Investment (continued on next page)

Cooperative Name	Broadband Entity Name	Business Justification					
		CapEx	Annual OpEx	Take Rates	Annual Revenues	Sources of Funding	Measure of ROI
Anza Electric Cooperative	*ConnectAnza*	60% of $4.4 million Phase 1 cost covered by CASF grant; Phase 2 buildout expected to cost $3.3 million.	Projected annual operating expenses $800,000	40% projected take-rate appears conservative	Projected annual revenues $1.2 million	$4.4 million grants (two grants) from California Advanced Services Fund (2015 and 2019)	Positive cash flow expected by year 4 due on large part to the subsidy effect of the grant
Arrowhead Electric Cooperative	*True North Broadband*	$20.1 million, with $11.3 million funded by the federal grant, $4.8 million in the federal loan and $4 million from the county grant. The grants covered roughly 75% of the total investment cost.	(Not Available)	36% take rate modeled on projections, currently at almost 60% take rate.	$3 Million projected annual revenues	USDA grants and low-interest loans totaling $16 million (2010); Cook County provided $4 million through its 1% sales tax fund.	Positive margins as of 2017; positive cash flow expected to take a number of years.
Barry Electric Cooperative	*goBEC Fiber Network*	$42 million for BEC members; $4.5 million to serve non-members.	~$1.6 million	Expected take-rate was 50% over five years. Initial take-rates 20-26% with 2-4% monthly growth rate.	~$2 million	CAF II auction resulted in award of $6.1 million to BEC in late 2018. Grant to be distributed over ten years.	BEC projecting five years to break-even.

Table 4. Business Decision Making — the Business Case for Broadband Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Business Justification					
		CapEx	Annual OpEx	Take Rates	Annual Revenues	Sources of Funding	Measure of ROI
Delta-Montrose Electric Association	*Elevate Fiber*	$62 million, excluding cost of initial fiber ring connecting DMEA electrical substations.	2018 ~ $3.4M forecast year-5 to hit $9M+	Take-rate as indicated by advance signups must be 25% for zone construction to begin; zones in service for more than 1 year exhibit robust take-rates, some as high as 60%.	Projected revenues of $5.1 million (2019) and $7 million (2020).	$2.65 million grant from Colorado's Broadband Fund; otherwise internally funded.	DMEA expects positive cash (EBITDA basis) by 2020, 3 1/2 years after launch, and positive net income by 2024.
Douglas Electric Cooperative	*Douglas Fast Net*	~$25 million invested to date	~$9.5 million (2018)	25%	~$11 million (2018)	Original loan from DEC to DFN was repaid and replaced by outside loans in 2014. Over $9M in funding also received in the form of grants and support, e.g., for educational facilities and federal stimulus money. $9M	~8% (2018)

Table 4. Business Decision Making — the Business Case for Broadband Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Business Justification					
		CapEx	Annual OpEx	Take Rates	Annual Revenues	Sources of Funding	Measure of ROI
Jo-Carroll Energy	*Sand Prairie Broadband*	Expected to be $85 million when the fiber network is fully built out.	Projected to be $3.5 million when network is completed.	Tied to payback; range from 30% to 80% depending on density and capital expenditure	Subscriber revenues in 2017 were ~$1 million (95% wireless and 5% fiber-optic)	Current funding is 100% self-generated from revenues. JCE expects full build-out to require some grant assistance	Areas are not built out with fiber until enough signups exist to ensure a ten-year discounted payback period on the drops and portion of mainline fiber.
Midwest Energy & Communications	*[Same name]*	Projected cost for initial five-year buildout projected to be $73 million.	Expected to be $14 million when fiber network is fully established.	Approaching 70% in some areas that were built-out early in the five-year deployment period.	Expected to be $18 million when network is established	Crowd-funding used to ensure positive revenue and cash flows before fiber network construction is extended into new areas.	MEC expects positive net income and cash flow by the fifth year with a targeted internal rate of return (IRR) of 10% when the network is fully mature.

Table 4. Business Decision Making — the Business Case for Broadband Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Business Justification					
		CapEx	Annual OpEx	Take Rates	Annual Revenues	Sources of Funding	Measure of ROI
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	$54 million	(Not Available)	(Not Available)	(Not Available)	(Not Available)	The number of years needed to fully recover the fiber broadband infrastructure investment is expected to be lengthy. However, many of the benefits of the fiber network are not easily quantifiable.
North Alabama Electric Cooperative	*NA Fiber*	$24.5 million	(Not Availalble)	(Not Available)	(Not Available)	ARRA rural broadband grant of $19.6 million received in 2010, covering 80% of $24.5M capital cost of network.	(Not Available)
Orcas Power and Light Cooperative	*Rock Island Communications*	$25 million. Rock Island has adopted a form of "pay-as-you-go" where it provides incentive for "fiber-hoods" to pay the majority of last-mile costs.	Projected to be $3 to 6 milion by 2022.	Conservative target for market penetration is 60% of San Juan County.	Annual revenue was $3.6 million in 2017 with a target to generate $8.7 million by 2022.	Operating revenue from customer subscriptions, loan/line of credit from CoBank and direct investment in middle-mile/last-mile construction build-out by subscribers ($2.5 million to date).	Positive cash flow acheived in 2018.

Table 4. Business Decision Making — the Business Case for Broadband Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Business Justification					
		CapEx	Annual OpEx	Take Rates	Annual Revenues	Sources of Funding	Measure of ROI
Roanoke Electric Cooperative	*Roanoke Connect*	Phase 1 Investment cost of the 200-mile, Phase 1 fiber-optic backbone was approximately $4 million. Phase 2 Investment cost for last mile deployment including demand response devices = $27.2 million	2019 - ~$650,000	The 30% projected take-rate may be conservative given that 70% of the local population have no other broadband options. Update-to-date take rates have averaged 40%	2019 Projected = $395k Broadband and $244k Wholesale power Demand Savings (Contra Revenue)	CFC Financing One Community Development Block Grant has so far been obtained and REC is actively exploring other potential funding sources. Applications submitted $4 million State Grant; More will be requested from USDA Re-Connect Grant	REC's business case values its demand response, system automation and broadband backbone investments, using data provided by its power supplier NCEMC. Annual cash flow is positive for the demand response opportunities of smart thermostats and water heater controls, even when lost revenues due to lower kilowatt-hour usage are factored in.

Table 4. Business Decision Making — the Business Case for Broadband Investment (continued from previous page)

Cooperative Name	Broadband Entity Name	Business Justification					
		CapEx	Annual OpEx	Take Rates	Annual Revenues	Sources of Funding	Measure of ROI
Valley Electric Association	*Valley Communications Association*	$46.5 million (current investment in wireless and fiber).	Expected $6.25 million.	~50% of membership has active broadband service, via wireless or fiber connection.	Annual revenues $6.1 million (2018). VEA management emphasized the Importance of monthly recurring revenue.	Financed through normal co-op financing channels and without the help of grants	Payback on the investment is expected in seven years based on the current and projected growth rates. Financial benefits accruing to VEA from its use of the broadband network for internal, operational requirements have not yet been fully quantified.

Table 5. Business Decision Making — the Broadband Business Model (continued on next page)

Cooperative Name	Broadband Entity Name	Business Model			
		Organizational Structure	Dedicated vs. Shared Staffing	For-profit vs. Not-for-profit	Broadband Products Offered
Anza Electric Cooperative	*ConnectAnza*	ConnectAnza is an operating division of the electric cooperative, not a for-profit subsidiary. Broadband communications closely integrated with electric operations.	Five dedicated, technical personnel; shared services such as members services and accounting.	Not-for-profit operating division of the cooperative.	Broadband Internet; optional VOIP; dark fiber for countywide services. Programming content not currently offered.
Arrowhead Electric Cooperative	*True North Broadband*	True North Broadband is an operating division of AEC (not a subsidiary). AEC owns the entire broadband network.	Six dedicated staff persons work in the broadband division — three handle customer service and billing, another three outside plant personnel perform maintenance, construction and in-home installations. Calls from broadband subscribers are handled jointly with Connsolidated Telecommunications Co. (CTC) of Brainerd, MN.	Eventual profits from the broadband business will be treated as "non-operating revenue."	Internet access and telephone, faciitated through partnership with CTC. True North offers Roku for streaming video from the Internet.

Table 5. Business Decision Making — the Broadband Business Model (continued from previous page)

		Business Model			
Cooperative Name	**Broadband Entity Name**	**Organizational Structure**	**Dedicated vs. Shared Staffing**	**For-profit vs. Not-for-profit**	**Broadband Products Offered**
Barry Electric Cooperative	*goBEC Fiber Network*	goBEC Fiber Network is a wholly owned, not-for-profit subsidiary of BEC.	All employees of the fiber broadband subsidiary are BEC employees. BEC has seen >50% growth in staffing since 2015 (31 to 47). Dedicated personnel include: 2 indoor techs, 2 outdoor techs, 2 CSRs, 1 marketing person.	Not-for-profit	Internet, VoIP-based telephone and IP-based TV/video services. Internet speeds offered are from 250 Mbps to 1 Gbps. TV offer enabled by partnership with Co-Mo Electric Cooperative for video head-end facilities.
Delta-Montrose Electric Association	*Elevate Fiber*	Elevate Fiber is a wholly owned, for-profit subsidiary of DMEA.	Elevate Fiber has ~16 dedicated employees including network engineers, installers and outside plant technicians. Back-office functions are treated as shared services.	For Profit	Current broadband service offerings include Symmetrical Internet access speeds of 100 Mbps or 1 Gbps and VoIP service. Elevate has just become the first broadband service provider in the area to offer an app-based streaming video service using the MOBITV platform which has a look and feel similar to that of traditional cable TV.

Table 5. Business Decision Making — the Broadband Business Model (continued from previous page)

		Business Model			
Cooperative Name	**Broadband Entity Name**	**Organizational Structure**	**Dedicated vs. Shared Staffing**	**For-profit vs. Not-for-profit**	**Broadband Products Offered**
Douglas Electric Cooperative	*Douglas Fast Net*	The broadband network was built by DFN. DEC purchases reduced rate services; hence the cooperative benefits from the for-profit subsidiary, not vice versa.	DFN employs 47 people (2018), exceeding the number of electric employees at DEC. There is no resource-sharing or joint service delivery between DEC and DFN, resulting in a high degree of operational and financial independence between the electric cooperative and DFN.	For Profit	Internet access (100 Mbps to 1 Gbps) and voice services.
Jo-Carroll Energy	*Sand Prairie Broadband*	Broadband services offered through a regular operating division of JCE, not a subsidiary. Sand Prairie operates as a "fiber cooperative." JCE owns the fiber backbone and drops (last mile); Sand Prairie pays for the retail drops. Both electric/gas operational requirements and external requirements are considered in a ranking/weighting process as the fiber network layout is expanded.	Network operations are a shared responsibility between JCE's three core business units of electric, natural gas and broadband. All three business units are subject to a 'pro-rata' share of administrative services, such as billing and mapping. Only services specific to the business unit, such as Tier I technical call center support, are exclusively part of the respective business units' operating costs.	Not-for-profit	High-speed Internet access only. JCE is providing marketing materials to assist subscribers unfamilair with over-the-top (OTT) products such as streaming video options plus VoIP, IoT (ie.e.security sensors)

Table 5. Business Decision Making — the Broadband Business Model (continued from previous page)

		Business Model			
Cooperative Name	**Broadband Entity Name**	**Organizational Structure**	**Dedicated vs. Shared Staffing**	**For-profit vs. Not-for-profit**	**Broadband Products Offered**
Midwest Energy & Communications	*[Same name]*	The fiber business is a new division under the MEC "flagship" brand, not a new subsidiary.	20 staff have been added to date. Dedicated staff include fiber service reps, tech support, and installation/repair. All other personnel are shared resources. Sactivity-based cost accounting used to meet MPSC rrequirements and avoid unwanted cross-subsidization.	Selling fiber broadband services to non-members is considered a for-profit service and the associated margins accrue to the cooperative's established margin structure. Non-member subscribers pay the capital cost of network buildout.	High-speed Internet; voice services offered through Alianza. MEC also offers subscribers ViewLocal (a package of local TV stations) and regularly provides broadband adoption workshops on "cutting the cord" and going "Over-the-top."
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	NIneStar Connect, a fully integrated, multiservice cooperative, came into existence in 2011 with the merger of Central Indiana Power and Hancock Telecom. Its communications division operates as a telecommunications cooperative.	A team of 34 works on the technical side to maintain the fiber network, which is used by all the operating functions. Back office functions such as customer support accounting and billing are consolidated for administrative efficiency.	NineStar operates both not-for-profit and for-profit subsidiaries. Communication services outside Ninestar's electric membership area are operated by Central Indiana Communications as Ninestar's CLEC on a for-profit basis.	Services offered include high-speed Internet, telephone, video and security solutions to residential and business customers. Internet access speeds up to 300 Mbps to residential customers with "Triple-Play" bundles of Internet+Phone+TV. Business customers' Internet speeds currently include 600 Mbps and 1 Gbps options. Services offered to business customers include hosted phone service, outsourced IT, and video services.

Table 5. Business Decision Making — the Broadband Business Model (continued from previous page)

		Business Model			
Cooperative Name	**Broadband Entity Name**	**Organizational Structure**	**Dedicated vs. Shared Staffing**	**For-profit vs. Not-for-profit**	**Broadband Products Offered**
North Alabama Electric Cooperative	*NA Fiber*	NaFiber is an operating division of NAEC, not a subsidiary or spin-off	11 dedicated employees (as of June 2018) Dedicated installers work on fiber network and member drops; shared back-office functions in finance, accounting, billing and payroll.	Not-for-profit	Fiber Internet access at speeds from 50 Mbps to 1 Gbps, telephone and digital TV services.
Orcas Power and Light Cooperative	*Rock Island Communications*	Rock Island is a wholly-owned, for-profit subsidiary of OPALCO. OPALCO owns the backbone fiber; Rock Island owns all distribution fiber and LTE sites; OPALCO owns Rock Island.	40 full-time, dedicated employees.	For-profit subsidiary of OPALCO.	Fiber-connected subscribers offered Internet access service up to 1 Gbps and digital telephone service. Rock Island also offers a full suite of IT services — hosting, email, technology classes, etc.

Table 5. Business Decision Making — the Broadband Business Model (continued from previous page)

		Business Model			
Cooperative Name	**Broadband Entity Name**	**Organizational Structure**	**Dedicated vs. Shared Staffing**	**For-profit vs. Not-for-profit**	**Broadband Products Offered**
Roanoke Electric Cooperative	*Roanoke Connect*	REC owns and operates the broadband backbone network and provides support related to the co-op's demand response and system automation programs. As such, related capital costs are rate-based as with other investments for system improvement. Roanoke Connect is a wholly-owned subsidiary (CLEC).	REC has a total of 62 employees (2018).	Roanoke Connect is a wholly-owned, for-profit subsidiary of REC	High-speed Internet only. No telephone service offering.
Valley Electric Association (VEA)	*Valley Communications Association (VCA)*	VCA is a wholly-owned broadband communications subsidiary of VEA and co-op members receive patronage capital in VCA revenues.	Intercompany agreements define boundaries between the communications and electrical infrastructures. Some thirty personnel are dedicated to the broadband business while back office resources are shared. VEA's move into broadband services resulted in a 15% increase in overall VEA staffing from 142 to 163. All departments were impacted.		Wireless Internet access at 25 Mbps initially, recently increased to 40 Mbps. Fiber broadband will offer speeds of 50 Mbps to 1 Gbps. VoIP telephone also offered.

Technology Decision-Making Factors

Introduction and Overview

Decisions about what communication technologies to deploy and network architectures to adopt, at least on the scale that many electric cooperatives are now considering, are unprecedented. While virtually all electric utilities have past experience with communications — for substation control, backhaul of metering data, mobile communications with crews in the field and feeder monitoring, to name a few applications — only a handful of the featured co-ops have lengthy experience in retail communications services. And, much of that experience predated current-day, digital broadband technologies, such as fiber-optics. Many of the 2018 case studies reflect a common pattern of technology investment — the cooperative first connects its electrical substations and offices with high-speed communications lines, generally fiber-optic. This broadband infrastructure then becomes the foundation, or backbone, for a wider communications network that ultimately enables advanced grid management and automation, and expands Internet access to businesses, institutions, and households in the communities served. Nearly 18,000 miles of fiber have been deployed by the twelve co-ops in the case studies, an astonishing feat for electric utilities of any kind given the short time frame involved.

One creative approach adopted by several of the featured co-ops is the melding of fixed wireless and fiber-optic networks. In some instances, the fixed wireless is rapidly deployed to provide improved, e.g., 25 Mbps, Internet access and a revenue stream for the new business entity, while the fiber network is being built out. In others, last-mile access is wireless and the network backbone/middle mile is fiber-optic. Either way, electric co-ops have demonstrated that they are highly responsive to the communication needs of the communities they serve.

Key Insights from the Case Studies

- **Minimum Access Speeds –** A wide consensus exists among the cooperatives studied that a minimum Internet access speed of at least 25 Mbps will be required to fully realize the potential of the Internet and take advantage of applications such as video streaming, telemedicine, and distance learning, as well as bandwidth-hungry applications in the future. For low-density, rural areas, high-speed Internet access is what enables full participation in the larger world.

- **Fiber is the Overwhelming Choice –** The vast majority of broadband networks being deployed by the case study co-ops are fiber-optic. Fiber-optic communications is viewed by these co-ops as the most resilient, financially viable and capable, if not "future-proof," network architecture available. Fiber-optic networks are also considered the best fit with the high-speed, low-latency requirements of advanced electric grid operations and near-real-time data backhaul. These networks offer subscribers Internet access speeds up to 1 Gbps and possibly higher.

- **Rapid, Extensive Buildout –** Fiber-optic networks built and planned by the twelve cooperatives encompass approximately 17,700 route-miles. That this level of network deployment has taken place in the last few years is remarkable.

- **Fixed Wireless as Interim Solution –** Several co-ops have deployed fixed wireless networks as an interim broadband solution while their fiber-optic communication networks are being built out. This has the dual advantage of meeting the immediate needs of communities that are currently unserved or underserved with regard to high-speed Internet access and generating an early revenue stream.

Tables 6 and 7 on the following pages contain technology decision factor data from the 2018 broadband case studies.

Table 6. Technology Decision Making — Scope of the Broadband Network (continued on next page)

Cooperative Name	Broadband Entity Name	Network Scope	
		Network Route-miles	Overhead/ Underground
Anza Electric Cooperative	*ConnectAnza*	~600 miles	Almost entirely pole-mounted (10,000 poles)
Arrowhead Electric Cooperative	*True North Broadband*	Approximately 800 miles.	Generally follows electric lines — 425 miles overhead; 375 miles underground
Barry Electric Cooperative	*goBEC Fiber Network*	1,100 route-miles of fiber planned.	Most of fiber network going on overhead on poles and in BEC rights-of-way. Fiber is being buried in areas where too many poles would need to be replaced due to inadequate from existing lines.
Delta-Montrose Electric Association	*Elevate Fiber*	3,000 miles of fiber planned by 2021.	Overhead everywhere. DMEA has pole lines available, buried only where necessary. Following electric co-op easements everywhere possible.
Douglas Electric Cooperative	*Douglas Fast Net*	Nearly 1,300 miles of the fiber network is carried overhead, passing approximately 35,000 homes and business premises.	130 miles placed underground.
Jo-Carroll Energy	*Sand Prairie Broadband*	164 miles of mainline and drop fiber deployed; ~3,000 mainline fiber miles and ~700 miles of drop fiber miles planned.	Almost equal shares of overhead and underground.
Midwest Energy & Communications	*[Same name]*	>2,000 route-miles	80% overhead / 20% underground, following electric system
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	1,900 miles of fiber	70% underground/ 30% overhead
North Alabama Electric Cooperative	*NA Fiber*	1,250 miles of fiber	95% aerial / 5% URD

Table 6. Technology Decision Making — Scope of the Broadband Network (continued from previous page)

Cooperative Name	Broadband Entity Name	Network Scope	
		Network Route-miles	Overhead/ Underground
Orcas Power and Light Cooperative	*Rock Island Communications*	526 miles	84% underground distribution fiber / 16% overhead distribution fiber.
Roanoke Electric Cooperative	*Roanoke Connect*	200-mile fiber ring currently in place. An additional 150-200 miles is possible, depending on how much additional grant funding becomes available.	Mostly overhead
Valley Electric Association (VEA)	*Valley Communications Association (VCA)*	Ultimate FTTH network will encompass 1,342 route-miles.	(Not Available)

Table 7. Technology Decision Making — Broadband Network Architecture (continued on next page)

Cooperative Name	Broadband Entity Name	Network Architecture				
		General	Regional Transport	Network Backbone	Middle Mile	Last Mile (Retail Drop)
Anza Electric Cooperative	*ConnectAnza*	100% FTTP GPON network	(Not Available)	Fiber	Fiber	100% fiber except microwave or wireless where physical limitations exist
Arrowhead Electric Cooperative	*True North Broadband*	100% FTTP GPON distributed tap system (for low-cost service in low-density, rural areas).	(Not Available)	(Not Available)	(Not Available)	(Not Available)
Barry Electric Cooperative	*goBEC Fiber Network*	100% fiber network. GPON with Calix electronics. Has capability for direct Ethernet connections. Fiber network backed up by KAMO fiber network connecting substations.	goBEC has two backbone service providers. One is Level3 (CenturyLink) and the other is KAMO Electric Cooperative. Primary provider is Level3. Both are 10Gbps	10 Gbps MPLS fiber ring connects BEC offices with seven remote areas, designed for resiliency in event of tornado strikes.	Fiber	Fiber

Table 7. Technology Decision Making — Broadband Network Architecture (continued from previous page)

Cooperative Name	Broadband Entity Name	Network Architecture				
		General	Regional Transport	Network Backbone	Middle Mile	Last Mile (Retail Drop)
Delta-Montrose Electric Association	*Elevate Fiber*	100% FTTP, using GPON architecture with 1:16 splits for residential and 1:8 for commercial.	Limited to only a few options: Fasttrack (a regional transport provider owned by two area electric co-ops), and Forethought (a CO based regional transport provider). Other options in area include CenturyLink and Spectrum, but all carriers are utilizing the same fiber backbone as it is the only one in existence for this area today.	Dual 10Gb fiber rings from diversified carriers for global interconnection. 10Gb ring architecture connecting seven regionalized comm shacks that host OLT connectivity.	Fiber	Fiber

Table 7. Technology Decision Making — Broadband Network Architecture (continued from previous page)

Cooperative Name	Broadband Entity Name	Network Architecture				
		General	Regional Transport	Network Backbone	Middle Mile	Last Mile (Retail Drop)
Douglas Electric Cooperative	*Douglas Fast Net*	DFN's first-generation infrastructure included a fiber middle mile and fiber to anchor institutions. Fixed wireless products were used for small business and residential applications. The technology subsequently evolved toward high-speed lines leased from the Incumbent Local Exchange Carrier (ILEC) and Digital Subscriber Lines (DSL), and eventually to the fiber-to-the-home (FTTH) GPON network being built out today. the move to all fiber will take time. DFN network still includes some fixed wireless and DSL components.	LS Networks is DFN's major transport access provider and strategic partner. The company is the for-profit descendent of Northwest Open Access Network (NoaNet) Oregon (2001), which utilized capacity on the Bonneville Power Administration's transmission fiber network under a federal Public Purpose Program. LS Networks, which launched in 2005, closely collaborates with the electric cooperatives that participate in its ownership.		N/A	DFN fiber network.

Table 7. Technology Decision Making — Broadband Network Architecture (continued from previous page)

Cooperative Name	Broadband Entity Name	Network Architecture				
		General	Regional Transport	Network Backbone	Middle Mile	Last Mile (Retail Drop)
Jo-Carroll Energy	*Sand Prairie Broadband*	Broadband services initially launched via fixed wireless network (2009-2016). FTTP was undertaken in 2015 and the fiber network is in the process of being built out. Fixed wireless provides an interim solution and a needed revenue stream.	(Not Available)	In JCE's case, the fiber backbone and middle mile are one and the same. Everything except the broadband service drops to homes and businesses are considered to be part of the network backbone.		Currently 95% wireless / 5% fiber, trending to 100% fiber.
Midwest Energy & Communications	*[Same name]*	MEC's broadband network is a bi-directional FTTx open network using Gigabit Passive Optical Network (GPON) electronics.	(Not Available)	MEC's FTTP network takes advantage of a 243-mile fiber communications ring that connects its electric substations and facilities to enable smarter grid operations.		(Not Available)
Ninestar Connect (formerly Central Indiana Power)	*Ninestar Connect / GigE Internet*	NineStar's network will ultimately be 100 percent FTTH with GPON with Calix electronics along with Cisco direct fiber drops (Active fiber). Less than 100 legacy DSL customers in CLEC space.	Indiana Fiber Network — 4,900 route-miles of fiber-optic cable connecting all of Indiana's major population centers.	Fiber ring connecting electrical substations	N/A	Fiber

Table 7. Technology Decision Making — Broadband Network Architecture (continued from previous page)

Cooperative Name	Broadband Entity Name	Network Architecture				
		General	Regional Transport	Network Backbone	Middle Mile	Last Mile (Retail Drop)
North Alabama Electric Cooperative	*NA Fiber*	Complete fibers network	N/A	160 miles	100% fiber	100% FTTH
Orcas Power and Light Cooperative	*Rock Island Communications*	Fiber-based hybrid (fiber to the home and LTE wireless) communications network. Deployment of an LTE fixed wireless system in partnership with T-Mobile delivered immediate cash-flow to the new Rock Island entity while the fiber network is being constructed. (38 LTE wireless towers)	The network relies on OPALCO's Power Grid Control Backbone, the fiber network the co-op uses to manage its electrical system, as its core. 165 miles of backbone / transport fiber in County. Partners with Bonneville Power Administration and Wave Fiber for Backhaul out of County to Seattle, WA.		The transport and distribution network is an active-Ethernet fiber-to-the-premise (FTTP) network supplemented by an LTE fixed wireless network for hard-to-reach locations. As of early this year, about 32 percent of Rock Island's customers are served by FTTP and 53 percent are served via the LTE wireless, with the remaining 15 percent being served by legacy DSL and other internet forms.	
Roanoke Electric Cooperative	*Roanoke Connect*	REC's broadband network relies on a hybrid architecture that combines both a fiber-optic backbone with fixed wireless technologies. Grant funds will be used to convert planned wireless backhaul to fiber backhaul.	Collaborating with MCNC - NC's statewide fiber broadband network	200 miles of fiber connecting REC's 12 substations to its offices.	Fiber laterals are extended from the backbone into areas containing higher population densities, whereas fixed wireless networking is deployed for the more rural middle-mile connections.	Last-mile connections to member premises are wireless.

Table 7. Technology Decision Making — Broadband Network Architecture (continued from previous page)

Cooperative Name	Broadband Entity Name	Network Architecture				
		General	Regional Transport	Network Backbone	Middle Mile	Last Mile (Retail Drop)
Valley Electric Association	*Valley Communications Association*	VCA's broadband network combines fixed wireless and fiber-optic technologies. The core wireless network is by Nokia with Nokia network gear on towers. Last mile equipment is supplied by Radwin. Use of Radwin's JET PtMP Beamforming solution enabled VCA to roll out its wireless network and connect 6,000 members in one year.	VCA and Churchill County Communications partnered with Las Vegas-based Switch to build a 500-mile, high-speed Internet connection between Reno and Las Vegas.	VEA's fiber backbone connecting substations (completed in 2016).	Fixed wireless network with fiber and microwave backhaul. FTTH in select areas with fiber backhaul.	Mainly wireless until fiber-optic network is built out.

Summary and Conclusion

Many electric cooperatives nationwide are considering significant investments in broadband communications. Experiences captured in NRECA's 2018 broadband case studies indicate that in every case, expansion of the network to bring reliable, high-speed Internet access to members became a key consideration. And in every case, the decision was made to leverage the utility's own broadband network backbone to serve members of the community at large. This is what electric cooperatives were created to do.

The case studies make clear that there is no universally applicable technology solution here, or well-tread business path, that everyone can follow. The featured co-ops have made a variety of organizational, financial, and technological choices that reflect their own, specific needs and the needs of their communities. Many have taken advantage of grant opportunities to improve their investment fundamentals. Others have realized opportunities to serve non-members in nearby locations. Still others have entered into innovative partnerships to deliver broadband services. A few have redefined themselves as integrated utility service providers. The bottom line, however, is unmistakable. Together, these cooperatives offer views through many lenses into the new world rapidly unfolding.

Photo Acknowledgements

Photo credits according to order of appearance in this report: Valley Electric Association, North Alabama Electric Cooperative, Valley Electric Association, Jo-Carroll Energy.

2018 Broadband Case Studies (81 pages)

All twelve Broadband Case Studies can be found at:
https://www.cooperative.com/programs-services/bts/Pages/Broadband-Co-op-Case-Studies.aspx

NRECA's Broadband Team

NRECA has a cross-departmental team that works on broadband issues and initiatives:

Front Office Lead:

- Jeffrey Connor, COO

Team Members:

- Paul Breakman – Business and Technology Strategies (Business Models and Solutions)
- Russell Tucker & Joe Goodenbery – Business and Technology Strategies (Economic Analysis)
- Stephen Bell & Tracy Warren – Media & PR (Communications)
- Kelly Wismer– Government Relations (Legislative Affairs)
- Brian O'Hara – Government Relations (Regulatory Affairs)
- Ty Thompson and Jessica Healy – General Counsel's Office (Legal)

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