The 51st State | Phase II

The Consumer-Centric Utility Future

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NRECA
America's Electric Cooperatives

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Executive Summary

The National Rural Electric Cooperative Association (NRECA) on behalf of its members, America's Electric Cooperatives, is providing the following response to the Solar Electric Power Association's[1] (SEPA) call for papers charting a path to a new energy landscape.

Background on America's Electric Cooperatives

Electric cooperatives are not-for-profit energy service providers, owned and governed by the consumers they serve. The co-op system includes 840 distribution and 65 G&T cooperatives serving 42 million consumers in 47 states with a majority being in rural areas. Co-ops serve 12 percent of electric consumers in the United States but operate and maintain 42 percent of distribution lines in a challenging engineering landscape due to lower consumer density, significantly greater miles of line, and often difficult terrain. By design, co-ops are consumer-centric. In addition to providing safe, affordable, and reliable electricity, they are committed to their communities, adaptive to local changes, and responsive to consumer needs. This consumer-centric model helps explain why co-ops enjoy the highest customer satisfaction scores in the industry as measured by both JD Power & Associates and the American Customer Satisfaction Index (ACSI).

Background on the 51st State Initiative

As SEPA has explained, the 51st State Initiative can be boiled down to two fundamental goals:

1. To create equitable business models and integrated grid structures to ensure that electricity is provided safely, reliably, efficiently, affordably, and cleanly; and,
2. To meet customer demand in the near and long term for solar and other distributed options.

In Phase I of the Initiative, SEPA asked participants to envision a blank slate, where no existing constraints, programs, structures, regulations, or restrictions would prevent the development of an ideal structure. NRECA participated in that process.

As stated in the Executive Summary of its submission, NRECA argued that the hypothetical 51st State should be designed to ensure reliable, affordable, safe and environmentally-responsible power. To accomplish that goal, investments in the 51st State's electric system should not be made in isolation. The electricity sector is complex, and each segment of the grid is affected by every other. In order to achieve reliability, affordability, safety and environmental responsibility, the ideal electric system in the 51st State should not promote specific policies or technologies. It should instead strive to achieve the best mix of resources. The 51st State should have an appropriate market structure designed so that a Load Serving Entity (LSE) such as an electric cooperative can optimize the system in ways that benefit all consumers. As LSE's, consumer-owned, consumer-directed not-for-profit private entities, cooperatives have the obligation to provide such a market structure and complete, transparent information to their consumer-members in order to facilitate their ability to make informed decisions.

As described in the previous submission, another cornerstone of the future 51st state for America's Electric Cooperatives is the importance of local control. The second cooperative principle, "democratic member control," provides that consumer-members have an active voice in the decisions of the Board and for the Board to be accountable to meet the needs and wants of their consumer-members. In addition, applying

1 Soon to be renamed the Smart Electric Power Alliance

the seventh cooperative principle of "concern for community," local ownership in the co-op territory can serve the economic interests of and provide for sustainable development of local communities.

NRECA further explained that the 51st State should have a regulatory framework that accounts for the rights and responsibilities of all stakeholders. It should also leave the regulatory compact intact in order for the utility to continue to meet its obligation to serve all consumers and to make investments necessary to provide reliable, safe and affordable service. An experienced decision-maker is necessary to balance competing policy goals and oversee the system as a whole while also remaining accountable to the public. An electric cooperative fulfills both of these criteria.

Finally, NRECA stated that the 51st State should be designed to allow for the continued growth of the solar and Distributed Energy Resources (DER) markets. Consumers in the 51st State must be aware of the true costs in order to make informed decisions regarding Distributed Generation (DG) projects. DG projects must be cost-effective so that all costs are considered and cost shifting does not occur.

In Phase II of the Initiative, SEPA now asks how the industry can move from today's familiar structures towards visions for the future. In this paper, NRECA explains what needs to happen to move from today's world – the Current State – towards the vision NRECA described in Phase I.

Current State

In today's world, there are numerous business and regulatory models. Some states have adopted retail competition for at least some of their retail consumers while others have maintained traditional monopoly utility service at retail. At wholesale, some areas have developed centralized markets while others continue to rely on traditional bilateral markets. No two of the centralized markets have exactly the same market rules and tariffs. Retail consumers may be served by Investor-Owned Utilities (IOUs), municipal utilities, electric cooperatives, retail electric suppliers, demand response aggregators, solar providers, or other third-party service providers. Wholesale consumers may build their own generation, buy power from IOUs, munis, co-ops, federal utilities, or independent power producers.

In this paper, NRECA uses the term Consumer-Centric Utility (CCU) business model to refer to the future LSE model described in the previous submission to phase 1 of the 51st State Initiative. A CCU is a LSE or utility that integrates and optimizes a portfolio of resources on behalf of consumers, including central-station generation, transmission, distribution, and DER, including energy efficiency, demand response, distributed generation and storage, and community-scale generation and storage. The CCU may own or contract for rights to resources or may integrate resources owned and operated by others, but the CCU's goal is to ensure that the portfolio is optimized to balance a range of policy goals according to its consumers' preferences. Those goals generally include safety, reliability, affordability, rate stability, risk management, and environmental sustainability. Investor-owned utilities, municipal utilities, and electric cooperatives can all be CCUs if they integrate and optimize a portfolio of resources on behalf of their consumers even though the incentives for each sector are different.

In the current state, the CCU has proven itself to be an ideal vehicle to perform these functions because it manages risk, optimizes grid integration and provides energy advice, benefiting all consumers on the grid. The CCU adopts new technologies and services meeting consumer needs as they become available and seeks to integrate them into its portfolio at the pace of value to all consumers. The CCU also seeks to enable individual consumers to invest in DER technology and services that meet their individual needs and to do so in a manner that balances the needs of the grid as well as other consumers. This is the art of "optimization" that the CCU is in an ideal position to fulfill.

Future State

NRECA does not know for sure what the future will bring. NRECA is excited about research taking place today on carbon capture and beneficial re-use, small modular reactors, next-gen large scale nuclear generation, off-shore wind generation technologies, and community-scale generation and storage, as well as advances in DER and distribution-system technologies. Because consumers in the future will continue to have different preferences, different approaches will better serve those preferences in light of local circumstances. The future 51st state will likely have numerous business, regulatory, and market models as does the current state. Nevertheless, whatever the future may look like in this 51st State, NRECA believes that the CCU model is ideally suited to bring about that future in a manner that ensures that electricity is provided safely, reliably, efficiently, affordably, and cleanly; and, that meets consumer demand in the near and long term for solar and other distributed options.

For that reason, NRECA believes that the future 51st state should adopt market designs and regulatory structures that support and benefit consumers and that support and enable CCUs to continue to make local portfolio decisions on behalf of their consumers. That approach will organically lead to an energy future in which most CCUs provide even greater resource options for households and businesses while continuing to support traditional goals of safety, affordability, reliability, rate stability, and environmental sustainability. Not only do these energy services and system enhancements meet consumer desires, they can be deployed in ways that enhance the resiliency of the electric system. This represents an evolution, not a revolution of the role of the electric utility that created the greatest engineering feat of the 20th Century under the Current State. The CCU's role will expand and adapt as consumer expectations and technology evolve. CCUs will keep the needs and aspirations of their consumer-members front and center while continuing to provide safe, affordable, sustainable, and, most importantly, reliable , and resilient electric service.

Stages to get to the Future State

As noted above, the 51st State in the future will recognize that the electricity sector is complex, and that each segment of the grid is affected by every other. In order to achieve reliability, affordability, safety and environmental responsibility, the ideal electric system in the 51st State will not promote specific policies or technologies but will instead have adopted regulatory and market structures that enable CCUs such as electric cooperatives to optimize the system in ways that benefit all of their consumers.

If we are going to get to the future 51st State NRECA described in Phase I of the 51st State Initiative, state policies that pick winners and losers today, such as some rate structures and rules for compensating DER, will need to be modified to give CCUs and their consumers more latitude to optimize investments for the benefit of all consumers. Where wholesale market designs have preferences for certain technologies or

Trusted Energy Advisor

Educate consumers and provide them with options in a way that adds value across the system

Risk Manager

Manage risks, particularly to reliability, safety, and costs

Grid Optimizer

Optimize grid integration in a cost-effective and sustainable manner undermine CCUs' efforts to manage their portfolios, those market rules will need to evolve over time to enable and even support CCUs' portfolio management activities.

Similarly, CCUs will need to take advantage of new technologies that will allow CCUs to make new and expanded offerings and behind-the-meter solutions available to consumers, including community solar, community storage, energy efficiency, time-of-use rates, reliability services, and other services as they become available and cost-effective. CCUs will leverage the power and advantages of DERs to enhance the electric distribution system's power quality and resiliency. In this expanded role, the CCU will continue serving as the trusted energy advisor, risk manager, and grid optimizer. The CCU model is extraordinarily flexible. Over the past 70 years, the grid has grown and changed and the resources on which the industry relied to serve consumers have changed with it. Nevertheless, through numerous changes and cycles, utilities have continued to provide consumers safe, reliable, affordable, and increasingly environmentally sustainable energy.

Current State → **Stage 1** → **Stage 2** → **Future State**

Utility Business Model	The flexibility of the Consumer-Centric Utility (CCU) will continue to promote innovation and enable new products and services to consumers.
Asset Deployment	The CCU will integrate new technologies in a way that optimizes the system in order to meet overall goals of providing electricity service in a reliable, safe, affordable, and sustainable manner that promotes economic prosperity.
IT	The CCU will play a key role in managing the technological changes taking place in the industry by addressing challenges related to Operations Technology (OT), Energy technology (ET), and Information Technology (IT).
Wholesale Market Design	Wholesale markets will continue to evolve to address changes in the environment, local and national economies, and technology.
Retail Market Design	The CCU, because of its ability to take a longer and broader view, will continue to benefit consumers by optimizing the system, managing costs and risks ensuring high quality and reliable service to meet consumers' evolving expectations.
Rates & Regulation	Rates and regulation will be tailored to local conditions and enable consumers access to new products and services while serving the interests of the system as a whole.

Since America's Electric Cooperatives were first formed, the industry has been in a continuous state of evolution, and cooperatives have consistently been able to adapt to those changes and take advantage of improvements in the system to serve consumers well.

In the Future State, CCUs of all stripes will continue to expand the number of participating consumer-members, types and combinations of energy services and grid enhancements that are optimal for its system. Being close to the consumer-member and operating through local control enhances the cooperatives' ability to fulfill the CCU role. America's Electric Cooperatives are well positioned to meet their consumer-members' quality of life and economic needs and wants for all manner of energy services including safe, reliable, resilient, and affordable electric service. Again, this is an evolution, not a revolution.

The path to this future state will be explored through the following six swim lanes: Utility Business Model, Asset Deployment, IT, Wholesale Market Design, Retail Market Design, Rates & Regulation.

Utility Business Model

Current State

There are two different core business models today, though there are numerous variations on each. The competitive model in restructured states and service territories is generally characterized by disaggregation into competitive retail electric suppliers, competitive independent power producers, competitive aggregators providing demand response or other retail services, and regulated wires companies. That model is not the focus of this paper. The other model is the more traditional utility model in which the utility has an obligation to serve retail consumers.

This paper is focused on the Consumer-Centric Utility (CCU). A CCU is a utility that integrates and optimizes a portfolio of resources on behalf of consumers, including central-station generation, transmission, distribution, and Distributed Energy Resources (DER), such as energy efficiency, demand response, distributed generation and storage, and community-scale generation and storage. The CCU may own or contract for rights to resources or may integrate resources owned and operated by others, but the CCU's goal is to ensure that the portfolio is optimized to balance a range of policy goals according to its consumers' preferences. Those goals generally include safety, reliability, affordability, rate stability, risk management, and environmental sustainability. Investor-owned utilities, municipal utilities, and electric cooperatives can all be CCUs if they integrate and optimize a portfolio of resources on behalf of their consumers even though the incentives for each sector are different.

In order to enhance their resource portfolios and meet consumer preferences, many CCUs are making the following options available to today's consumers in their service areas:

- Distributed Generation (DG), particularly renewable resources
- Storage, both thermal (water heaters, electric thermal storage, ice, etc.) and batteries
- Demand Response (DR) and Time-of-Use programs
- Energy Efficiency (EE) programs
- Distribution Automation Technologies (i.e. the "Smart Grid")

In the current state, the CCU has proven itself to be an ideal vehicle to enable these services in a manner that benefits all consumers on the grid. It has sufficient scale to make necessary investments in technology.

A CCU also benefits from "scope." That means it has a broad enough perspective across the interrelated elements of the grid to both recognize how new technologies can provide value across the CCU's operations and to make investments in disparate system elements required to harvest those benefits. For example, optimization of consumer-owned generation and storage for the benefit of all consumers on the system may require substantial enhancements to the utility's distribution facilities, telecommunications infrastructure, distribution SCADA, and data management systems. Because the CCU has a perspective that includes distribution and DER, it has the ability to see the need for those investments and the incentive to make them when it is in the interest of its consumers.

The CCU also gains efficiencies of integration because it can optimize the system to maximize the total value of its investments in different technologies and services for its consumers. As noted above, the CCU can make investments in one portion of its portfolio required to maximize value from other elements of that portfolio. It also has the ability to target investments in those elements of its portfolio that best meet consumer interests. For example, depending on its particular circumstances, a CCU might invest in demand response because that DR provides a good fit with the intermittent generation it purchased because of its low energy costs. Another CCU might invest in the infrastructure required to communicate with and control smart inverters on consumer-owned solar generation because that allows it to reduce voltage when faced with high market prices for power.

CCUs also have a sufficiently long-term vision to allow them to make long-term investments in their future, including new resources, new infrastructure, and the kinds of RD&D required to find develop new technologies. Entities with short-term business models are unlikely to invest millions in long-lived resources that may be required to optimize a portfolio. They are also unlikely to put money into testing use-cases for new technologies and services that have not yet proven their profitability, but that have long-term promise to reduce costs, enhance reliability, or offer consumers new choices at some point in the future.

And most importantly, the CCU has a consumer focus that drives it to investigate new technologies and services and integrate them into its portfolio when they can provide consumer value. The CCU's consumer focus is the greatest distinguishing feature between CCUs and other traditional utilities. Because they are consumer-owned, consumer-governed, not-for-profit utilities, cooperatives are naturally consumer-focused. Municipal utilities' local ownership and local control also leads them to lean towards consumer-focus. Investor-owned utilities can also be CCUs where their management philosophy or where state regulators drive them towards meeting consumer interests.

For all these reasons – scale, scope, integration, long-term vision, and consumer focus – the CCU is also well situated to enable individual consumers to invest in DER technology and services that meet their individual needs and to do so in a manner that reflects the needs of the grid as well as other consumers. This is the art of "optimization" that utility is ideally situated to fulfill.

Many in the industry now understand the need for system "optimizers" as new energy services and products emerge, as grid enabling technologies evolve and how they can enhance resiliency; the utilities are well positioned to meet such a role as CCU. Each sector has its own examples of current state operations and successes. NRECA is focusing on the cooperative role in this paper.

Electric cooperatives in the Current State have consistently demonstrated innovative technology leadership within the industry in areas such as Advanced Metering Infrastructure (AMI), load management, energy efficiency and demand response programs, as well as Smart Grid deployment, community solar programs, and interoperability standards. They invented tools to develop automated meter reading (AMR) before they came into vogue, deployed load management/demand response at five times the rate of other utilities, and leveraged the American Recovery and Reinvestment Act Smart Grid Demonstration Projects to become industry leaders in Smart Grid development.

Co-ops are among industry leaders in energy efficiency and demand response programs, unmanned aerial vehicles, community solar, and have recently developed the concept of community storage. Additionally, co-ops own the only recognized interoperability standard, and have posited the concept of dynamic modeling to enable the grid of the future. Finally, America's Electric Cooperatives, through NRECA, won a number of federal grants to advance all aspects of the electric and energy future both in the United States and globally, some including cyber security and automated grid control devices. All of these efforts are directed toward member and consumer-member value. They underscore the importance of Beneficial Electrification that NRECA has recently promoted as critical to any future state if economic and environmental gains are to be achieved. They demonstrate the power of local control of America's Electric Cooperatives.

Today, as CCUs, America's Electric Cooperatives meet their obligation to serve as diversified electric organizations that own and operate or contract with third parties some or all facets of electric service, incorporating generation, transmission, distribution and DERs as a bundled suite of services for the benefit of their consumer-members. This consumer-centric model has proven resilient and adaptable over time. While changing business structures have been introduced over the past twenty years, co-op utilities have continued to leverage an integrated set of resources to meet the fundamental need for safe and reliable service to their consumer-members and the communities they serve.

As stewards of their consumer-members' resources, co-ops have invested in new technologies and capabilities at "the rate of value", looking for solutions that meet participating consumer's expectations while delivering net benefit to all consumer-members. As the cost-benefit ratios change along with consumer-member needs, co-ops have adapted their service offerings. The co-op business model has fostered innovation, whether in remote, rugged locations, high cost locations or locations needing power quality enhancements.

In Georgia, Green Power EMC actively pursues solar opportunities, while also providing an educational program on solar systems to dozens of schools in its service area.[2] In South Dakota, co-ops help ranchers deploy solar-powered stockwells in remote locations. In New Mexico, a co-op installed a solar micro-grid on a community college campus in order to boost power quality at the remote location. After listening to their consumer-members' needs, each co-op developed a solution that appropriately balanced functional goals and cost effectiveness. Now, each of those co-ops is sharing knowledge gained from these projects with other co-ops across the country, demonstrating a higher level of cooperation that would be lost if co-ops were not in the role of optimizing the system.

NRECA believes future state policies and programs should provide this same foundation that can minimize the risks associated with rapid market change and extend benefits to all consumers.

2 GPEMC Case Study Provided in appendix

Future State

It is important for this discussion to differentiate between the future business model and the future utility business.

With respect to the business itself, we do not know for sure what the future will bring. We are excited about research taking place today on carbon capture and beneficial re-use, small modular reactors, next-gen large scale nuclear generation, off-shore wind generation technologies, community-scale generation and storage, distribution automation, IT and communications, as well as advances in DER and distribution-system technologies. All of these new developments are likely to bring new tools and new resources CCUs can use to meet consumer demands for safe, reliable, affordable and environmentally sustainable power. We also see trends towards more consumer interest in new technology and service choices that together with advancing technology could result in a more dynamic and complex distribution grid environment. In this environment, the composition of electric supply will probably continue to evolve towards a mixture of central station and localized resources, both onsite generation, storage, energy efficiency and active demand response at the premise level. Electric consumers across all forms of utility ownership and market structure will likely incorporate such advanced DER solutions.

With respect to business models, as NRECA explained in response to Phase I of the 51st State Initiative, NRECA believes that the CCU business model is ideally suited to bring about that future in a manner that ensures that electricity is provided safely, reliably, efficiently, affordably, and cleanly; and, that meets consumer demand in the near and long term for solar and other distributed options.[3]

Despite the changes in resources, services, and infrastructure requirements that we suspect the industry will see in the next decades, we anticipate that the CCU will be just as strong, just as beneficial to consumers and just as innovative in the future as it has been for the past 70 years. The CCU model is extraordinarily flexible. Over the past 70 years, the grid has grown and changed and the resources on which the industry relied to serve consumers have changed with it. We have seen coal reign as king and we have seen its role shrink. We have seen natural gas generation grow, get cut off at the knees by the Fuel Use Act, and then resurge to a leading role.

Wind generation has grown in fits and starts as the Production Tax Credit has been authorized, lapsed, and been reauthorized. Retail and wholesale electric markets have developed, evolved, and in some places, devolved. Nevertheless, through numerous changes and cycles, CCUs have continued to provide consumers safe, reliable, affordable, and increasingly environmentally sustainable energy. Since America's Electric Cooperatives were first formed, the industry has been in a continuous state of evolution, yet cooperatives have consistently been able to serve consumers well.

Certainly, co-ops, as CCUs, will continue to meet their obligations to serve, continue to thrive as businesses and continue to bring new behind-the-meter solutions in order to meet consumer-member wants and needs. As integrators and optimizers, the CCUs will continue to evaluate investment tradeoffs between technical architecture and distributed energy resources it can deploy for maximum value and to accommodate consumer investment decisions that on their own may be suboptimal.

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3 Of course, because consumers in the future will continue to have different preferences, and different approaches will better serve those preferences in light of local circumstances, the future
51st state will likely have numerous business, regulatory, and market models as does the current state and NRECA does not suggest that only one model can work.

As CCUs, America's Electric Cooperatives are large enough systems to achieve scale, but small enough to stay close to their consumer-members, get a clear understanding of what they want, and provide solutions. Instead of focusing on short term solutions, co-ops will continue to evaluate the long term elements, recover costs, and spur beneficial investment. The diversity of individual co-ops and the discreet pathways they take towards the future electric system for their communities will provide a great opportunity to share best practices with each other.

Co-ops will continue to play a central role as diversified utilities that maintain the core infrastructure of the electric system by providing safe and reliable service, EE, daily operations, system planning and grid operations, long range planning, capital investment and consumer service/billing. In terms of retail and wholesale market engagement, co-ops will provide energy supply for retail load, as well as aggregation of DER from retail consumers. In this structure they will continue to provide essential support to low-income and at risk populations consistent with the guidance from consumer-members and where applicable to policymakers/regulators.

Stages to get to the Future State

As noted above, NRECA believes that the Consumer Centric Utility business model that has served consumers well for the past 70 years will continue to do so. The business model itself need not evolve to meet the future successfully.

The business in which the CCUs are engaged may, however, appear to change as the resources, tools, processes and service options the CCUs use to satisfy consumer needs evolve and prove themselves valuable.

The stages to get to that Future State or those Future States will progress differently for different CCUs based on their particular system design, resource portfolio and consumer-member goals and priorities. That is the very essence of the CCU model. The CCU is focused on its consumers and what right for consumers in Boulder, CO in 2015 may be very different than what is right for consumers in Withlacoochee, FL at the same time. The CCU also seeks to integrate new technologies and services in the manner that permits it to optimize its portfolio. For that reason, a diverse solution set should be allowed to evolve over time as individual CCUs address opportunities and challenges based on their localized circumstances and priorities, as well as their unique value equation for investments in advanced grid technologies, new products and services.

A transition to the future in which new technologies or services are forced at a pace that fails to reflect consumers' different preferences or the pace at which those new options provide value in light of existing resource portfolios is guaranteed to lead to suboptimum results for consumers. A transition to the future in which government selects particular winners or losers is also certain to be suboptimum. As demonstrated by the Fuel Use Act, the government does a poor job of selecting resources. In 1978, in the Fuel Use Act, Congress and the Carter Administration effectively prohibited the use of natural gas for generation because they believed we were running out of natural gas. Instead, they aggressively advocated the use of coal for generation. Today, we are told we have nearly inexhaustible supplies of natural gas, but coal generation – including many units built in response to the Fuel Use Act – is highly disfavored for environmental reasons. As noted above, we do not know for certain today what our energy future looks like with interesting possibilities out there for carbon capture, nuclear, wind, and storage as well as DER.

Nevertheless, NRECA envisions a future where consumers are increasingly engaged as partners in the electric distribution system; a future in which smart feeder switching and distributed energy resources increase resiliency. In this future, CCUs' roles should be expanded to meet the challenges and gain the opportunities of the future in partnership with their consumer-members.

Moving forward, CCUs will expand technology choices as emerging options offer consumer value. However, the basic structure of the flexible CCU model will remain the same, with co-ops and other CCUs integrating and optimizing assets to maximize consumer-member value, system operations and resiliency enhancement. Despite some interest to see the complete overhaul of the current utility business model to accommodate new technologies, the flexible CCU model better allows electricity providers to accomplish their main goals for a set of consumers in a given place. Co-ops have always been an optimizer, and in the 51st State, they should continue to optimize the system to the benefit of their consumer-members. As the industry transitions to the Future State, cooperatives will learn from the experiences of other cooperatives.

Conclusions

The evolving CCU model promotes innovation and enables new products and services to be offered to consumers. CCUs can consider offering services in the behind-the-meter market based on the earned trust of their consumer. An example of this would be selling electric water heaters, solar panel systems, and battery systems in order to meet consumer needs, to reduce the overall carbon footprint and to generate additional revenue. The local utility ownership structure and market system will shape the approach to CCU services, but in every case success will be predicated on being a trusted energy resource, on managing risk and on grid optimization. America's Electric Cooperatives are well positioned to fulfill their role as the CCU to advance the needs of their consumer-members in the Future State.

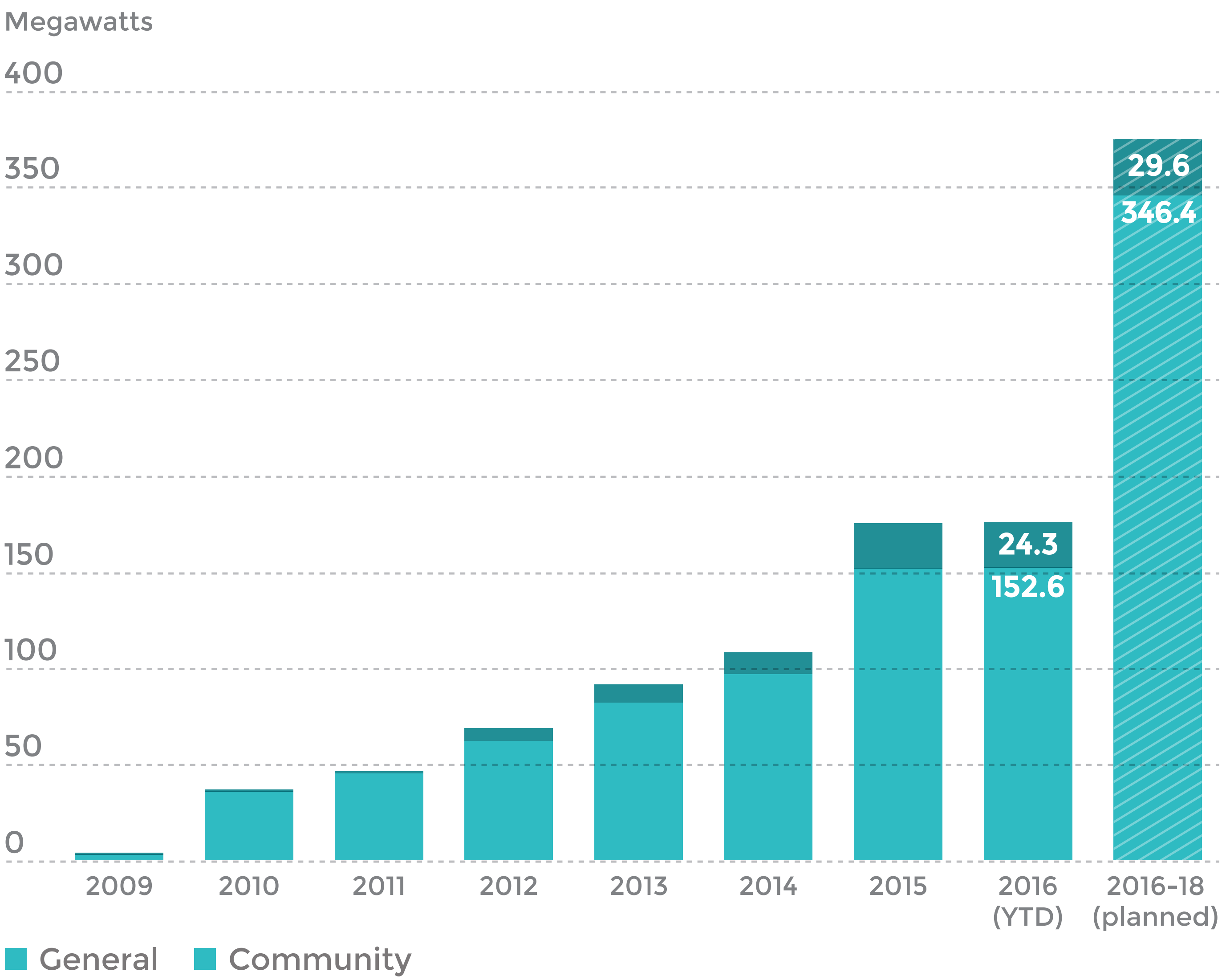
Asset Deployment

From a historical perspective, CCUs have invested in, built and operated electric infrastructure on behalf of consumer-members in a manner that balances cost, reliability, quality and safety. Those investments are recovered on an equitable basis and accomplished in an environmentally responsible manner. For America's Electric Cooperatives, these aspects are of great importantance for both individual consumer-members and the economic prosperity of their communities. For example, Hawaii's Kauai Island Utility Cooperative (KIUC) provides an appropriate example of co-op investment: KIUC has a solar plus storage project, producing energy during the day and storing the energy for use during peak demand periods.[4] Managing the full value chain from generation to distribution, co-op managers have evolved with industry advances in electric equipment (poles, wires & substations), energy technologies (Advanced Metering Infrastructure (AMI, SCADA/EMS) as well in the information systems and processes that support service to consumer-members. As providers of the full range of energy services to their consumer-members, co-ops look at investment in grid infrastructure as a way to ensure that service to consumers is optimized in a holistic manner that includes generation, transmission, distribution and distributed energy resources.

4 KIUC Case Study Provided in appendix

Cumulative Co-op Solar Capacity

by owned, purchased (PPA), or community solar capacity



Source: NRECA Business & Technology Strategies
NRECA – March 2016

Current State

In the past decade there has been considerable advancement in the technologies that empower grid operators to not only maintain but enhance system reliability and the quality of communication with and service to consumers. CCUs across the country have pursued the modernization of their systems, informed by their distribution grid challenges and the goals and interests of their consumer-members.

There is strong interest throughout the electric industry in grid modernization. Utilities are taking advantage of technical advances that can improve service to consumers in terms of day to day reliability, and can be central to managing the more distributed electric system envisioned in the Future State. Similar to the experiences of other utilities, both investor-owned and municipal, co-ops have implemented advanced metering capabilities such as Advanced Meter Reading (AMR) and AMI. In fact, Over 70% of co-ops across the U.S. are using AMI in some form and are pursuing increasing grid automation through Meter Data Management Systems (MDMS), automated distribution devices and data analytics capabilities.

For America's Electric Cooperatives, investment decisions related to electric infrastructure are made by the co-op's Board of Directors on behalf of the membership, and these decisions are executed by the co-op's management. The needs in this area are a function of unique system conditions, power supply portfolios and consumer-member priorities. As a result, it becomes evident that the approach taken by a co-op in one state or community may not necessarily be in the best interest of a co-op in another region of the country; cooperatives have to find the solutions that are right for their system and membership.[5] One size does not fit all.

Co-ops have historic strength in deploying innovative programs for their consumer-members, helping them save on energy costs through DR, EE, and DG programs. A great example of this comes from Minnesota-based Steele-Waseca Electric Cooperative and their Sunna Project, which provided a free water heater to be used as a storage vessel for power generated by rapidly expanding solar arrays.[6] The overall goal is to be responsive to the interests of all categories of members in the co-op's service territory – residential, small commercial and industrial, agricultural, and large commercial and industrial. For example, co-ops have worked with their commercial and industrial member segments to tailor programs that help with energy costs and reliability, both of which are integral to their competitiveness, and therefore the economic success of consumer-member communities.

The move to AMR in many territories, especially those in more rural areas, has been beneficial, reducing manual meter reading and expediting the billing process; as noted above, co-ops invented and deployed the first automated meter-reading technology. These technologies also assist with agriculture producer's biosecurity concerns, as well as reducing carbon emitted by vehicles used for meter reading. Co-ops have also deployed AMI in their service areas that has brought incremental functionality beyond what AMR can provide, such as acquire and make accessible consumer data in a more granular fashion – in both time and space–, aid in identifying and restoring outages and providing enhanced visibility into the distribution system that assists in optimizing system operations and reliability; this was evidenced by the hugely successful ARRA Smart Grid Demonstration Project completed in August of 2015, with continuing deployment of such technologies across co-op nation.

5 This is embodied in Cooperative Principle 4. Autonomy and Independence.

6 SWEC Case Study Provided in appendix

Future State

Certain macro drivers, such as continued penetration of DER, will change the nature of the electric system and the interaction/service to consumers, though full detail on the future state of physical grid infrastructure is uncertain. This Future State environment will be more complex from a grid operations perspective due to increasing two-way flow of energy. With this evolving resource come technical challenges: over-voltage protection, power quality, unity power factor, harmonics, and grid hosting capacity, which must be addressed while at the same time keeping the door open to new services and levels of service to consumers.

In the future 51st State environment, CCUs will play the central role as the purveyor of energy and related services to consumers. Third party vendors may play a part in serving consumers directly or in partnership with CCUs. CCUs will be able to optimize the value offered to their consumers, either by providing the grid environment that can be leveraged by third parties or by directly providing behind-the-meter products and services.

Future DERs will need various operating modes to shape the energy they produce to meet load requirements and reliability standards. As with conventional generation today, there may be a need for DERs with a variety of loading capabilities – including base, intermediate and peaking, in addition to the capability to supply ancillary services such as voltage support and frequency response. Given that co-ops provide the full range of services to their consumer-members, they are in a good position to evaluate the technology used to manage and schedule these DER resources in different operating modes, as well as the market mechanisms to deal with these modes delivered by DERs.

Co-ops are in the process of developing plans and implementing grid modernization investments that will greatly enhance the operational visibility and adaptability of the electric grid their consumer-members rely on. At the same time, co-ops envision a whole range of enhanced services that can be made available to individual consumer-members that will foster EE, and improve consumer-member satisfaction. One example of this is Great River Energy, a generation & transmission co-op that operates in Minnesota and Wisconsin, which has combined solar, storage, and demand response; it incentivizes its consumer-members to take part in their growing solar network, while storing excess solar energy in hot water heaters. This energy is then dispersed during peak hours.[7]

This Future State and its continual evolution is fueled by significant amounts of complex data about the system and consumer-members' electricity use; cooperatives are in a unique position to broker that data for the benefit of driving asset investment decisions, whether in the technical architecture of the distribution grid or in devices on the grid.

CCUs will continue to play a role in ensuring adequate transmission to central station as well as remote generation. A range of factors will inform the thinking regarding incremental transmission investment such as:

1. Aging infrastructure, replacement
2. Reliability criteria and critical infrastructure protection
3. Connection of generating resources in remote locations
4. Market congestion in restructured markets
5. Incentives

7 GRE Case Study Provided in appendix

6. Regulatory structures
7. Generation technology
8. Ownership structures such as incumbent utility vs a merchant provider

In terms of technology, CCUs will need to be included in decisions on the modernization of the bulk transmission system just as they will play a central role at the distribution level.[8]

In planning for the Future State, there is a common sense process for CCUs to iteratively assess conditions, goals and available technology over time. There are a host of mature solutions that are already being implemented on the distribution grid. From AMI to distribution automation solutions like grid sensors, automated switches and fault identification devices, CCUs will continue to deploy advanced grid capabilities that will allow much greater visibility and control over grid conditions, increasing information and means for consumers to be energy efficient and see not only shorter outages but an outright reduction in service disruption.

The need for on-premise technologies depends on consumer interest and program design. Ideally, consumers are afforded some end point monitoring and data capture capability through the aforementioned AMI platforms. However, there are also incremental enabling technologies that transmit information to consumers and allow them to respond to signals from their CCU that help optimize the system and save on energy costs.

As DER becomes more ubiquitous, however, there will be greater variation in system voltage and real challenges based on the grid's baseline design historically intended to manage power that flows in one direction only, from generation to load. CCUs and grid operators will play a critical role in managing this adaptation in a manner that does not disrupt reliability or greatly increase cost of service to consumer-members.

Co-ops are responsible for providing retail electric supply to their consumer-members and often do so through investment in and operation of wholesale level generation capacity. The consideration of new or updated generating capacity will be a function of a number of factors, such as long range forecasts of load, commodity prices, capacity requirements at the market level, availability and pricing of capital, and finally the regulatory and policy environment. Co-ops considering generation investment will apply all of these traditional factors and be able to also consider more distributed or diverse options to meet load such as EE, DG, when and where those alternatives make economic sense and do not degrade system reliability.

Being in the position to develop generation while also servicing retail load is a unique opportunity to weigh diverse options against each other, which co-ops and their consumer-members can greatly benefit from. Many distribution co-ops are part of member based associations with their generation and transmission cooperative associations who independently or through market intermediaries clear member load and supply between the members and into the broader market; this unique model is enhanced by the role of the distribution co-op as the optimizer at that level. In the Future State, DER could potentially make a substantive contribution to serving load, but in the interim, co-ops are analyzing and developing distributed solutions, such as community solar, that will inform the path to the Future State.

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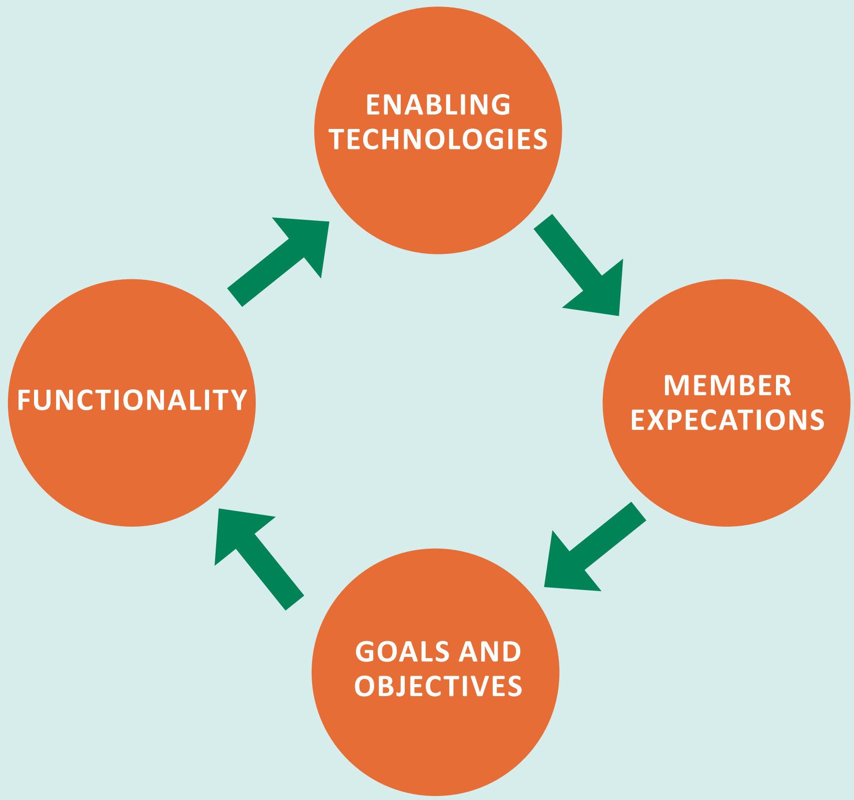
8 One example is Flexible Alternating Current Transmission System (FACTS) devices, or static equipment used for the AC transmission system, that enhance controllability and increase power transfer capability. There will also be the continued deployment of Synchrophasors, and Phasor Measurement Units (PMUs) that are 100 times faster than the current Supervisory Control and Data Acquisition (SCADA). These technologies allow grid operators to see grid conditions across control areas, enabling much greater ability to adjust to disruptions across the bulk systems, therefore limiting the impact on consumer service.

Stages to get to the Future State

From the CCU perspective, the overarching objective of grid enhancement is to be practical when considering incremental investment in advanced grid functionality. The Future State will entail a more complex operating environment and consumers that will have more sophisticated interaction with the distribution grid. Below is a conceptual illustration of a common sense iterative sequential methodology that can be applied in order to evaluate the asset investments that are best suited to meet consumer needs. Potential investment will be dependent on the individual CCU's goals and objectives that dictate a system's functional capabilities and the enabling technologies that are able to meet consumer expectations.

FIGURE 1. LINE OF SIGHT METHODOLOGY



For all CCUs, this examination needs to be set against the current state of the infrastructure and the usefulness of certain solutions to continue the provision of safe and reliable service to consumers at a reasonable cost. For example, many AMR systems that were deployed in the past decade by co-ops, municipal and investor-owned utilities remain viable and effective platforms to serve consumers and their value has not been fully amortized. Given these considerations, any move from AMR to AMI must be examined through a careful review of costs, incremental functionality and benefit. With the CCU as the trusted energy advisor, risk manager and optimizer, it is in a unique position to evaluate the tradeoffs between enhanced investments in the technical architecture of its distribution grid with deployment, whether owned by the co-op or in partnership with their consumer-members for the benefit of those participating and the rest of the membership. If the CCU is taken out of this optimizer role, those valuable asset investment decisions cannot be made.

America's Electric Cooperatives look at investments in grid modernization infrastructure such as AMI based on the benefits that can flow to consumer-members in relation to the cost of implementation. Co-op managers are continually examining their system condition, the expectations of consumer-members and the state of technology to determine what incremental grid modernization investment is needed. This ongoing exercise to examine the distribution environment allows co-ops to consider enhanced grid technologies that can address certain operational needs or challenges, while being cost effective for consumers. Co-ops are now embracing complex ("big") data and data analytics as yet another resource to realize additional value from past investment decisions as well as thoroughly assessing future positions.

Conclusions

CCU's will continue to integrate new technologies and consumer choices in a way that optimizes the use of those technologies in order to meet overall goals of providing electric service in a reliable, safe, affordable, and sustainable manner that promotes economic prosperity. CCU's must play a diligent role in asset deployment, as new technology can be placed on the grid both where it is beneficial to consumers and where it has the potential to be detrimental. Overall, emerging technologies have the potential to bring significant value to the grid, but DER investment decisions should be made in a constructive way that balances consumer and community objectives with system reliability and affordability.

IT and Beyond

As Consumer-Owned Utilities (CCUs) look to the future and the services that they will provide to their consumers, it is important to recognize that there will be significant challenges from a technological standpoint. These challenges are not just as it relates to information management. These challenges will come from operations and energy technology, as well as the ability to manage the more traditional Information Technology (IT) in use to meet customer back-office needs. Any success in managing this transition will require the ability to manage information about and from these technologies in order to provide the greatest benefit to consumers, and to do so in an increasingly secure way. With the CCU as the optimizer, people and processes will have the best chance of success, while at the same time respecting cyber security concerns.

Current State

CCUs around the country have been upgrading their systems with new technology to meet existing challenges. Co-ops in particular, although adopting technologies at various paces depending upon the needs of their consumer-members, have been early adopters of cost-effective technologies that provide advantages to their consumer-members. The co-ops' consumer-centric utility business model focuses on one aspect: providing exceptional service at a reasonable cost.

Co-ops have been among the first to make technology investments where they provide either a service or cost advantage to consumer-members. In addition, these investments have been vetted through collaboration in the use of the co-op network and the efforts of the Business and Technology Strategies group at NRECA through the Cooperative Research Network (CRN), which is funded by cooperatives and has leveraged federal funds and additional membership support to enhance co-ops' industry leadership role.

There are many examples of early co-op technology adoption and collaborative efforts.

TELECOMMUNICATIONS NETWORKS

Due to the rural makeup of many of the electric co-ops, the importance of having robust telecommunications networks is critical. In many cases, the co-ops' networks are a backbone for communication among those communities, and the use of the electric right of way supports that need, and takes advantage of any cost savings or reliability improvement that can be achieved through the exchange of information on those networks.

SCADA

The use of Supervisory Control and Data Acquisition SCADA technologies carrying data through the communications networks has allowed co-ops to closely monitor their electric grid and respond to areas of both immediate and long-term needs.

AMI AND SMART METER DEPLOYMENTS

Since the early to mid-2000's, a significant number of co-ops have invested in AMI and through NRECA's Smart Grid Pilot and other initiatives, have been able to identify and gain comfort with expanding their AMI programs. Currently over 70% of co-ops are using AMI in some form, and over 40% are beginning to make investments in meter data management systems (MDMS), automated distribution devices, and data analytics capabilities.[9]

ADDRESSING INTEROPERABILITY THROUGH SUPPORT OF MULTISPEAK AND OTHER INITIATIVES

Writing software for IT integration is an expensive and complicated proposition, and the cost of interoperability is frequently hard to predict and ever changing. Recognizing this, NRECA and its members developed MultiSpeak, a set of standards for enabling the creation of common semantics between systems so that data could be more interchangeable, and interoperability between systems would be available more easily.

COOPERATIVE BILLING AND OTHER IT SERVICES

Several co-op billing organizations have evolved to serve the needs of fellow members of NRECA and smaller utility operations. This approach represents an early version of "cloud computing" as referred to in today's vernacular.

CYBER SECURITY

NRECA published a Guide to Developing a Cyber Security and Risk Mitigation Plan, which is in use by many utilities, not just co-ops. Co-op researchers are also working on a project, "Essence," aimed at developing the next generation of automated cyber security for the industry.

DYNAMIC MODELING

The Open Modeling Framework (OMF) is a software development effort led by NRECA with a goal of making advanced power systems models usable in the electric cooperative community. The OMF will enable utilities to evaluate smart grid components using real-world data prior to purchase. This will support utility investment decision-making by modeling the cost and benefits, incorporating engineering, weather, financial and other data specific to the utility.

9 Rural Smart Grid Survey, November 2015 by SoCore Energy and ZPrime

As the industry moves forward, information technology management is the one obligation that will not change because it is critical to electric network operations, consumer relationships, data security and privacy, and provides the opportunity to improve reliability and service quality.

The Future State

Changes in the electric market, including available technology, are influencing the services that CCUs will have to provide. Pressing examples of these services include DER and their integration into the system, smart grid integration, grid modernization, system interoperability, distribution automation, and technology advances in smart homes and intelligent buildings.

The advent of DG resources such as solar and wind, DR, and micro grids are considered to be disruptive technologies to the traditional electric grid because of the variability in availability and the challenges they present to maintaining a reliable network. Understanding the impact of these technologies, and what solutions are available to manage them, is critical.

Introduction of the smart grid, grid modernization, and distribution automation provide opportunities for CCUs to monitor and manage their network, while also providing cost savings and carbon emission reductions through the reduction of vehicle and staffing call out. Advances in electric system technology and digitalization of devices provide a plethora of solutions that can provide benefit to all consumers. Technologies should be suited for individual communities. Technological deployment decisions will require an in-depth understanding of the costs, risks, and benefits associated with those technologies and how they will affect the operation of an electric provider, as well as how to integrate new investments with exiting investments.

Additional approaches to serving consumers will become available in the 51st State. These may include some of the following examples:

- Simulation software for planning, integration and operation of DER.
- Utility processing and/or software as a service beyond billing and general ledger, in particular for data analytics, billing or consumption pattern presentation to consumers.
- Cloud computing where appropriate, but with the appropriate level of guarantees associated with data integrity and data privacy, especially as related to consumer-member information.
- High bandwidth networking technologies (wired, wireless, or both) to add additional monitoring and control options.
- New sensor devices such as unmanned aerial systems (drones) or synchrophaser power measurement devices
- Internet based consumer interfaces through third parties (the “Internet of Things” or IoT)
- Mobile apps that enhance the consumer experience

As these new technologies evolve and are introduced into the utility environment, there are a number of questions that will confront CCU management staff as they prepare for and enter the 51st State. Among those are the following:

What functionalities and capabilities are required for tracking and analyzing the data requirements?
Utilities already operate multiple systems such as CIS, SCADA, AMI, MDMS, data warehouse and outage management systems. The opportunity for increasing integration and interoperability between these systems can lead to new analytics, provide for visual presentation of system conditions, and improve ease of use. One emerging example is Automatic Vehicle Location systems being integrated with OMS to show where trucks are on a map during an outage to speed up recovery. AMI can be used to determine if service has been restored and to gather data to identify voltage and other system problems. In order to properly track and analyze data requirements, a data modeling framework and capabilities will need to be established to not only analyze the logical relationship of data and data flow, but also be able to design a physical model that the utility IT infrastructure can support. This provides great knowledge of the state of the grid and is critical to the future 51st State.

To what extent is real-time information and communication exchange required?
There is a need for both, but in most cases, real-time information and communication exchange are required for systems used to manage the real-time generation dispatch and real-time transmission and distribution system operations. With safety and reliability as primary objectives for CCUs, the availability to decision makers of certain real-time information is critical. But the availability of a history of real-time information can also be of significant value when used to determine root causes of system problems or to evaluate the impact on the system of certain events, or introduction of new resources and the variability associated with those resources. Again, the capability to provide that data when needed supports the requirement for significant interoperability capabilities between systems, and a robust communication network to support the transport of that information.

Who owns customer data and information, and how is it safeguarded?
Technology advances in smart homes and intelligent buildings place additional requirements on electric providers, as well as more informed consumers with changing (usually more demanding) interaction preferences, and more IoT technology available from the market place. Whether customer data is owned by the consumer, or by the CCU, in either case the CCU has an obligation to protect that information from data breaches and/or misuse. NRECA has developed a model customer privacy policy for use by its members. Customer data safeguards may vary by state, and are evolving. Cyber security approaches will include critical components such as the need to prevent access to that data through protocols, firewalls and other practices, but also employ encryption for transport of any of that data, as more IoT functionality is adopted and more data is transported through wireless or other networks not maintained by the utility.

Who is responsible for these investments?
CCUs will have a governance process that determines how investments will be made, what standards should be in place, and follows a process that determines who will be responsible, how those investments will be funded, and how risks will be mitigated. That governance process must exist to satisfy the enterprise-wide objectives, and is the responsibility of all executive management to make those decisions based upon a weighing of the value that the investment brings to its consumer-members against the costs and risks that

come from that investment. NRECA's Draft IT Architecture Guide provides some guidance in establishing such a framework for making such decisions.

What protocols and other safeguards are needed and who is responsible for cyber-security?
A framework for cyber security has been established as part of NRECA members' participation in DOE funded projects. Recommended protocols are consistent with standards developed by the National Institute of Standards and Technology, as well as DOE and other working groups. These protocols and safeguards are still evolving and NRECA will continue to monitor and communicate this evolution to its members.

Are decisions made between devices in real time, or are decisions made by a central operator and pushed downstream?
It is highly likely that a combination of approaches will be required, dependent on the applications, the speed within which decisions must be made, and other factors. For example, in order to assure safety for linemen working with potentially energized DER, it is more likely that a centralized decision approach should be used. Other less critical, but still essential, decisions can be automated through rules-based instruction to the devices.

How frequently and quickly must decisions be made based on the data collected?
Accuracy of decision-making will always be more important than speed, especially in the case of impact on safety of utility employees or consumers, or of the impact on electric grid reliability. Increasing communications bandwidth, new sensors, and improved human interfaces will allow faster gathering of data and more visibility into the electric grid. Decisions may be handled by machines (for example in automatic source transfer) or by system operators. The end goal is still safety, reliability, and efficiency, not necessarily speed.

Stages to get to the Future State

One of the most critical challenges facing CCUs as they navigate the technology transition will be the availability of large volumes of data and the need to establish a framework through which that data can be managed effectively. Although other industries that operate global internet infrastructure (Facebook, Google, etc.) can claim higher data volumes, the electric utility industry works with data that is safety-critical and operates at higher speed (i.e. synchrophaser power measurement units).

Understanding the data that is available from its source systems, e.g. MDMS, Geographic Information Systems (GIS), Outage Management Systems (OMS), as well as any new data sources, and providing that data where it is needed will be a major driver of how to fully support the future state. What this requires is the ability to model the data sources and enable the flow of that data to ultimate points of need.

Developing an understanding of the data and its value to consumers is critical to preparing to enter the future 51st State. Successful CCUs will maintain an information systems overview as well as the ability to maintain an enterprise-wide model of their existing data, within the various systems that they own and operate. But simply maintaining such an inventory of data is only one ingredient of success. In addition, the business purpose and the value of maintaining such data leads to a series of additional questions that most organizations have the tools, resources, processes and criteria for, in order to properly maintain these data. The tools identified above are all deployable today, or in the near future, to meet future objectives.

For America's Electric Cooperatives, the pace of technology adoption will vary depending on consumer preferences. However, normal technology change management is required. Best practices for change management include alignment in the organization (i.e. Enterprise-wide Technology Roadmaps, Enterprise-wide Planning and Governance, and managing the convergence of IT and OT organizations), criticality of robust telecommunications capabilities, Open System Architecture that allows inter-operability among systems, and concern with regard to NERC Critical Infrastructure Protection (CIP), reliability standards and cyber security.

NRECA's Continued Support of Transition to the 51st State

NRECA, in collaboration with many member systems, has continued to provide support to this evolving marketplace and provide assistance to its member co-ops in meeting requirements not only from an IT management perspective, but also from a perspective of how new operational and energy technologies will affect the traditional role of providing electric service to NRECA consumer-members.

NRECA, in association with our member groups, has provided a number of white papers, study results and recommendations to assist in addressing the challenges discussed on this topic. There are several other additional initiatives that have been undertaken that are intended to assist NRECA members in either understanding the impact of new technologies in the 51st State, or to provide tools to consumer-members with which to support their individual needs and efforts in responding to the transition in the market place. Among those are the following:

DRPOWER – A collaborative effort with the Pacific Northwest National Laboratory to establish data repositories and open-access models of the electric grid. This project will be focused on establishing and building tools for cleaning, maintaining and securing power system data with the end goal of improving collaboration between utilities and the research community. The project is being layered on the Open Modeling Framework that the co-ops have built to provide collaborative, online approach to collecting data and analyzing issues of dynamic power flow and cost-benefit analysis for new technologies.

Next Generation IT Architecture Guide (DRAFT) — guidance Guide to addressing a number of both IT and governance issues previously discussed, as well as providing an underpinning for the information systems management requirements of the future.

ARPA-E Grid Ballast project – A project aimed at creating low-cost, demand side energy management tools to improve the flexibility and resiliency of the electric grid. These tools are expected to facilitate the integration of DR as a resource into the electric grid. The concept behind this initiative is that frequency and voltage control can be established at the premise without the need to implement a robust telecommunications network to support load control, thereby reducing the costs of load control programs by 50 percent. The devices will also be capable of local coordination and, optionally, direct control by utility operators.

Essence —A tool developed by NRECA and the Department of Energy to fight cybercrime. Essence is essentially an algorithm that establishes a “normal” state for a computer network and monitors the system continually for anything out of the ordinary. When an anomaly is detected, an alarm is raised. Essence will trim the average time between a breach and detection from 204 days to only one hour.

“DSO” - functionality – This project aims to provide simulations tools to study new functions and technology to both inform utilities on the pros and cons of new technology and to speed up deployment. This is an initiative supported by NRECA that envisions a changing role for the co-op. In this role, the co-op may choose to or be asked to perform some functions of the wholesale environment, but would perform such a role at the distribution level, thereby making it easier to integrate renewables from solar or other distributed generation into the grid. Such an operation would require a robust telecommunications network, interoperability between systems, and the ability to perform data analytics and require great flexibility to meet different circumstances of America’s Electric Cooperatives face and will face in the future.

Due to their Consumer-Centric Utility model, co-ops are uniquely positioned to not only understand each facet of these decisions, but to do so in a manner that simultaneously benefits and satisfies their consumer-members’ expectations and enhances grid operations and resiliency.

Conclusions

As the transition in the electric market moves forward and technology challenges and opportunities present themselves, the ability of the CCU to make decisions related to technology investments, efficiency improvements, and/or providing DER options to consumers, will be a critical component of successfully fulfilling their mission. The CCU should have the ability to make those decisions, and act as a system integrator on behalf of its consumers, whether it be for energy resources, or for the operations technology or information technology required to provide those services. This model allows the full consideration of best solutions and minimal risk in the delivery of services to consumers and other stakeholders.

Wholesale Market Design

Consumer-Centric Utilities (CCUs) operate under and are active participants in a variety of wholesale market structures throughout the United States. For example, co-ops in New England operate within Independent System Operator (ISO)-New England, a Regional Transmission Organizations (RTO) that traces its roots to the New England Power Pool (NEPOOL), one of the oldest power pools in the U.S. In contrast, co-ops operating in the southeast and WECC, exclusive of the California ISO, operate in bilateral markets.

Current State

There are fundamentally two types of wholesale generation markets in the U.S. – centralized and bilateral markets, though the two overlap and co-exist in centralized-market regions. The centralized RTO/ISO model, where suppliers compete in short-term markets to balance market requirements, is the norm in the Northeast, Mid-Atlantic, much of the Midwest, Texas, and California. Bilateral transactions also exist within centralized markets. The bilateral model, which is marked more by bilateral arrangements ranging from standardized contract packages to customized structured transactions as a component of the traditionally regulated model, is prevalent in the Southeast, most of the Southwest, parts of the Midwest and the West, excluding California. Development and evolution of centralized markets over the past 25 years occurred on a regional basis prompted in large part by seminal legal and regulatory changes (EPACT 1992, FERC Orders 888, 889, and 2000, and expansion of retail choice), and was in some cases facilitated by the presence of a functioning power pool. Some of the centralized markets have capacity markets designed to help compensate for longer term generation investments. These markets tend to be quite controversial and usually overlap primarily with regions where the states also have restructured retail markets and some form of retail competition for consumers. Many of these markets have functional issues that drive constant change to the detailed market rules, but the fundamental concept essentially remains the same.

In those service territories with both centralized wholesale markets and retail competition, the distinction between wholesale and retail electric markets is now blurring. Some competitive retail suppliers are passing wholesale prices directly through to retail consumers. Some competitive aggregators are bidding retail consumers' demand response directly into the wholesale markets. Some larger consumers are also looking to increase their ability to participate in the wholesale markets both as consumers and as providers of capacity, generation, and ancillary services.

By contrast, CCUs operating in both bilateral and centralized market regions act as an intermediary between retail consumers and the wholesale markets. CCUs may act as wholesale customers in both market structures, purchasing resources as part of the portfolios they manage for the benefit of their consumers. CCUs may also act as suppliers in both wholesale market structures, selling resources into the markets where doing so allows them to manage costs for their consumers. CCUs may also be using DER to reduce their risk exposure when acting as consumer in the wholesale markets or as a resource they can bid into the wholesale markets when it is to the advantage of all their consumers for them to act as suppliers.

Future State

This paper does not advocate for a single wholesale market model in the future 51st State. No one size fits all and different market models work better for certain regions than others. There is one key, however. In areas where CCUs serve consumers, the wholesale markets in the future 51st State will be designed to enable and support CCUs' efforts to manage a portfolio of resources on behalf of their consumers that includes generation, transmission, distribution and DER. Regulators and market operators will focus on ensuring that the wholesale markets and wholesale regulatory structures enhance wholesale customers' ability to obtain, deliver, and manage the portfolios of resources they need to serve their retail consumers more affordably, more reliably, and with less discrimination by other market participants.

The wholesale markets are a critical element of many CCUs' resource portfolio. For the foreseeable future, centralized generation resources will be a significant element of those portfolios, and the markets provide CCUs with an important option for acquiring rights to generation and capacity without the obligation to take on the cost and risk of building their own generation. The centralized markets, where they are available, can offer an efficient source of short-term resources. Bilateral markets permit CCUs to put together a diverse generation portfolio with long-, medium-, and short-term contracts for a wide variety of resources with different fuel sources, different emissions characteristics, different operating characteristics, different locations, and different risk profiles. Thus, in the future 51st State, CCUs will have efficient and unfettered access to those bilateral markets so that they can manage, optimize and integrate a resource portfolio that controls cost and risk for their consumers.

Similarly, in the future 51st state CCUs will be permitted to continue to act as the intermediary between their consumers and the wholesale markets. As discussed above and as NRECA argued in the Order 745 docket, DER is a significant part of many CCUs' integrated resource portfolios. If those DER resources are disaggregated and permitted to participate directly in wholesale markets for their own benefit, it can severely undermine the CCUs' ability to manage cost and risks for their entire consumer base. Cherry picking can undermine the economics of the CCUs' demand response programs, reducing the total level of demand response available in the market, reducing CCUs' incentives to invest in DER and the infrastructure required to enable it, and effectively removing DER from the CCUs' integrated portfolio. It can also undermine reliability by increasing the unpredictability of load on the CCUs' systems. It was for these reasons that FERC permitted appropriate regulatory authorities – state PUCs, municipal governments, and cooperative boards – to decide whether to allow aggregators to bypass utility DR programs and bid retail demand response directly into the wholesale markets.

In the future 51st State, therefore, CCUs will continue to have the right to act as the intermediary between retail consumers and the wholesale markets. CCUs will be able to develop the demand response, efficiency, and customer-generation programs that best integrate within an optimum resource portfolio and to bring those resources into the wholesale market in the manner that best meets their consumers' needs. That will allow them to promote DER, manage market risks across their whole resource portfolio, and ultimately provide their members with safe, reliable, affordable, and environmentally sustainable power at a reasonably predictable price over the long term.

Thus, by preserving CCUs' access to wholesale markets, right to serve as market intermediary for consumers, and flexibility to do so in the manner that best meets local needs in light of individual CCU circumstances, the future 51st State's wholesale market design will preserve all of the benefits that the CCU business model offers consumers as discussed in the first section of this paper. It can ensure that CCUs have the ability and incentive to meet consumers' changing needs, to integrate new technologies and services into their resource portfolios, and to bring the benefit of those new technologies into the wholesale market as a market participant and market intermediary.

Stages to get to the Future State

To get from the Current State to the future 51st State, FERC and the RTOs will need to examine their market designs to determine what their purpose is and what their impact is on the ability of CCUs to perform their key functions. Has the wholesale regulatory structure promoted markets for the sake of creating markets, or to ensure that the markets better meet the needs of wholesale consumers? Do the wholesale market designs ensure that CCUs have unfettered access to bilateral markets or do rules such as Minimum Offer Price Rules discourage risk management activities? Do the markets recognize the CCUs' need to manage diverse resource portfolios or do they value only the lowest cost resources regardless of the resources' environmental, operational, or risk attributes? Are pricing structures designed to minimize cost to consumers or to serve some other purposes? Is transmission being built to ensure that CCUs have access to the long-term transmission rights they need to meet the long-term needs of their retail consumers?

The following address a few of the issues that FERC and the RTOs should consider as they transition from today's markets to the Future 51st State.

Flexibility in Market Design

In addressing the inevitable changes to wholesale market design that can be expected, NRECA cautions against a "one size fits all policy" that would potentially be inappropriate for a significant portion of the country and may reflect the vision of an idealized but untested future. Market design changes should be evolutionary and reflect the local conditions which those markets are serving.

The markets within which electric co-ops operate vary by region and jurisdiction so NRECA does not recommend any particular market structure over another. Rather, it is necessary that CCUs be able to maintain operational and organizational flexibility in all market types while adhering to reliability and market rules to which they are subject.

Dispatch should remain the responsibility of the balancing authority, subject to any binding commercial and reliability obligations. The balancing authority may be the utility in a bilateral market, or the RTO/ISO in a centralized market.

Transmission cost recovery differs depending on the market type, ownership structure for assets, and commercial arrangements among suppliers, customers, and investors. In short, there is not a common mechanism that applies in all situations, nor should there be.

In centralized RTO markets it is common that locational marginal prices (LMP) and uplift payments are sufficient to cover a generator's fuel, start-up, and other short-run operating costs (otherwise the generator's cost-based bid would not have cleared the market), and that net profit from these energy and/or ancillary service sales plus capacity market revenue (or resource adequacy payments under purchase power agreements (PPAs) are applied to fixed costs. There is no guarantee that total revenue will be sufficient to cover all costs or achieve a targeted return on investment, but investors and owners of those assets have accepted the risks. Conversely, cost recovery in traditionally regulated markets are managed by a combination of cost-plus tariffs and bilateral PPAs, where PPAs are, or should be, voluntary actions of the co-op or other CCU as the result of a coordinated planning effort and careful consideration of procuring resources that meet multiple accepted criteria for least-cost, reliability, and extant resource or environmental rules and regulations. Charges for transmission use, rebalancing, and other operational activities of the extant system are generally covered under FERC tariffs.

CCUs, both private and public, should not be prohibited from transmission ownership; market performance is enhanced by liquidity, enabling CCUs to invest to support the common goal of effective markets to meet consumer and producer needs. Dispersed ownership is permitted and common in both RTO and traditional market structures.

Ancillary Services

The concept of ancillary services emerged as a major market design issue in the 1990s as wholesale markets evolved after the Energy Policy Act of 1992 and moved further forward with the issuance of Orders 888 / 889. If a significant penetration of DER occurs on the distribution system, it would be reasonable if such an investigation occurred and new ancillary services were developed to reflect the physical and economic realities of the distribution system. For example, ERCOT, unique in that it is based exclusively on energy pricing, has proposed replacing its four main ancillary services with six new ancillary services. Most of these changes are designed to account for the reduction in system inertia brought on by significant wind expansion, which is making outages and other system events more severe in low-load and high-wind hours. ERCOT has said this change will probably take place in 2016 or 2017 at the earliest, and it has not yet been approved. This is an example of appropriately deployed DER providing wholesale as well as retail value.

Reliability

All CCU consumers, including those served by co-ops, municipal utilities and IOUs, desire a reliable electric power grid. Therefore, any changes to wholesale market structure will need to be rooted in the concept that the existing level of reliability and power quality must be maintained, and preferably enhanced, as wholesale market design changes are evaluated.

It is important that CCUs continue to be able to own, operate or contract for generation on behalf of their consumers if they so choose. The ability to own and operate (i.e., self-supply) is critical to the continued economic and financial success of the CCUs. This does not preclude their ability to choose to enter into bilateral contracts with other suppliers, their ability to trade for power in the open market at market prices, or any cost effective combination of these approaches. However, it does provide greater scope and flexibility to preserve their business model, effectively conduct least-cost planning with their consumer-members, and provide for their long-term success.

Distributed Energy Resources

Accounting for distributed energy resources in the capacity planning process should be a local matter for electric suppliers in the 51st State; there is no one-size-fits-all measure. As a planning region gets larger, with increasing numbers and types of supply resources, the probability of DER's contribution may imply higher reliability just as financial theory predicts more stable investment results with more diversity.

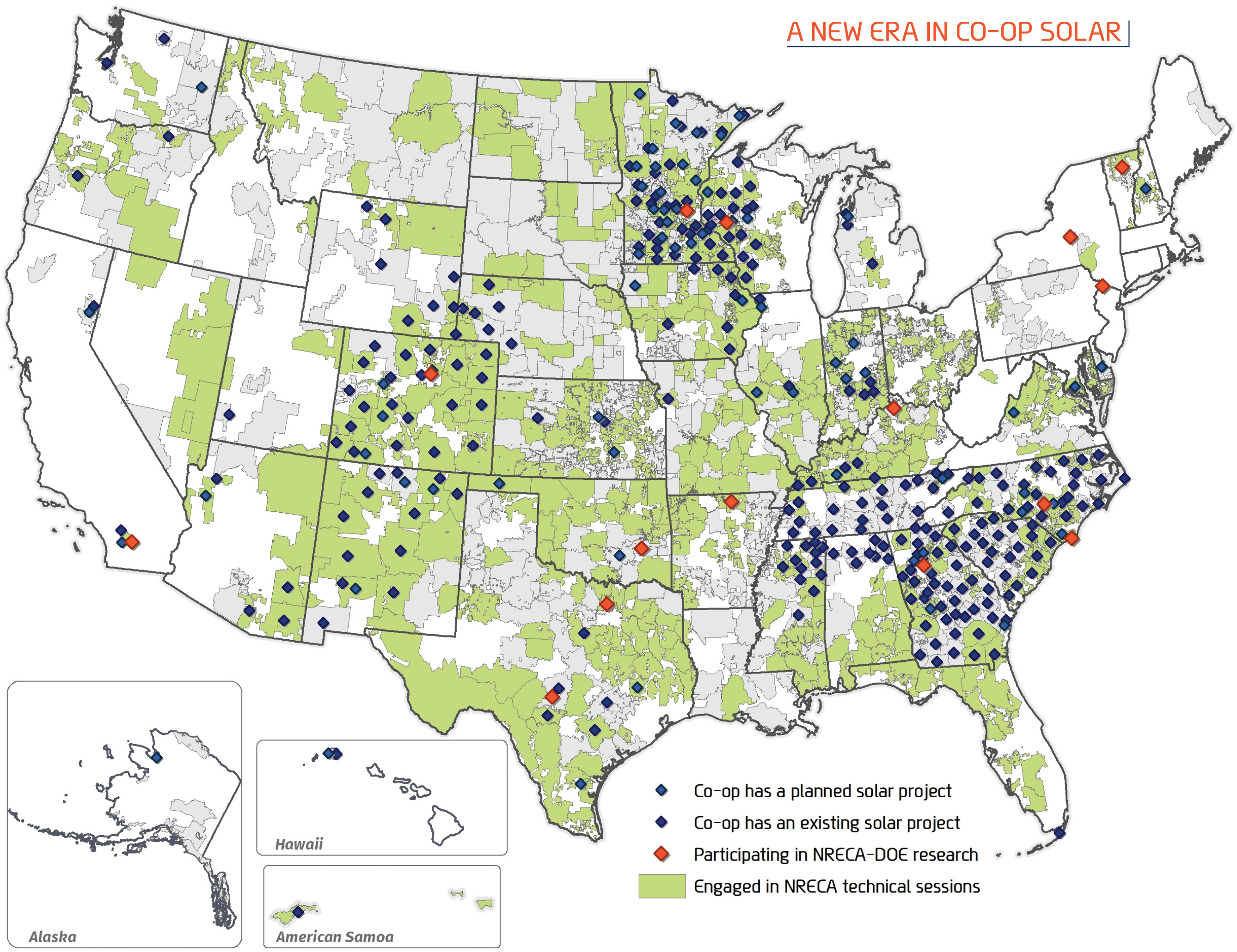
The contribution of any resource and its economic value to the system, either for planning capacity or operating reserves and reliability, depends on several factors including location, dispatchability, forced outage expectations, and seasonal and/or diurnal output profile. A few examples may illustrate the wide variation.

- Location issues – resources that are downstream of a transmission constraint may inherently provide more value because if they provide relief during high-load congested periods, while resources that are behind the meter that are operated at the user's behest will reduce load but may not carry additional supply value and therefore not be equivalent to a disptachable supply resource
- Intermittency issues – resources that are, by nature, intermittent and subject to uncertain feedstocks (wind levels, river flows, insolation, methane capture) will have a probabilistic but not a deterministic contribution to the planning margin and little or no contribution to short term operating reserves and reliability.

However, each of these factors can be overcome if the CCU maintains the role of optimizer, making timely and effective investment decisions to support consumers and operation of their distribution grid.

Retail Market Design

The introduction of new technologies opens up new markets for the services those technologies can offer Consumer-Centric Utilities (CCUs) and consumers. However, this does not necessarily mean that significant changes to the current retail electric market designs will be required. New technologies, new services, and new providers for those products are not a new phenomenon, and NRECA members, as well as many other traditional utilities operating under long-standing retail electric market designs, have long embraced new technologies and the innovation they bring on behalf of their consumers. CCUs in particular have found that these innovative technologies and services, when implemented efficiently and effectively over time, can help them to reduce costs, improve reliability and increase consumer satisfaction, while also helping to meet potential wholesale market distortions. For that reason, co-ops have been early adopters of these technologies and service options, including AMR and AMI, distribution automation and remote sensing, storage, demand response, distributed generation, on-bill financing for energy efficiency, pre-paid service, and community solar.



NRECA Business and Technology Strategies

Current State

Retail electricity markets in the United States can be separated into the following categories:

- Seventeen states and the District of Columbia[10] have adopted retail open-access for at least some of the utilities in their states. Under retail open-access consumers have the option to procure the generation component of their electric service competitively. It should be noted that all jurisdictions adopting retail competition operate within RTOs and ISOs. In most states, cooperative and municipal territories were exempted from retail competition or given the option whether to participate or not. In at least two states that adopted retail competition for co-op territories, no competitive supplier has ever stepped forward to offer competitive retail service to any co-op's residential consumers.
- The remaining areas of the country are served by traditional utilities with an obligation to serve, including co-ops, IOUs, and public power utilities.

A handful of states are currently considering overhauling the existing retail market by instituting a Distribution System Operator (DSO) model, where pricing is provided on distribution circuits in a manner similar to the transmission nodal model in RTOs and ISOs. The primary goal of the DSO model is to send information to market participants about local pricing conditions, including congestion on the system, thus allowing for better integration of innovations such as DG, DR, Real Time Pricing (RTP) and others. Co-ops fulfill this DSO function role for their consumer-members, to the extent the conditions exist, and are positioned to fulfill that role as noted above if the need arises. The DSO debate often devolves into a debate about the role or need for the utility to be involved. NRECA advocates that all Consumer-Centric Utilities, particularly co-ops, are well positioned to fulfill that role, and effective markets will need CCUs involved to fulfill the optimization value and functions noted throughout this paper.

In competitive retail territories, suppliers tend to offer only an energy commodity typically acquired from the short-term energy markets. For that reason, consumers served by competitive retailers tend to be exposed to short-term wholesale market risks, and need to find new technologies and services that permit them to hedge and manage those risks. These consumers also tend not to be able to rely on their competitive energy supplier to offer them a suite of additional technology and service options. In this model, creating a new market that permits consumers to acquire new technologies and services for themselves may make sense.

In territories still served by traditional utilities, however, different opportunities exist. Consumers in those areas are not exposed to short-term wholesale market risks because utilities in non-restructured territories have retained an obligation to provide consumers safe, reliable, and affordable service at stable, long-term rates. In order to meet that obligation, co-ops and other consumer-centric utilities manage a portfolio of resources that allow them to optimize the system and manage risk on consumers' behalf. This portfolio typically includes generation, transmission, distribution, and distributed energy-side resources. While very few utilities will directly own all of the resources in their portfolio, they are in a position to optimize across all layers of the system through a combination of ownership and contracts of varying lengths. Thus, a utility may own some generation, transmission and distribution facilities. They may have a portfolio of long-, medium-, and short-term contracts for energy and capacity, they may also contract with several other utilities or an RTO for transmission service, and they may have dozens of different rate, tariff and

10 www.eia.gov/todayinenergy/detail.cfm?id=6250

contractual options for integrating customer price response and customer-owned distributed resources into their portfolio. That breadth of approach then permits the utility to minimize costs and risks for the system as a whole, while providing individual consumers with options that meet their individual needs.

This CCU model is perfectly structured to incorporate new technologies, services, and service providers. Consumer-centric utilities' purpose is to manage their portfolio of resources on behalf of their consumers. As new technologies and services become available and cost-effective, consumer-centric utilities have an incentive to integrate them into their portfolio in a manner that permits them to better manage costs and risks and to provide better service. For example, Roanoke Electric Cooperative in North Carolina implemented the Upgrade to Save program, in which the co-op helped interested consumer-members identify possible efficiency upgrades, then subsequently installed them at no up-front cost. Similarly, The Electric Cooperatives of South Carolina implemented the Help My House program, an on-bill financing program that gives consumer-members access to capital needed to make efficiency upgrades[11].

The CCU model is also well structured to enable the development of third-party service providers. Co-ops strongly supported the development of wholesale competition and open access transmission because they wanted to have the ability to purchase energy from independent power producers (IPPs), in the event those IPPs were able to develop resources at a lower cost than the co-op. Similarly, co-ops have contracted with third parties for demand response services, energy efficiency upgrades and for development of community solar when the third party could offer these services at lower cost. Those co-ops in organized markets that have capacity constructs are actively engaged in bidding traditional resources as well as demand response programs and renewables.

Consumers served by consumer-centric utilities are also free to acquire new technology and some services directly from third parties. While some co-ops are offering consumer-members solar energy options, smart thermostats, whole-house energy management systems, and/or energy efficiency audits, for example, consumers are also able to acquire those technologies and services from others. Many consumer-centric utilities have adopted programs that encourage consumers to invest in third party technologies if those investments will benefit the consumer and the community.

Future State

The United States will continue to have multiple retail market design models in the future which will be driven by the circumstances of each jurisdiction. NRECA can foresee a future state where service territories with retail access see new forms of competition enabled through DSOs. As with the introduction of retail competition in the 1990s, decisions to implement changes in market design will be driven by local needs and the desire to make changes from the status quo.

Outside of retail access states, we anticipate that CCUs will continue to provide electricity services and options to consumers in a manner that reduces risks to all consumers across the grid. The introduction or adoption of new technologies does not require dramatic retail electric market design changes, rather continued evolution to maximize consumer-membership value. In fact, as discussed above, co-ops have successfully introduced many of the innovations discussed in the 51st State Initiative using the Consumer-Centric Utility model, such as Oklahoma Electric Cooperative, which implemented a pre-paid billing program that further promoted energy efficiency, and lowered consumer-member energy costs[12].

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11 REC Case Study Provided in appendix

12 OEC Case Study Provided in appendix

Markets may develop, evolve, and go away for different energy-related technologies and services, but those changes neither depend on nor require changes in the retail electric markets. Because consumer-centric utilities are an enabler and integrator for new technologies and services, their business model does not require revolutionary changes, even as the tools they use to meet consumers' needs changes over time.

In the future, just as today, CCUs will continue to serve as their consumers' trusted energy advisor. The consumer-centric utility, because of its ability to take a longer and broader view, will continue to look out for all consumers and be able to plan over longer timeframes to optimize the system, to manage costs and risks for their consumers, to ensure high quality, reliable service and to meet consumers' evolving expectations.

Stages to get to Future State

Because consumer-centric utilities in traditionally-regulated service territories are well positioned today to encourage and integrate new technologies and services, a continued evolution, not revolution, is required to get to a different future state.

Change has been a constant in the electric utility industry and will continue to be in the future. Fortunately, co-ops and other consumer-centric utilities are connected to and responsive to the needs and wants of their consumers, and for this reason a large measure of autonomy and self-determination should be ensured. Consumer-centric utilities understand the unique aspects of their service territory and the unique nature of their existing resource portfolio. And, as new technologies and services become available that can help them to lower costs, reduce risks, or improve service for their consumers, those consumer-centric utilities will respond. They may adopt new programs, new prices, new incentives, and new contractual options to enable the use of those technologies and services, to integrate them into the portfolio, and to optimize that portfolio for the benefit of their consumers. They will invest in the other infrastructure required to maximize the value available from their portfolio, including the new technologies and services. And, they will invest in the staff and the back- and middle-office processes required to maximize the value available from their portfolio, including those new technologies and services. The nature and timing of these changes and new investments will be driven by consumer needs, and vary among different utility service territories and even among different consumer groups of a single utility.

It is important to recognize that the value each consumer-centric utility puts on a service or technology will vary. Each utility will need to determine for itself the value of different DER technologies to its grid in light of its consumers' preferences and the other resources available to it. The CCU model allows for investments, including DG, storage, DR and EE to be optimized for the system as a whole, which produces the lowest cost and highest reliability for consumers. The value will be based in part on existing generation, transmission and distribution, as well as fuel supply, renewable potential and other factors unique to each system.

Rates and Regulation

The design of regulatory policies will significantly influence the development and structure of the electric power industry as new innovations continue to be introduced. Well-designed regulation will promote efficiency for a number of factors, including the introduction of resources, the operation of the utility and consumption by customers.

Regardless of the ownership structure of a utility, whenever considering any sort of regulatory and rate change scenario, a few key considerations are:

- There is no universal answer to the questions posed in the 51st State Initiative: utilities operate across the nation in a variety of wholesale and retail environments.
- Consumers need to be treated fairly by the regulator, CCU, and third party energy service providers; rates should be based on sound economics, not policy mandates
- The responsibility for optimization, safety, reliability and resiliency should continue to be the responsibility of the CCUs.

Current State

Part of the challenge of the 51st State is the fact that CCUs currently face different regulatory regimes from economic regulation to consumer choice as noted in the retail markets swim lane discussion above. Each regulatory and retail market regime will lead to differing performance by CCUs. This is part of the evolving utility compact.

America's Electric Cooperatives operate in a unique position in the regulatory policy debate because the majority of them are self-regulated by their local Board. As such, rate setting and regulation should be focused upon providing consumers the appropriate information needed to make efficient energy choices, while still accounting for all costs. Inasmuch as eliminating all subsidies in electricity tariffs is probably not practical, the existence and extent of subsidies should remain under the purview of the local Board and in cases where they exist they should be identified and transparent. Finally, the rates and regulatory systems should encourage the electric power industry to operate in the most efficient manner possible. Within this framework, locally controlled co-op systems are well positioned to understand the needs of their consumer-members and the local conditions to be able to balance the equities that occur as part of any rate and regulation setting.

While co-ops in some cases operate under the authority of local state regulatory authorities, they are nonetheless held to high standards by their consumer-members, who demand reliability, fair prices, and a growing level of consumer choices to serve their needs. Self-regulation through local control is well suited for the diverse and flexible co-op system.

NRECA currently embraces pricing and cost approaches that align with the following principles:

- Pricing sends signals to consumers to encourage the efficient consumption of electric service
- Allocation of the revenue requirement is tailored to local conditions and is transparent

- Cross-subsidies between consumer groups are minimized and transparent
- Desires of consumer-members are reflected in the decisions of the local board

Future State

Given the flexibility of the business model, CCUs will continue to fulfill the same support role they currently do while enabling consumers to access new products and services in the 51st State. As the energy industry changes, CCUs will continue to evolve to meet increasingly diverse consumer-member needs in ways that are reliable, cost-effective and sustainable. The CCU-consumer relationship structure is a necessary component of this. Consumers should be encouraged to understand how and why regulatory changes are taking place.

The addition of new DER and grid enhancement technologies will make it more complex for CCUs to track how much each consumer benefits from their services, leading CCUs to find different ways to recoup their investments. DER technologies also create challenges for utility resource planning, which require taking a longer view of what is needed across the grid. CCUs know their services will be needed in the future, but poorly planned DER integration could muddle long term planning, and create potentially unfair burdens for consumers. Ideally, all electricity consumers would be charged their actual incurred cost, determined by price signals sent from their provider. Technology investments are depreciated over short time periods so cost recovery will likely not fall under traditional utility depreciation models. Price setting will have to account for economic depreciable life of the investment, O&M cost impacts, marketing and consumer relations, and other costs. Consumers will be educated as new technologies are adopted, so they understand the added benefits and risks. The very nature of the CCU framework should ensure rate and price transparency. Finally, consumers will potentially require additional consumer protections in the Future State as more and more providers become involved in the market and enter with non-transparent and provider-favorable agreements with consumers.

The CCU is expected to remain the sole operator of the grid and will still bear the responsibility for safety and reliability. However, third party entities that provide a service to consumers, such as rooftop solar, impact the reliability of the system, and therefore should bear some responsibility and receive oversight. This means the utility or state regulatory bodies should have some form of authority to enforce standards that maintain reliability and stability over third parties. Attempting to move this function to a third party or multiple parties would in all likelihood compromise the integrity of the distribution system and endanger the safety of consumers and the reliability of the system as a whole.

Critical issues associated with cost recovery and the maintenance of reliability include the following:

- Should be based on local conditions. For instance, the most aggressive co-op on solar in Iowa, Farmers Electric Cooperative, does not offer net metering. So, there is no universal rate structure that works for a specific area.
- In certain situations, CCUs need to leverage new technologies and change rate making so that it reflects reality, and ensures users are not “gaming the system”.
- Regulation should be voluntary, incentive-based, ideally following the idea of “carrots instead of sticks”.

- Need to differentiate services between obligatory and desired in order to eliminate free riders.
- No mandates- a market that evolves from co-op obligations and consumer needs should sort things out on its own.

The utility of the future will need to recognize that pricing will become increasingly complex. First, the utility may be offering new and expanded services which are currently not available. Pricing strategies will need to be developed which capture existing co-op principles (send an efficient price signal, provide a fair and transparent allocation of costs and determine extent of subsidization if any) and the synergies which may be created (i.e. installation of DERs that avoids distribution investment) or triggers additional costs (i.e. installation of DG may trigger feeder upgrades).

America's Electric cooperatives have traditionally adopted a cost-based model for recovering the revenue requirement of the system. NRECA does not believe that an alternative approach would yield superior results. Whereas Performance Based Ratemaking (PBR) or incentive based mechanisms have been implemented for IOUs in the United States, such systems are inappropriate for member controlled utilities such as co-ops because a co-op could not pay an incentive to itself. Further, the recovery of investments should be left to the co-ops. Simplistic approaches such as categorization of "fixed" and "variable" costs ignore the complexity of a utility system. This can be seen in the industry today, as variable pricing models based on volume, a longtime mainstay, are being replaced more and more with fixed charges. Improper cost recovery implementation and management can lead to sending the wrong signals to consumers regarding investments. That said, the Future State will require rate and price setting that will require balancing far more levels of complex inputs that in the past. Local decision-making and control by the local Board of the cooperative CCU will be as important, if not more important, than in the past. Rates and regulation are more art than science and are hugely affected by local conditions; thus the local control model of America's Electric Cooperatives is well positioned for the future 51st State.

Stages to get to Future State

Consumer-Centric Utilities will continue to recognize and find the right balance of new technologies that are best for local conditions and in accord with their regulatory direction. Each CCU will need to chart its course to the Future State, doing so with the direction of its regulatory body, whether state, municipal or local board. The evolution of revenue recovery by CCUs through rates and price formation will be divergent. By definition, one size cannot fit all, nor would it be in consumers' interest.

The changing nature of the utility landscape means that communities will require different degrees of change and at different paces. In addition, consumer interests will vary widely so products and services will have to take that into account as well. Going forward, it will be important to determine how DER assets can create value across the grid network. New additions to the grid, like solar panels, energy storage, micro grids and DSO functions will require new thinking in terms of how people are paying for their energy. Although new technologies generally offer unique and progressive benefits, Consumer-Centric Utilities will continue to provide trusted advice, risk management services and system optimization on behalf of consumers. The reason to adopt new technologies is to build on the goals of providing electric energy service in a safe, reliable, affordable, and resilient manner that enables improved consumer quality of life and the opportunity for economic prosperity. Consumers still need fairly priced power delivered in a reliable fashion regardless of technologies deployed.

A critical part of introducing new technology is to reflect the value of that technology to consumers. In the case of DER, pricing strategies will also need to be designed in such a manner as to maintain equity among the membership. Every rate setting seeks to do this; DER pricing requires the same balancing of interests.

The technologies envisioned to transition to the Future State will be capital intensive. This will require cost recovery from all consumers or those consumers who utilize the technology. Given forecast changes, rates and pricing will likely become more complex given the addition of new technologies.

It is vital that any rate changes implemented on consumers are transparent and understandable. Each rate change should be carefully examined and communicated to all consumers. Future rates will be built around the idea of equitable pricing and treatment. Additionally, new rates structures should take special consideration of the impacts on low-income consumers.

America's Electric Cooperatives will use different approaches to build the appropriate linkage between revenue recovery and rates and pricing. This will require more complex analysis and understanding of consumer interests, load profiles, supply cost, technology cost and integration costs to be able to "balance the equities" when setting rates and pricing. However, since co-ops decisions to invest in new technology are directly accountable to the co-op membership rather than shareholders or state regulators, those decisions will be grounded in meeting local needs. In the transition to the Future State, cooperatives are experimenting with a number of different and evolving revenue recovery models. For example, many co-op rate and price setting mechanisms considers the impacts on low income member-consumers. One example is a group of Colorado co-ops, which worked together with the Colorado Energy Office and GRID Alternatives to provide community solar specifically for low-income consumer-members[13]. By providing a transparent implementation process devoted to creating equitable rates and pricing, co-op consumer-members will be at the center of decisions affecting their own electric networks. Again, each co-op community will then be able to choose the developmental path of their networks, which will allow consumer-members to experience benefits customized to their needs.

Conclusion

The major theme across these swim lanes is clear: because of its flexibility, the Consumer-Centric Utility (CCU) business model will continue to promote increased innovation while offering new products and services that are tailored to local conditions and enhance resiliency of the electric grid. In the future, an even greater number of CCUs will offer more energy solutions based on local conditions and local consumer desires.

- No single set of solutions will universally apply to all service areas. Flexibility should be afforded for local solutions to be implemented which match the wants and needs of consumers and meet local characteristics; indeed one size does not fit all.

13 CEO and Grid Alternatives Case study provided in Appendix

- Optimization of asset deployment is important in order to promote efficiency, and to maximize the value of those assets. The CCU of the 51st State should continue to serve as an enabler of new technologies that bring value to the system, including DER.
- This future 51st State model does not require a complete overhaul, but would allow evolutionary changes to be made as technologies are introduced and integrated by the CCU.

As the trusted energy advisor, risk manager, and grid optimizer, the CCU is an ideal model moving into the future. Policies that support and benefit consumers will lead organically to an energy future where DERs provide a rich array of options for every kind of household while simultaneously providing electricity service in a safe, affordable, reliable, and sustainable manner.

America's Electric Cooperatives are well positioned to fulfill their role as the CCU for their consumer-members. The cooperatives and their consumer-members' interests are aligned well to enable robust energy service offerings and enhanced grid operations and resiliency, improving their consumer-members' quality of life and economic prosperity.

Appendix: Case Studies

Solar

Great River Energy (GRE) is a generation and transmission cooperative that comprises 28 distribution cooperatives in Minnesota and Wisconsin. GRE serves about 660,000 accounts or about 1.7 million people. About 57 percent of GRE's end-use consumer-members are residential consumers, and 43 percent are commercial and industrial. It has a variety of generation resources totaling more than 2,800 megawatts, the largest of which is the Coal Creek Station with 1,140 MW of coal-based generation. GRE has sufficient capacity resources through 2027, but it will need to add renewable resources by 2024 to meet the Minnesota renewable mandate of 25 percent by 2025. As part of its resource planning and as a learning experience, GRE has deployed a 272-kilowatt solar array at its campus in Maple Grove, Minnesota. The site had an existing 72-kw rooftop array and a 250-kw wind turbine. This array was sized to not exceed the average building load.

GRE plans to deploy up to twenty 20-kW solar projects at each distribution co-op member's location through 2015, making up the "20-kW membership initiative." GRE members have the option to install additional solar modules to the array for community solar on an incremental cost basis. Two of the five installations completed in 2014 have committed to doing so, one sized at 57.4 kW and the other at 45.9 kW. Three of the 14 planned installations in 2015 have committed to adding community solar and another four are still considering it. All co-op members are allowed to supply up to 5 percent of their own needs under the current all-requirements power supply contract.

The 20-kW membership initiative was started in order to address three main issues. First, to create visibility across the membership and to showcase how the GRE portfolio is evolving by providing an opportunity for each member to have an array on its distribution system. The program also provides a real-world, hands-on experience with small-scale solar design and installation, which consumer-members can participate in.

Finally, it provides an opportunity for members to start a community solar program at a favorably priced increment. There is no limitation on the size of incremental solar that a member can add.

To support the 20-kW membership projects, GRE developed two contracts.

- A standard site lease agreement allowing GRE to place an array on each member site.
- A solar development agreement engages members wishing to develop incremental solar that could be used as a community solar resource.

Additional solar resources are priced at the incremental cost, which allows members to realize a competitive price on a small-scale solar project.

Another available opportunity to advance co-ops' grid infrastructure is "community storage," an emerging approach that enables co-ops and their consumer-members to share in the benefits of the energy storage available in hot water heaters, electric vehicles, or home battery storage systems. By coordinating the use of this overall storage capability, a co-op can reap system-wide load management benefits that can be passed on to members.

Great River Energy has made a substantial effort to take full advantage of this simple tactic, by using a common home appliance: electric water heaters. In fact, there is nearly a gigawatt-hour worth of storage in hot water heaters in the service territories of GRE's 28 distribution cooperatives.

GRE has done this by integrating the common home appliance with the newer DG technologies that have been proliferating across their service territory, such as wind and solar power. By funneling latent energy generated by these sources to water heaters, and then using advanced controlling systems, participating customers are able to heat their water without suffering peak induced issues or interruptions. Studies indicate that consumers could save up to $200 annually, which would offset the cost of installation in 3-5 years. This technique also makes it easier for the co-op to manage energy load demands across their entire community.

As consumer-members benefit from these services, the augmented efficiency also cuts costs for the co-op. This is because of a phenomenon known as the "rebound effect." As the *21st Century* report explains, lowering costs give members "the ability to afford a bigger refrigerator [or] the increased enjoyment of a bigger television or a new mobile device that increases connections with the world. Efficiency is inextricably tied to people's increased quality of life, which means that more electricity is used, and it is used more efficiently."

Created in 2001, **Green Power EMC** (GPEMC) is owned by 38 of the 41 electric cooperatives in the state of Georgia, to whom GPEMC currently provides 32 megawatts of renewable electricity. These 38 cooperatives are also members of Oglethorpe Power Corporation (OPC), their generation cooperative; the remaining three cooperatives in the state have their power supply needs provided for by the Tennessee Valley Authority (TVA). GPEMC's generation portfolio consists mostly of wood-fueled biomass, landfill gas and hydropower, with about 465 kilowatts of solar. Peak load for the OPC Georgia cooperatives is about 9,000 MW.

Though co-ops in Georgia do not have any mandates or renewable portfolio standards to meet, members of GPEMC may choose, on a subscription basis, to buy into various proposed projects. GPEMC recently announced agreements to purchase the full output of three planned projects: a 20-MW solar project and a 52-MW solar project located near Hazlehurst, Ga., both owned and operated by the Silicon Ranch Corporation, and a 131-MW solar project owned and operated by Southern Power near Butler, Ga. The outputs of these are scheduled to come online in late 2015 to late 2016, with purchase power agreements from 25 to 30 years.

GPEMC's most visible project to date is its Sun Power for Schools program, where it has provided 37 solar demonstration systems to schools in its members' service areas across the state. As each site averages about 1.2 kW, this program is primarily educational. To simplify installation, each system is a standard kit developed by GPEMC and its contractor, and is mounted behind the meter at each participating school. Each system is comprised of four to eight photovoltaic panels, from a variety of panel and inverter manufactures, as well as other appropriate electrical disconnects. The solar array is pole-mounted to a pole mount, which also houses the wiring. Each kit also contains a weather station and data acquisition capabilities. Installation and routine maintenance is performed by a solar contractor. The average installed cost of each system is about $14,000. GPEMC currently has three producing solar purchase power agreements in place for 465 kW. It has worked to implement the 7.5-MW Azalea Solar project power purchase agreement. Green Power EMC and its member EMCs recently announced agreements that will allow for projects totaling 203 MW. In addition, GPEMC is evaluating the development and construction of several small utility-scale solar projects of approximately 1 MW each.

The 38 members of GPEMC are eligible to participate in any power project on a subscription basis and at any level they deem appropriate, including not participating at all. As GPEMC is a co-op, the output of any power project is sold to members at cost. Member co-ops generally roll the cost per kWh of each project into their overall power portfolio cost.

As the price of renewables, especially solar, continues to fall and those of traditional generation resources continue to rise, member interest in renewables will increase. Green Power EMC has been successful in keeping the co-ops of Georgia working together and leveraging their collective strengths to meet the challenges and opportunities of renewable energy. GPEMC is working on instituting a four-part strategy with its co-op members to prepare them for potential changes in the energy system. The objective of co-ops is to pursue better current volumetric-based retail rate structures with the fixed-cost nature of the utility business. The co-ops also want to focus on building and/or buying solar assets. Not only to acquire hands-on experience, but also to and show leadership and credibility with an emerging energy technology. In addition, GPEMC co-ops are able to better educate and assist their consumer-members with new solar projects. Finally, GPEMC can readily offer opportunities for their membership to engage and participate in EMC/co-op-sponsored solar energy projects and service.

The **Colorado Energy Office and GRID Alternatives** have undertaken five community solar projects designed to demonstrate the viability of community solar models that serve low-income households. Delta Montrose Electric Association, Gunnison County Electric Association, Holy Cross Energy, San Miguel Power Association and Yampa Valley Electric Association volunteered to build low-income projects totaling 579 kW, each of which is designed to optimize the community solar model to reduce energy costs for the utilities' highest need customers, who are classified as those who spend more than 4 percent of income on utility bills. This effort was created to help relieve lower income families in Colorado's rural communities.

By providing the co-ops with these community solar models, the two organizations are helping to ensure that the consumer-members the co-ops serve are receiving affordable energy, while utilizing newer and more efficient technology.

GRID Alternatives (GRID) received a $1.2 million Colorado Energy Office (CEO) grant in August 2015 to implement low-income community solar, and has played an instrumental role securing agreements from each utility partner. GRID leveraged the CEO investment to attract additional resources from partnering utilities, private funds and in-kind equipment donations.

Each utility is piloting a slight variation on the low-income community solar model to address the unique needs of rural utility service areas and their customers. The projects selected are both affordable and scalable for utility partners, and offer great potential to expand across the state.

The ability to provide low-income consumer-members with local renewable energy is what makes these Colorado co-ops unique, and demonstrates the innate ability of co-ops to provide all consumer-members with efficient and appropriate forms of power.

CEO and GRID Alternatives expect to secure additional partnerships with utilities through 2017 to install 1 MW of combined solar energy for a minimum of 300 low income subscribers.

Energy Efficiency

Roanoke Electric Cooperative (REC), with its headquarters in Aulander, North Carolina, is a co-op network with a service area of 1,500 square miles, which includes 95% residential customers and 5% C&I customers. High cost residential bills caused the co-op community to look for ways to be more efficient. However, most consumer-members were not interested in borrowing from REC. REC decided to pursue and a solution that would be more inclusive to their constituents, while still creating greater value for the community as a while. This began the “Upgrade to Save” program.

The Upgrade to Save program was designed to provide an energy audit and on-bill financing for consumer-members interested in making energy efficiency investments which would reduce their electric power costs. Consumer-members seeking to minimize their power costs contact REC, who then then aids the consumer-member in identifying what upgrades they might be able to make, and which upgrades would be most beneficial. The recommended upgrades include a variety of appliances and techniques, and typical upgrades include better insulation, heating enhancements, and more efficient lighting equipment. Once identified and selected, the upgrades are installed at no up-front cost to the consumer-member. After installed, the upgrades are maintained by the co-op program. In order to recover installation costs, each participating consumer-member is apportioned a fixed-fee on their electric bill, which is calculated to be less than their estimated savings for that billing period.

Through this process, participating consumer-members are provided easy, debt-free access to capital needed to upgrade to a more efficient way of using electricity. Participating consumer-members generally see a decrease in their electricity bill. As more consumer-members participate in the program, they increase the overall efficiency of the co-op, allowing the co-op to pay lower demand costs on their purchased energy. The co-op also has more flexibility when determining how else to comply with state energy mandates; instead of being forced to make a less beneficial asset decision in order to comply, the co-op can potentially explore other less expensive and equally helpful options.

REC estimates that the average monthly savings of a participating consumer-member is around $58, after the monthly fee. Where the co-op targeted a 25% saving for consumer-members, they estimate that consumer-members are saving close to 50%.

The Electric Cooperatives of South Carolina helped to spearhead an on-bill financing pilot program, in an effort to determine better energy efficiency practices. On-bill financing (OBF) allows individuals to finance energy efficiency retrofits with low-interest loans that they repay on their monthly electric bills. More than 30 co-ops around the country have some type of OBF program. South Carolina's HMH program is based on a 2010 state law that ties the loan to the meter and allows co-ops to disconnect for non-payment. The loan obligation is passed on to the next homeowner when a home is sold or to the next tenant when a rental property changes hands.

The Help My House (HMH) Loan Pilot Program began as a test of energy efficiency as both a consumer product and a cost-effective replacement for investment in new generation by electric utilities. The pilot program was designed to finance "whole house", meaning all measures were evaluated as part of the same system, efficiency upgrades through 10 year, 2.5% interest loans, and to examine the impact on individual consumer-members, participating co-ops, and wholesale power purchasing. The program began in 2011 where HMH analyzed the financial impacts on the electric systems in 125 weatherization homes.

A post-retrofit analysis of the performance of these homes showed a reduction in electricity use by more than a third, or an average annual savings of nearly 11,000 kWh. Because the total electricity bills of participants went down, participants were satisfied with the program and their co-ops. Participating co-ops also gained a better understanding of the financial impacts for an expanded and ongoing on-bill financing program. After the HMH pilot ended, 3 of the participant co-ops started their own OBF program, as did two other South Carolina co-ops that had only observed the results of the HMH pilot.

Storage

Kauai Island Utility Cooperative (KIUC) is a co-op in Lihue, Hawaii, that serves roughly 33,000 electric customers. KIUC has been unique in its experience with high penetration of solar PV during daylight hours, as Hawaii as a whole has seen a rapid expansion in residential solar systems. Distributed and utility-scale solar and other renewable resources supply nearly 80 percent of the KIUC system load during the day. The remainder is served by run-of-river hydro, a biomass plant and an efficient combined-cycle facility operating on naphtha and diesel fuel.

A significant issue for KIUC is system stability during the daytime, when solar penetration reaches a high level of contribution to meeting load, causing the idling of fossil generation assets that provide system inertia and spinning reserve. Any additional solar resource during the daylight hours exacerbates that effect. Increasing the load in the daytime helps to avoid the potential need to curtail solar, and potentially reduces load during the peak period. The dispatchable system provides cost-effective solar energy without adding to curtailment or stability risk.

KIUC and SolarCity have pioneered a new approach to the combination of solar power and battery energy storage. On September 9, 2015, the two jointly announced an agreement whereby SolarCity will construct a battery energy facility to supply on-peak power to the cooperative. The unique and noteworthy aspect of this is that, in addition to providing the battery energy system, SolarCity will supply a 13 MW photovoltaic solar array. The primary purpose of the array is to energize the battery and replenish it after the battery has been discharged for load.

The KIUC service area abounds in solar energy resource and the co-op has taken full advantage of that resource in order to reduce the consumption of fossil fuels otherwise required to run the diesel engines supplying the Island's electricity. These steps have included actively supporting roof-top solar PV and solar water heating, purchases from third-party solar systems, and acquiring PV energy from systems developed by a subsidiary organization.

Because the peak load of the KIUC system routinely occurs after sunset, between the hours of 7 PM and 10 PM, dispatching the SolarCity battery for capacity and energy during those peak load hours effectively provides a solar-powered generation resource that will be used at night, allowing diesel engines to be idled or operate at minimum load.

Battery energy storage is a well-known option for smoothing the intermittent output of wind generation and solar facilities and for other services. Batteries in a variety of forms have been in operation for some time in providing backup power, spinning reserve, frequency regulation, and other forms of system support. In addition, battery storage systems are a means of demand-side management, allowing owners of battery storage to reduce total energy costs by discharging to reduce peak demands, providing for a reduction of demand charges, and recharging during off-peak periods when electric rates are lower.

KIUC is noteworthy in that nearly all of the capacity and energy from the solar system comes to the co-op through the battery system. KIUC had previously installed 4.5 MW of battery energy storage, and will be adding 6 MW additional this year, to resolve intermittency effects from the high penetration of solar energy on Kauai.

Consumer-members of **Steele-Waseca Cooperative Electric** (SWEC), a small electricity provider south of Minneapolis, recently began expressing a strong desire to own some form of solar energy. Although SWEC receives a great deal of renewable energy from Great River Energy, its Maple Grove, Minn. based generation and transmission co-op, consumer-members expressed great interest in owning their own project within their own community. However, a rural co-op with fewer than 10,000 consumer-members would inevitably face monetary challenges while pursuing any form of sufficient solar program.

In order to provide for their consumer-members, SWEC decided to pair a potential solar program to their already successful community storage program. Community storage means power suppliers can rely more on renewable energy sources such as solar and wind because they can draw on the aggregated storage during times that variable generation drops off. This can make electricity an environmentally responsible choice, since it's replacing fossil fuel use, as in the case of electric cars, with a greater reliance on green power. Not only does this better enable consumers to keep their electric costs down, but it also allows them to promote clean technology. In this sense, the co-op benefits, the consumer-members benefit, and the community as a whole becomes more sustainable and green.

In 2015, SWEC began offering solar power ownership packaged with its long-successful demand-response program that uses grid-enabled water heaters. Dubbed the Sunna Project, participating consumer-members receive a free 105-gallon electric water heater that the co-op controls to shave peak demand, plus the opportunity to purchase one 410-watt solar panel for $170. This comes out to nearly 90 percent less than the average price of a panel. As a result, before work had begun on their proposed solar array, more than 20 percent of the array's 250 panels were sold. Meanwhile, SWCE gave away more electric water heaters in the first four months of 2015 than it gave away in all of 2014.

Each panel of the new solar array is expected to generate an average of 510 kWh of electricity per panel per year. The entire community solar garden will produce approximately 127,500 kWh per year. Additionally, though the co-op gave away the heaters for free, they now estimate that they have more control over around 20% of its potential load peak. This means that not only are participating consumer-members benefitting, but the community as a whole benefits from more efficient energy management. A final added advantage is that the co-op gains about 4,500 kWh per year in additional electricity sales from every Sunna participant's water heater, which helps to increase the co-ops residential class.

Pre-Paid Billing

Oklahoma Electric Cooperative is Oklahoma's largest electric co-op, with 53,000 meters of service line, 92% of which is residential. OEC uses Exceleron's web base prepaid billing system. This means there is no in-home devices or special equipment needed, as all access is handled through software via interfaces.

This step was taken due to research into other prepaid programs, which showed largely beneficial results given the co-op had the proper AMI equipment. Prepayment is a simple program, which allows consumers to pay their electrical bill in advance, or on the go. This allows consumers to purchase their power on their own schedule, avoid potentially large deposits for energy service, and better understand exactly how they are using the electricity they buy, allowing them to be more efficient on their own. Prepayment has been thought of as a way to allow consumers to think about how they power their homes in much the same way they fill up their vehicle with fuel. Prepayment is also beneficial to the utility providing it. Prepayment allows utilities to collect past debt in a convenient way, as a portion of the each tendered amount will be applied to debt already owed, so that the consumer is able to better stay up to date with energy payments. This helps to prevent consumers from incurring additional debt, and overall creates a community with higher consumer satisfaction.

OEC implemented their prepaid service in 2006, with two main aims: to reduce write-offs, and to give consumer-members easier budgeting options.

The enrollment for the program was a minimum of $25, and current consumer-members were offered refunds on their deposits. Participates were able to choose how they wanted to receive their notifications, such as via email, text, automated phone message, etc. They were also able to visit a website and view their unique numbers, such as daily usage, low balance, and cut offs.

As of 2014, the number of participants had grown to almost 7,000. Data also showed that a large majority of participants were between 25-55, with even younger participants also warming to the idea. It appears the ease and mobility of the payment system is appealing to the technical society of today.

One large misconnection of the prepay system is that the savings the programs are producing are simply results of forced disconnections, mean the customer then cannot use power. While disconnections do happen, OEC has conducted studies showing that a most enrolled consumers have never experienced a disconnect, and even those who do generally have the issue received in a few hours. OEC estimates that there is a .01% savings amount due to disconnects, far smaller than the 5-15% savings that the programs tend to generate.

Smart Grid

Nationally recognized for innovative and advanced use of the Smart Grid, **Vermont Electric Cooperative** (VEC) is the largest locally owned electric distribution utility in Vermont. VEC serves 75 towns covering 2,056 square miles in northern Vermont, with 2,823 miles of line and approximately 39,500 meters. The territory is rugged and hard to serve in some areas. A large number of the utility poles cannot be accessed with a bucket truck. Field personnel sometimes have to walk great distances with equipment to restore power to remote locations. Technology has been a critical component of providing service in this difficult geography, as well as ensuring strong financial results.

An essential component of VEC's technology platform was the ability to be able to integrate the utility mapping system to its Operation Technology and Information Technology platforms. During the summer of 2000, VEC performed a GPS inventory of its field assets, followed by a roll-out of an electronic mapping system in 2001. Laptops were introduced to field personnel in 2002 and paper maps were eliminated in 2003. At the time, data services were not available in the field. Modems were installed in the field offices to enable regular updates to the mapping system.

During the next two years, VEC personnel evaluated a number of automated two-way meter platforms. A number of telephone (copper) based systems were tested and rejected due to the high failure rates that resulted from lightning surges. A number of Radio-Frequency based systems were evaluated and rejected due to the high cost and the lack of reliable communication due to Vermont's mountainous terrain and variety of weather. VEC settled on a power-line carrier system, specifically the Two Way Automated Communication System (TWACS). The system proved to be quite cost-effective with a payback of less than five years *(see figure 1).*

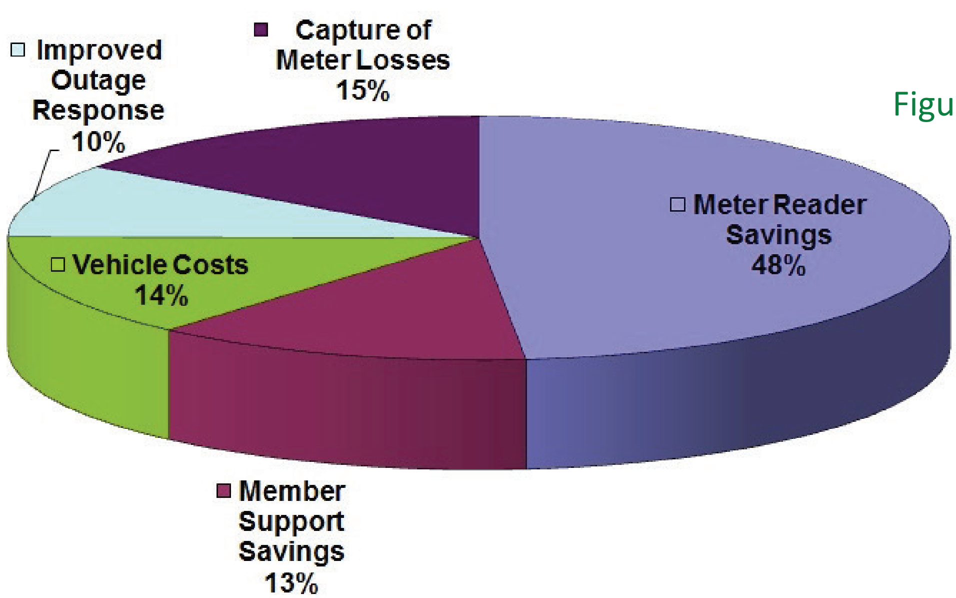
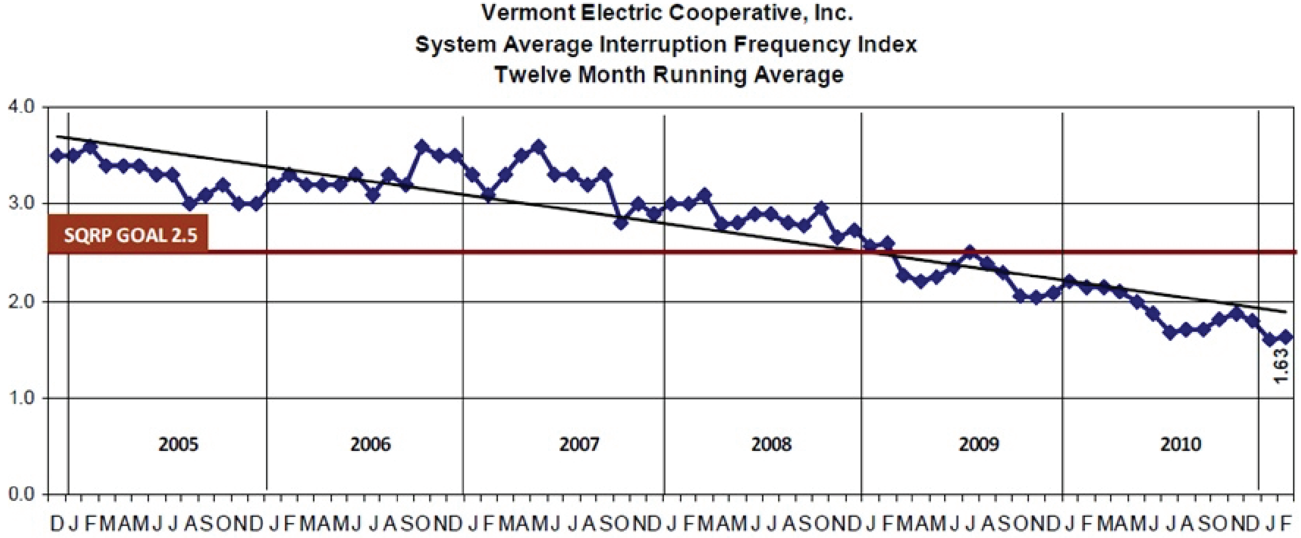


Figure 1

In 2008 VEC i… ter system. The
positive resul… ponding to
large scale ou… se of Microsoft
SharePoint to… ation to consumer-

members. One of the most valuable aspects of the integrated OMS was that it provided an extensive and rich database on outage causes, enabling VEC to systematically improve the quality of service. The system enabled VEC to cut in half the number of consumer-member outages over the next several years.

In late 2008 VEC made the decision to use its own technical resources to develop a program to provide its consumer-members with the ability to view their hourly and daily usage. VEC introduced the wattWATCHERS program to its consumer-members at the May2009 annual meeting. wattWATCHERS also allowed consumer-members to set high usage alerts that would be sent via text message or email. The program was popular for many years and was replaced by a mobile platform called SmartHub in 2014. SmartHub is an account management tool that enables consumer-members to manage all aspects of their utility account. In addition to paying their bill, consumer-members can view their power usage data, report an outage, and set up alerts to be notified when a power outage occurs and when it's been restored.



Acquisition (SCADA) capability. In 2014, VEC (upgraded??) its SCADA system to enable integration with the Automated Meter Infrastructure (AMI) to create the smart grid. This enabled VEC to develop programs to evaluate every sub and feeder comparing substation load to aggregated smart meter load and enabling fine measurement of system losses and transformer loading.

VEC is now positioned to remain relevant well into the future. VEC consumer-members have been adopting solar at very high rates. Currently net metering capacity represents 12.5% of VEC's peak load, with another 8% of peak load capacity planned to be on-line in the next year through utility-scale solar projects. There is another 100 Megawatts of wind generation connected to the VEC grid, well over its 85 Megawatt peak. VEC would not be able to manage this level of distributed generation without an integrated technology platform.

With the innovation of storage technologies and the continued reduction in cost of solar in the near future, loads will continue to go down and consumer-members will have the opportunity to disconnect from the grid. VEC is aggressively working to continue to be relevant for its consumer-members in this new utility environment. Today, VEC's electric supply is more than 75% carbon-free. VEC will continue to focus on reducing the carbon in Vermont's energy supply by providing opportunities for its consumer-members to move their transportation, heating and cooling to electricity. VEC will educate consumer-members about products such as air-source hot water heaters, electric vehicles, electric storage and electric maple sugaring technology and will facilitate on-bill payment and innovative financing options. These opportunities coupled with the smart grid and innovative rate structures will allow consumer-members to save money and contribute to Vermont's mission to reduce its carbon footprint, all the while optimizing the use of the grid.

VEC will continue to be responsible for providing reliable electric service to the meter. VEC believes the opportunity for increasing revenues is beyond the meter and it could not happen without the technology platform that has been developed over the past 15 years.

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