

Using Design Thinking to Test the Case For Distributed Energy Services: Poudre Valley REA's Regional Center Project

Key Findings

- Poudre Valley REA (PVREA) is working on a multi-year project to create member-first DER solutions.
- Through Design Thinking research, PVREA developed a deeper understanding of the energy habits, goals, and perceptions of their co-op members.
- Providing consumer-centric options and services to co-op members sets cooperatives up for a brighter future by improving member engagement and satisfaction.

What has changed?

Poudre Valley REA and NRECA's Business and Technology Strategies department partnered on a Regional Center project that is exploring innovative ways electric cooperatives might respond to rising consumer interest in distributed energy resources.

Poudre Valley REA (PVREA) is a 42,000-member cooperative serving a region of Colorado's Front Range surrounding the city of Fort Collins. Recently named the Smart Electric Power Alliance's Power Player 2018 Electric Cooperative Utility of the Year for a community solar program designed for low and moderate income consumers, PVREA is focused on further engaging a membership that is demonstrating a strong interest in energy alternatives.

The [Regional Center program](#) is a research partnership between NRECA and individual electric cooperatives to test the function and value of distributed energy resources.

In 2017, PVREA and NRECA launched the "Consumer-Centric Technology and Behavior Project," with three sets of activities. One is to test the functionality of a suite of distributed energy technologies and energy efficiency measures. The second is to utilize a program design process called design thinking to better understand what motivated consumer-members regarding of new products and services. The third phase is to build and pilot new consumer offerings taken from the findings from the first two steps. These new offerings will be rolled out in stages, and ideally will better meet consumer expectations, while also adding value for the cooperative as a whole.

In this project, PVREA senior staff have taken an approach to utility product development that intentionally shifts from a 'utility-first' mindset to a 'consumer-first' one. The approach builds on the vision shared in NRECA's 2016 white paper "[The Consumer-Centric Utility](#)." By its nature, the member-owned cooperative

electric utility is positioned to better accommodate member interest in consumer-owned and sited energy technologies, while integrating those resources in ways that strengthen the cooperative as a whole.

The Regional Center project at PVREA uses input from co-op members to design the kinds of products and services they would like to see the co-op offer.

There are two main parts to the project. The first is a focus group of co-op members. While this doesn't sound very exciting or unusual, it was not the typical focus group. It utilized a principal known as design thinking. Design thinking is an approach to developing products, services and experiences that address consumers' emotional needs. Many people may snicker at this idea. After all, utilities sell electricity or, as we often say, 'cold beer and lights.' However there is not a major successful company that sells goods to consumers that does not use design thinking in one form or another.

One of the key differences in the Poudre Valley focus group is that the people participating were not average consumers. A typical focus group attempts to be representative of the majority of a company's customers or users. Design thinking looks for a small number of participants that are out of the mainstream. These are people that spend time thinking about their bill, energy purchases, or the future of the community. They are not experts. But, they have thoughts and feelings that are deeply held. They are early adopters. They are passionate. They are people that may represent the cutting edge. In design thinking, the theory is that if you design something based on the thoughts of these customers, you will improve the customer experience of the mainstream.

Design thinking allows companies of all types to create better products, better user experiences and better customer satisfaction. It uses detailed observations of customers in their daily lives, not simply assumptions, to begin a discussion of how best to solve their problems while meeting the needs of the organization. The approach is being used successfully at a wide range of organizations, from Fortune 500 companies to small non-profits. Universities have started offering courses in design thinking to students from all disciplines, and some consulting firms are specializing in helping clients with the process. Now, utilities are exploring how they can leverage design thinking for energy services solutions.

The hands-on part of the project is the installation and testing of a network or suite of distributed energy technologies and controllable building loads at the cooperative headquarters. The goal is to test how these technologies and loads might be operated as a network to achieve the types of results that a consumer might expect to achieve, such as reducing peak energy use, while maximizing the value of on-site distributed generation and battery storage.

What is Design Thinking?

When the word *design* comes up, it's often in the context of creating a physical product, like a can opener, or a building. But whether they realize it or not, every type of business — from mega-corporations to local non-profits — design products, services, or experiences. There are many names for this activity — *product development*, *program design*, *product design*, *engineering*, and *research & development (R&D)* — but ultimately it boils down to solving problems and finding ways to create value for customers by bringing innovative opportunities to life. It's applicable to any field and can be practiced by anyone, regardless of whether or not they have a creative or design background.

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Design thinking seeks to get at the heart of the problem through observations of customers, especially extreme customers like early-adopters, in their everyday settings and one-on-one interviews. Extreme users are more likely than standard customers to have developed work-arounds or new ways to use existing tools and services, and their innovations are often appealing to much broader audiences.¹

At its core, design thinking is a human-focused, participatory, iterative process. It asks practitioners to approach problems with empathy and open minds, question their assumptions, and genuinely engage with customers through multiple rounds of quick feedback on possible solutions. The goal, according to IDEO, a leading design thinking consulting firm, is “to match people’s needs with what is technically feasible and a viable business strategy.”²

¹ <https://www.linkedin.com/pulse/3-reasons-why-extreme-users-boost-your-innovation-vivien-gauthier/>

² <https://www.ideo.com/post/change-by-design>

What has been accomplished to date?

In July 2018, PVREA began test operations of its technology suite. The components were selected to mimic in type and scale something that a residential consumer, motivated to leverage the full value of distributed energy and in-home efficiency, might choose to install. The demonstration components include:

- 4.92 kW (4.2 kWac) TenK Duo ground mount photovoltaic (PV) system from Today’s Power (designed as a direct-to-customer, do-it-yourself product);
- sonnenBatterie Eco Compact 10 kWh system, including controllers, with 7 kW maximum power output;
- Spirae Wave demand response and distributed generation management software;
- A natural gas-powered generator that can operate in parallel to the grid;
- Energy efficiency upgrades at PVREA’s headquarters, specifically LED lighting and controls.

Originally, the cooperative planned to utilize a 125 kW Cummins natural gas/propane generator already installed at its headquarters as part of the technology test. It would become a generation source operated in parallel with the grid to provide behind-the-meter demand response, and able to provide the synchronous volt/VAR support of the grid in self-supply mode. However, unlike many newer models, the cooperative’s Cummins unit was not easily modified to run as a synchronous generator in full demand response mode. Going forward, the co-op will use the Spirae software to control an existing generator in an active, but more traditional “break-before-make” load-shedding mode.

The two elements of the test set-up that are of particular interest to PVREA are the least proven in everyday use – the sonnen battery and the Spirae software.

At the outset, PVREA had specified a Tesla Powerwall 7 kW/14 kWh battery for the project, citing member interest in the famous Tesla brand. However, the company could or would not deliver that model, instead promoting the purchase of a larger (and much more expensive) utility scale battery system. PVREA found a

more willing partner in sonnen, a German company that has recently moved manufacturing and marketing to the U.S. In early operations, PVREA has used the battery to store solar generated by the TenK solar PV system and to use that stored solar power to meet building loads during periods of peak demand, in lieu of the grid.

Spirae is a company developed through a research program at nearby Colorado State University. While many distributed technologies come with proprietary control systems, Spirae promises to deliver a single software package that can control any number of technologies.

While the interest behind the technology demonstration at the PVREA headquarters might be described as the “how does it work?” – the consumer part of the project can be characterized as the “why do they want it?” To explore changing consumer interest in energy service options, NRECA introduced PVREA to a research study organized by E Source. The latter is a utility-focused research firm that specializes in customer issues and the efficient use of energy. PVREA joined 18 other electric utilities in the E Source project “2020 Residential Ethnographic Research,” which takes a unique approach to eliciting a consumer-driven design of energy services.

Rather than measuring consumer interest through a large survey, or in focus groups, the E Source 2020 design project concentrates on a handful of individual consumers at each participating utility. Consumers are initially screened for awareness and interest in topics chosen by each utility (PVREA selected rate design, electric vehicles, and energy efficiency as its core topics). In a process described as “mobile ethnography,” four PVREA members used their smart phones to record their responses to a set of questions in the topic areas, as well as to other questions related to energy use and perceptions about their utility. The recordings and interactions with a live interviewer were made daily over a five-day period, literally while the individuals were going about their daily routines. The individuals then sat for an in-depth, hour-long interview with the researchers by Skype to drill deeper into some of the ideas and concerns raised in the mobile recordings.

The cooperative received a report from E Source that included the findings from the in-depth interviews with PVREA members, but also a summary of the ideas and attitudes harvested from the customers of the other utilities participating in the research project.

Surprises and Challenges

Milton Geiger, alternative energy administrator at PVREA and manager of the Regional Center project, says that his biggest surprise, and one shared by colleagues at PVREA, is his perception of the value of the E Source behavioral design project. “I was very skeptical at the beginning about the whole process of design thinking, but my perception has flipped,” he says. “In the ethnographic research, we intentionally spent a lot of time getting very candid thoughts from our members. As a result, we have started to change the way we approach problems. We are taking less of a paternalistic attitude towards our members. We’re better able to look at a problem from their perspective.”

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- Milton Geiger, PVREA

The mobile ethnography created a layered and unvarnished picture of the energy habits, goals, and perceptions of a small group of motivated co-op members. The interviews provide suggestions for what PVREA might test in the next stage of the project in terms of a new rate structure (time-of-use appealed to these

members), incentives on and support for electric vehicle charging, and consumer-friendly communications about energy use. While these members have a generally positive impression of the co-op, reaction on some subjects revealed gaps. The fixed facilities charge was perceived not simply as too high, but as a disincentive to energy efficiency. And, despite the co-op's efforts in community solar, the co-op was perceived to be out of step with consumer interest in solar and renewable energy in general.

It was in the “easy” part of the project – building and operating the microgrid at the co-op headquarters – that Geiger says the co-op “encountered tremendous challenges” that took months to resolve. The issues were less with the individual pieces of equipment and more in the integration of technologies from various vendors, in a building with systems dating back to 1994. An additional challenge came in staff bandwidth. PVREA relied solely on in-house staff to set up the technology demonstration at the cooperative's headquarters. Working around the primary need of employees to attend to day-to-day responsibilities created unavoidable delays.

The TenK solar PV system was chosen to mimic the kind of PV system that a member might purchase directly from a supplier and install at home with minimal assistance from a licensed electrician. Shortly after the TenK kit was delivered to the cooperative, the PV company filed for bankruptcy. Installation proved to be more difficult than advertised, and the absence of company support added a cautionary note for consumers doing business with vendors of new technologies. The installation proved to be time-consuming and the all-in costs of the PV system were much higher than that of a similar-sized PV system purchased from and installed by a solar contractor.

With the generator restricted to operating in traditional ‘stand-by’ mode, PVREA will have to run simulated models of a generator operating in demand response mode, which may slightly diminish the full value of the tests that will be performed in the next stage.

Spirae's software is designed for large facilities; the company has had to make changes to its technology to match the building level load in the PVREA demonstration. In addition, the need to address network cybersecurity added a layer of complexity.

What's Next?

Poudre Valley REA is now merging the two phases of the research project to test how consumers with distributed energy resources might respond to different rate structures. PVREA's headquarters building – with its microgrid suite of technologies and control software – will stand in for the consumer. In the mode of a consumer, the cooperative will utilize the distributed resources to maximum advantage under four rate structures, including the co-op's current standard rate. The idea, Geiger says, is to push the ability of the behind-the-meter technologies to provide the most favorable combined financial return to the consumer and the co-op. Under a time-of-use rate, for example, the co-op will utilize the microgrid technologies at its disposal to shift consumption and leverage on-site generation to maximize the potential to save money.

PVREA will also test the capability of the behind-the-meter distributed energy to deliver optimal value to the grid while maintaining value for the member. Geiger expects that each rate scenario will be tested for at least one billing cycle.

What Can Other Co-ops Expect To Learn From This Project?

Electric cooperatives are often urged to look to successful retailers and technology providers such as Starbucks, Amazon and Apple for ideas on how to understand and respond to changing customer interests and demands. The ethnographic study that PVREA is participating in brings this closer to home. Unlike a retailer of consumer goods, an electric utility is a natural monopoly. But, that doesn't mean that the utility must remain a "choice desert," observes Geiger, especially with rising options for self-generation through solar and battery storage. "The question we face is how to offer choices to our members," he says. "Because, if we don't offer those choices, it will be done without us."

The PVREA 'residential microgrid' will provide tangible data on the relative reliability and maturity of the individual technologies, and a demonstration of what it takes to manage the output and use in ways that save money and increase comfort and reliability.

This advisory on the Poudre Valley REA Regional Center is the first in a series.

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