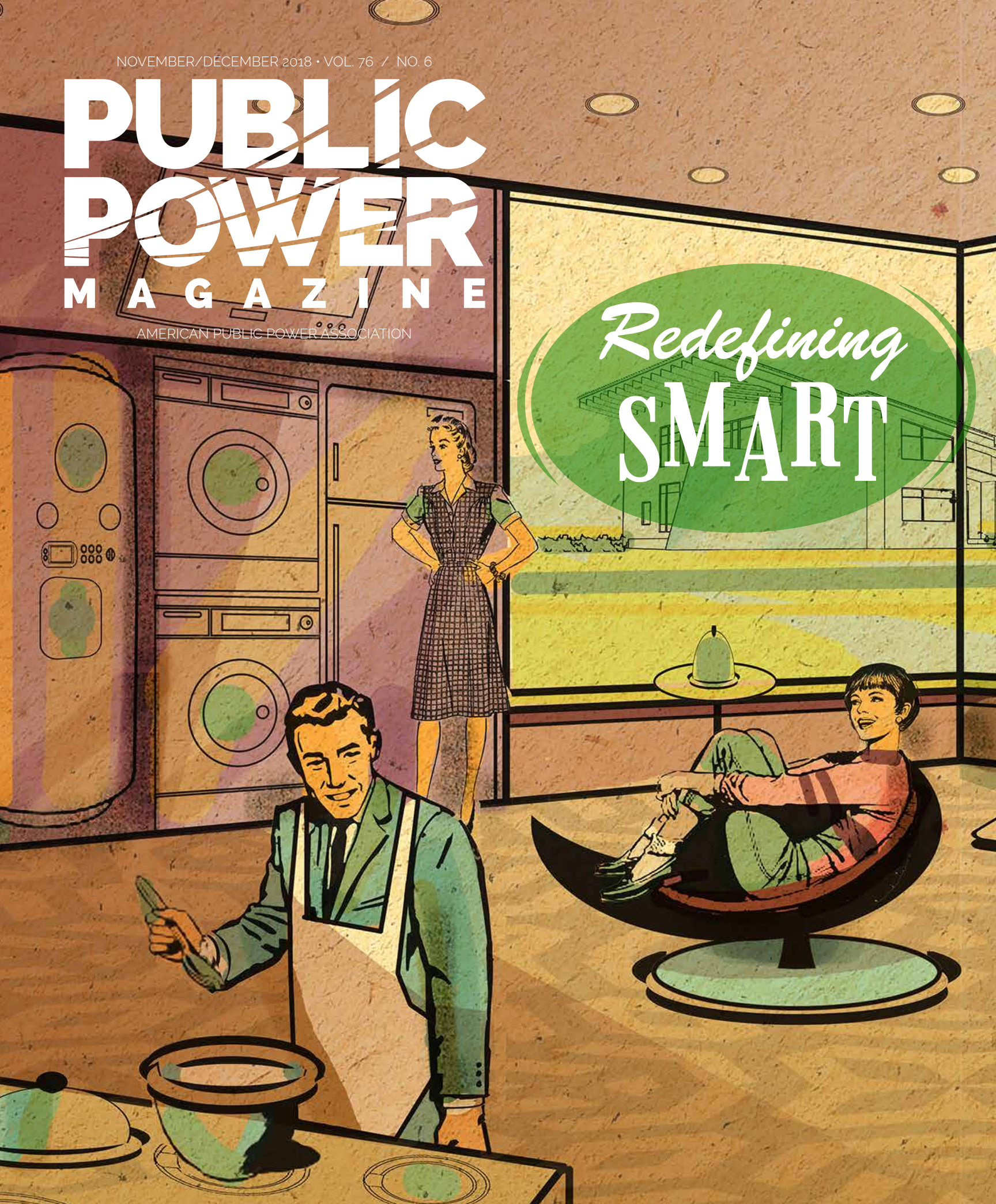
NOVEMBER/DECEMBER 2018 • VOL. 76 / NO. 6

PUBLIC POWER MAGAZINE

AMERICAN PUBLIC POWER ASSOCIATION



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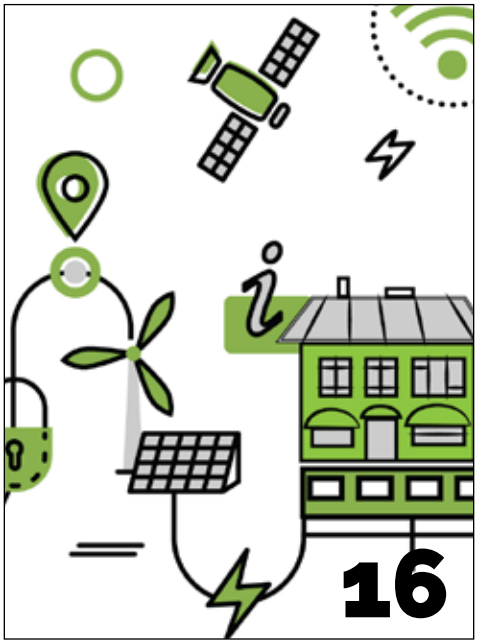

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Public Power Magazine (ISSN 0033-3654) is published six times a year by the American Public Power Association, 2451 Crystal Drive, Suite 1000, Arlington, VA 22202-4804.

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Periodical postage paid in Arlington, Va., and additional mailing offices.

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The American Public Power Association is the voice of not-for-profit, community-owned utilities that power 2,000 towns and cities nationwide. We advocate before federal government to protect the interests of the more than 49 million customers that public power utilities serve, and the 93,000 people they employ. Our association offers expertise on electricity policy, technology, trends, training, and operations. We empower members to strengthen their communities by providing superior service, engaging citizens, and instilling pride in community-owned power.

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PUBLIC POWER LINES

SUE KELLY, PRESIDENT & CEO, AMERICAN PUBLIC POWER ASSOCIATION

Our Own Flavor of Smart

It has been more than a decade since the Energy Independence and Security Act of 2007 brought a concrete policy direction — and dedicated funding — for smart grid technologies to the electric utility industry. The act, plus funding through the American Recovery and Reinvestment Act of 2009, led to more than $5 billion in investments into everything from smart meters to storage systems and grid monitoring devices.

A lot else has happened in the past 10 years. Communities nationwide are exploring how to become smart cities. Industry players have begun to lump energy efficiency and demand response under the umbrella of "smart energy use." And your customers use smartphones and smart devices in their homes every day.

Smart is what today's customers seem to crave. Yet one almost wonders if "smart" terminology is being overused or if it has become diluted by being a catch-all.

Surveys show that people want to live in smart cities, but there is no single definition for what makes a city "smart." Many of you, our members, talk about smart grid technologies and offering new services for customers with smart homes. However, no two initiatives are identical in the technology or approach used.

We focused this issue of Public Power Magazine to cut through all the noise on what is "smart" and offer the public power perspective.

Increased connectivity, information, and efficiencies seem to be a common theme when we look at smart initiatives in public power. As is evident in the articles throughout this issue, it is not just about knowing more, but about doing more with what we now know.

In the true spirit of public power, many of the people who contributed to this issue note that we should not get hung up over needing one industry definition of a smart city, utility, or home. Instead, we should each focus on what our communities want and become our own flavor of smart.

As we look ahead to the next decade, our priority should be to keep our eyes and ears open to the obstacles and opportunities for our communities. We can do this not only by providing the electricity that powers the technologies of the future, but also by serving as pioneers — leading our communities to rethink how we live, work, and connect.

The examples of innovative public power work highlighted here are far from exhaustive. We at the American Public Power Association know many of you are making strides to push and prepare our industry for the future. That's why I invite you to take part in two activities with us. First, engage with us in Public Power Forward, a strategic initiative to help prepare public power for a new era in electricity. To join in the discussion of how you are handling new technologies or changing the way you do business, visit www.PublicPower.org/About/Members/Listservs to subscribe to the Public Power Forward listserv.

Second, get active in DEED — Demonstration of Energy & Efficiency Developments — public power's research and development program (www.PublicPower.org/DEED-RD-Funding). If your utility is not yet a member of DEED, I encourage you to join — you'll contribute to advancing public power and learn from the innovations of other public power utilities. And if you're already a DEED member, don't be afraid to dip your toe into the water by submitting a grant application for a project you've been considering. No project is too small, and what you learn just might prove to be a jumping off point for a new smart program or service.

So, if being smart is about sharing and applying our collective knowledge, then public power is ideally positioned to go to the head of the class.

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Not your father's energy efficiency

Utility programs adapt to the modern customer

BY JAMES PATERSON, CONTRIBUTING WRITER

It has been more than 40 years since a solemn President Jimmy Carter warned Americans that we were facing a new energy dilemma: a supply that was limited and a "shortage that is permanent."

Whether or not Carter's televised address was politically wise or scientifically accurate has been widely debated, but it did display the thinking at the time that gave birth to an idea that has been with us since: energy efficiency.

Initially, in the late 1970s, "energy efficiency" meant more attention to measures familiar to any thrifty business or homeowner, such as turning off lights or turning down thermostats. But it grew to be a popular mantra and became a big part of a concerted effort in the public and among electric utilities to conserve energy, trim costs, and reduce emissions.

Energy efficiency led utilities to incentivize efficient light bulbs and appliances and remotely regulate heating and air conditioning during peaks. Now we're in a new era with high-tech systems to coordinate multiple devices, appliances, and equipment — even window coverings — and cut a home's energy use with a few taps on a cellphone.

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"Fundamental end uses now don't really change too much — things like the building envelope, lighting, and heating or air conditioning equipment. There are improvements, but they are incremental," said John Phelan, energy services manager at Fort Collins Utilities, a public power utility serving about 70,500 customers in Colorado. "Where we see significant change is in how we deliver programs. Our role is shifting to delivering a package of equipment and services that provide efficiencies and make it very easy for customers to say yes."

Fort Collins has offered customers an array of more traditional products and services to help meet the city's aggressive energy and water conservation goals, including financing for upgrades, audits, and rebates on everything from insulation and smart thermostats to LED bulbs.

In 2017, Fort Collins Utilities received the American Public Power Association's Energy Innovator Award for its Efficiency Works program, which tested a new model for comprehensive home performance contracting that reached more customers and was easier for customers to participate in.

Now, the utility is moving on to finding new ways to help businesses and customers cut use during coincident peak periods. One way is using a new application that lets the user configure a customized system for automating energy use adjustments to save money and energy.

> **"Our role is shifting to delivering a package of equipment and services that provide efficiencies and make it very easy for customers to say yes."**
>
> **JOHN PHELAN**
> ENERGY SERVICES MANAGER,
> FORT COLLINS UTILITIES

Sue Coakley, executive director of the Northeast Energy Efficiency Partnership, one of six regional efficiency organizations supported by the federal government, has traced the history of efficiency measures and said efforts like Fort Collins' are part of a new crop of "intelligent efficiencies" that "broaden and deepen the reach and impact of efficiency programs.

"Home energy management systems, building controls, and software as a solution (SaaS) systems now harness the power of machine learning, data analytics, social networking, and cloud computing to provide customer-specific dashboards of actionable information," she said. "This has spawned a new generation of behavioral programs designed to increase efficiency and reduce peak demand through customer-managed energy use."

Encouraging incremental change

Randy Corbin, assistant vice president for energy policy and sustainability at American Municipal Power, a joint action agency that supplies electricity and services to more than 130 public power utilities in nine states, argues that while dramatic technological advances are important, incremental change is necessary and can create surprising results.

AMP offers its members a comprehensive Efficiency Smart package of services (or a la carte choices) that it guarantees will deliver specific levels of efficiencies. In 2017, the program resulted in 17,129 residential and 182 business upgrades and 15,503 megawatt-hours of savings by member customers. The program is offered through a contract with the Vermont Energy Investment Corporation.

One of the most successful programs provides LED bulbs at a discounted price through local retailers. Some 14,500 customers purchased more than 58,000 LED bulbs in 2017, up 5,000 from 2016. Corbin says the program offers rebates for energy-efficient residential and business equipment and products and free removal of old and inefficient refrigerators and freezers. The program also offers technical assistance, account management services, and customized financial incentives for large business customers.

Corbin notes that while AMP is always looking for significant technological developments, major reductions in load can often be obtained with advances in existing equipment, such as heat pumps that now can function at significantly lower temperatures than the previous standard, when they were ineffective below 30 degrees, and light bulbs, which became dramatically more efficient with the introduction of compact fluorescent bulbs and, later, LEDs.

"Some of these products or services aren't

"Staying current with information about the best, most efficient products that businesses and homeowners use each day is critical."

RANDY CORBIN, ASSISTANT VICE PRESIDENT FOR ENERGY POLICY AND SUSTAINABILITY, AMERICAN MUNICIPAL POWER

as sexy as other things that we hear about, but they are often where we can get the biggest efficiencies," Corbin said. "Staying current with information about the best, most efficient products that businesses and homeowners use each day is critical."

AMP promotes the Efficiency Smart program as an economic development tool, Corbin said, because there is strong evidence that savings for its members' commercial and industrial accounts will attract new businesses and help existing ones thrive.

"The potential for economic development is a key element that energy efficiency programs don't give enough attention to," he said.

As part of this revised focus, AMP recently upgraded its website, helped members develop new ways to get the message out about the program, and, after careful review, moved to emphasize demand reduction rather than energy savings. It is changing its business rebates to make them easier for small businesses to use and providing services to low-income residents and others in need.

Convenience over cost

At Shakopee Public Utilities Commission in Minnesota, officials also wanted to make changes and add new technology, but they wanted to test carefully first. The utility already had a comprehensive energy efficiency effort, including rebates on nearly a dozen products, and a home energy report service that allowed customers to compare their use with that of about 100 nearby homes, eventually resulting in significant customer efficiency measures.

John Crooks, utilities manager at Shakopee, said that the utility was interested in a carefully studied approach to smart homes.

"We wanted to give residential customers the opportunity to have control over the electricity they use in their homes with new technologies — beyond an on-off switch. We wanted to see if such a program would provide energy saving benefits," he said.

About 125 homeowners agreed to be considered for the project, from which utility experts chose eight customers with various types of homes of different ages and who themselves were different demographically. The customers were equipped with efficient lighting, timed lighting controls, real-time energy monitoring, a "phantom kill switch" near the garage door, remote air conditioning control, and upgrades to their electrical systems — all controllable from a computer, smartphone, or tablet.

Crooks said energy use did not decline dramatically, but the utility did find that customers liked the convenience of the system, and he believes it could be fine-tuned to offer significant savings, particularly in an area where energy costs are higher.

"The fact that participants haven't requested removal of the equipment demonstrates that for a certain customer base, the devices become a convenience where the energy savings is a secondary concern. It becomes second nature to just hit the button for the phantom kill switch, as opposed to going around the house shutting things off."

Putting customers in control

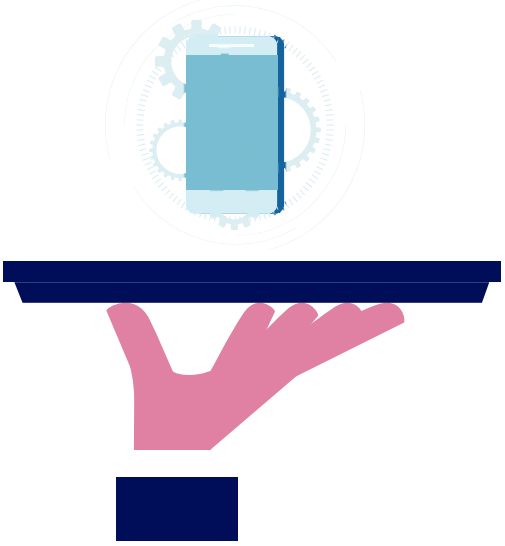
Fort Collins Utilities is taking steps to make it easier for its customers to link to and communicate with energy saving devices, through a program initially designed to help commercial customers navigate its coincident peak rate structure.

"We wanted a robust, agile system that could help us handle the crucial peak periods but also branch out and provide customers with other tools," said Philip Tucker, key accounts representative at Fort Collins Utilities.

The utility started by finding ways to notify city facilities about peak periods, which saved recreation facilities a considerable amount by not using lights and dryers when those higher rates were in effect.

Then, the utility provided users an "if this, then that," or IFTTT, application in September that allows customers to create custom methods to adjust their usage, typically with a device as simple as a cellphone.

"The channel allows end users to easily create custom conditional programs to automate actions and responses based on utility-defined triggers," Tucker said. In its limited use so far, it has been very popular.



> **"Customers always want to have more data, and as soon as possible."**
>
> MICHAEL MCCABE, BUSINESS EFFICIENCY PROGRAM COORDINATOR, GAINESVILLE REGIONAL UTILITIES

"I have people stopping by my desk saying, 'I want that application.' Once they understand what it is and what it is capable of, they see the advantages and the control that is in their hands," he added.

In October, the utility also began using time of day pricing with its residential customers, setting different rates for peak periods that vary by season. That will be followed by a residential IFTTT application, which the utility plans to release in November.

In Florida, Gainesville Regional Utilities offers commercial customers insight into what's using up peak energy.

"Customers always want to have more data, and as soon as possible," said Michael McCabe, business efficiency program coordinator at GRU. "We're able to gather the data from the meter, but we don't have the ability to put it all together in a user-friendly form."

The utility conducts audits for commercial customers and offers a subscription service provided through Automated Energy, which allows customers to see detailed information from the previous day about when their peak demand is set and how much energy they used at different times. McCabe says this has helped some of GRU's larger customers detect anomalies and identify areas where they can cut back on or shift energy use throughout the day.

"Initially, they just want to see what their profile looks like for an average workday. From there, they are experimenting and tailoring," he said, noting that most customers see a decline in demand within the first month of using the service. McCabe said that it can also be helpful when a building's controls are reset — after a storm, for example — to see if the service report shows higher than expected use that customers can adjust before they get the monthly bill.

Estimating costs, anticipating updates

Corbin noted that energy efficiency efforts might seem to be win-win, as they are good for a utility's image, can save customers money, and help the utility manage peak periods and supply. However, there are challenges, and such efforts require planning and thought.

He said that utilities can easily overlook costs or staffing for the program or handling products in areas other than those they traditionally offer.

At Fort Collins, Pablo Bauleo, chief engineer, said that a number of considerations with technology are often overlooked.

"Standing up one of these systems tends to be more expensive than we expect," he said, noting that data-handling equipment and trained staff needs are often underestimated.

Bauleo said utilities must consider the fact that technology and players in the tech industry change. For instance, when one Wi-Fi provider updated its routers, it made sure phones and other devices were also upgraded, but neglected thermostats, which required the utility to make hundreds of service calls.

Phelan added that energy-efficient equipment can become outdated quickly. "Look at the thermostat. Previously, the one in most homes could have been there for decades. Now, they may be outdated in three to five years."

Education is key

Barbara Andrews, public engagement specialist at Fort Collins, said energy efficiency programs have to be sold inside and outside of the utility and not just as an afterthought. She emphasized that education about energy efficiency measures must be aggressive and well-conceived.

Andrews developed an educational process for commercial customers that focused on the people actually operating equipment. They needed the information — either directly or from facility managers trained to provide accurate instruction. Easy-to-read materials about response to peak periods were provided that could be posted near the equipment.

Fort Collins is making information about time-of-day pricing a priority, including a website description that clearly outlines the structure.

Corbin noted that energy efficiency programs also must be examined in the context of customer relations. "[An energy efficiency] program represents a very public-facing, and sometimes a first, direct interaction between your utility and potentially a high number of customers," he explained. "Delving deeply and directly into this customer service phase of the utility business requires proper diligence but can pay off."

Phelan noted that Fort Collins collects sophisticated data about customers indicating who might have the most interest in new developments and be the most likely to use them comfortably. In its smart home project, Shakopee used such data when it chose the homes for the project and collected data afterward to see how the systems were used by different demographic groups and in homes of different styles and ages.

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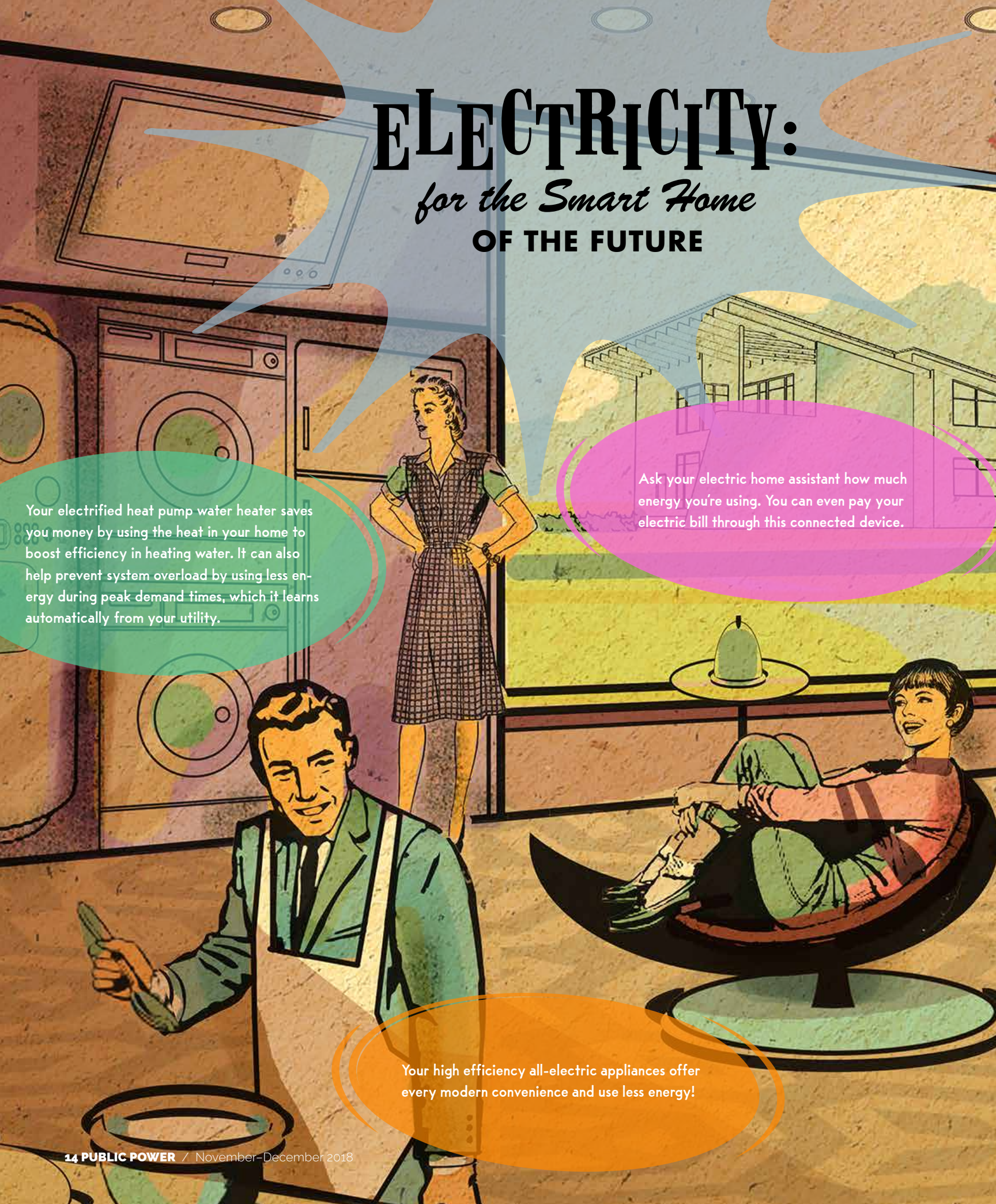

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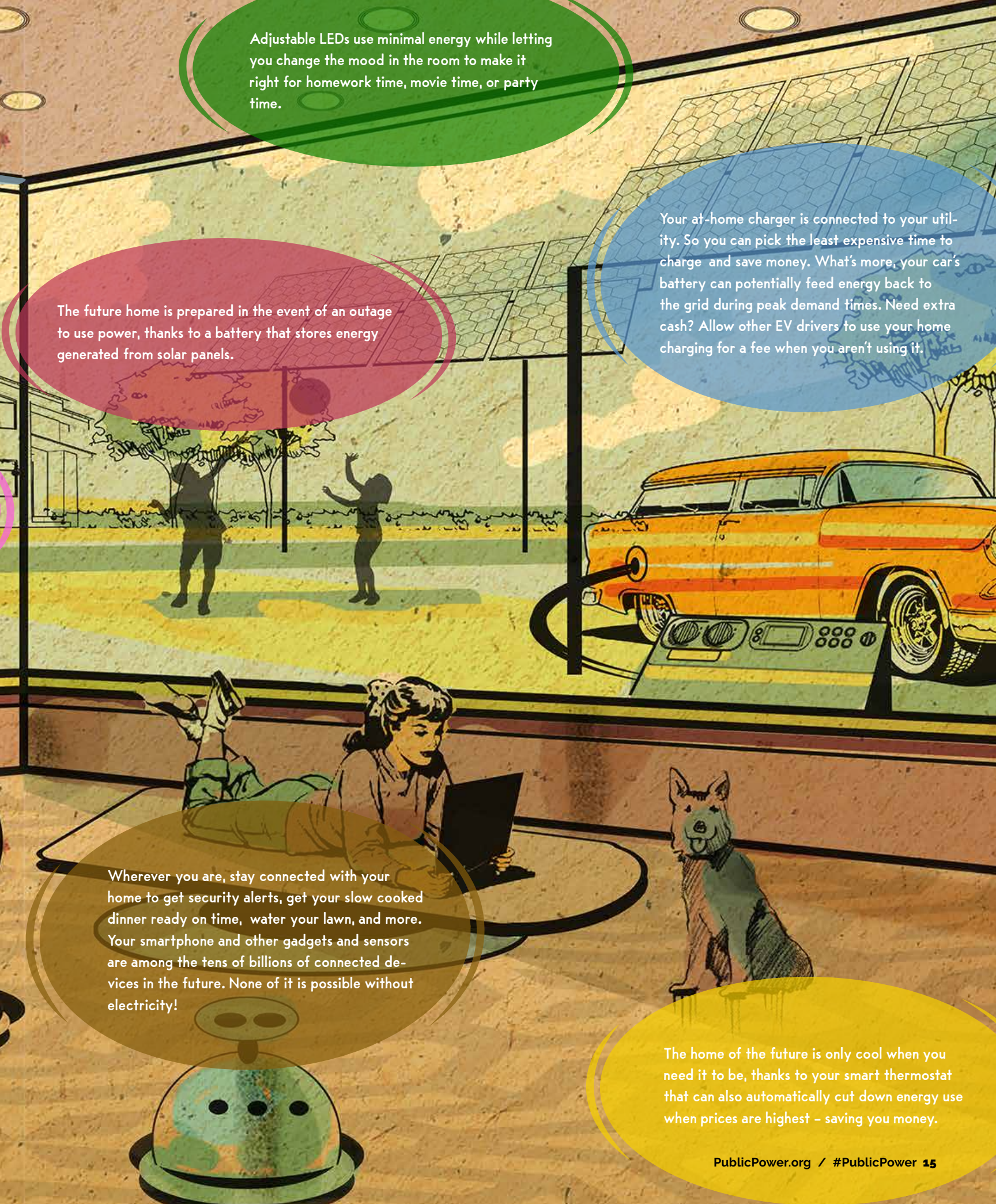
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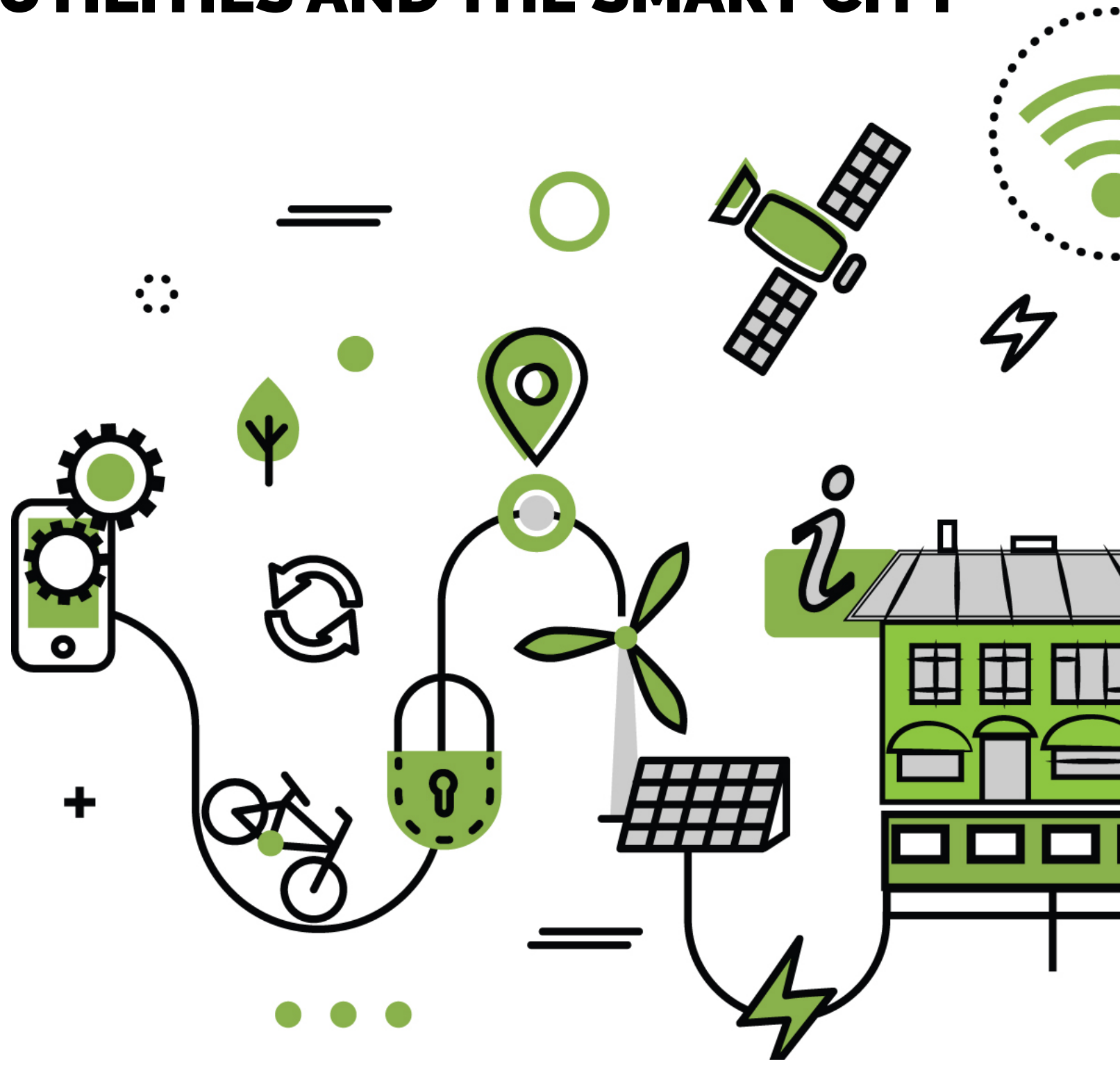
The home of the future is only cool when you need it to be, thanks to your smart thermostat that can also automatically cut down energy use when prices are highest – saving you money.

UTILITIES AND THE SMART CITY



BUILDING BETTER COMMUNITIES

BY SUSAN PARTAIN, SENIOR EDITOR AND CONTENT STRATEGIST, AND **PAUL CIAMPOLI**, NEWS DIRECTOR, AMERICAN PUBLIC POWER ASSOCIATION

As new technologies rise and fall, one constant seems to remain: Electricity is used to power "smart" devices. Beyond simply powering the technologies that make smart cities possible, utilities are a crucial player in any community's smart city initiatives. From upgrading broadband service to fostering mobility, public power utilities explain how taking a lead in smart city projects improves their communities.

SMART IS DEFINING POSSIBILITIES

"The one thing that's wrong with 'smart city' is it implies that cities aren't smart today," said Paula Gold-Williams, president and CEO of CPS Energy in San Antonio, Texas. There isn't one definition of a smart city, she said. Rather, "it's a testament to the possibilities of what you want to do when you're enabled by technology along the way."

"It's not important for the industry to think of a definition. It's more important that we start to put solutions in the hands of customers," Gold-Williams said.

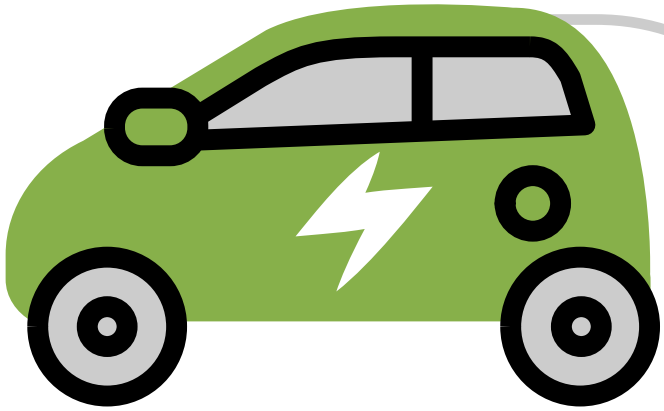
"It doesn't matter what it looks like on the East Coast or the West Coast. It matters what you put in your community, and, again, municipal power's going to be well-positioned for that, and we know that that's one of our value propositions," she added.

San Antonio and CPS Energy are leaders in smart city efforts in the U.S. Earlier this year, global law firm Dentons announced Gold-Williams as a smart cities/communities think tank energy industry co-chair, along with former Secretary of Energy Ernest Moniz. The think tank will advise public and private stakeholders on what the firm sees as the 14 pillars of success for a smart city program. The energy pillar, chaired by Gold-Williams and Moniz, will look at how smart cities and communities incorporate a multidirectional grid and advance clean energy solutions that include a broad array of distributed energy resources.

> **"A city becomes a smart city when you can integrate technology with people to make lives function better."**
>
> KRISTIAN FENNER, ASSISTANT ADMINISTRATOR, COLUMBUS DIVISION OF POWER.

Juliet Shavit, CEO of SmartMark Communications and a smart city subject matter expert, is the author of Creating a Smart City Roadmap for Public Power, a new whitepaper from the American Public Power Association. The paper explains that "smart has come to mean the intersection of digital with knowledge or intelligence."

For a community considering a smart city project, Shavit advised that "there will always be newer technologies, faster internet speeds, more efficient transportation models, etc. Yet, taking the first step to identify the needs of your community is the foundation for your smart city roadmap."



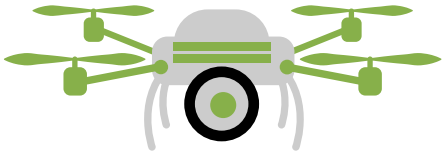
SMART IS ENABLING QUALITY OF LIFE

In Columbus, Ohio, the foundation for a smarter city is increased mobility. In 2016, the city won the federal Department of Transportation's Smart City Challenge, competing against 77 cities nationwide for up to $40 million to "revolutionize their transportation systems to help improve people's lives." The city also received a $10 million grant from the Paul G. Allen Philanthropies.

"A city becomes a smart city when you can integrate technology with people to make lives function better," said Kristian Fenner, assistant administrator at the Columbus Division of Power.

"Our mayor believes that mobility is the great equalizer of the 21st century, and if we can provide equitable access to mobility for our residents, that will help us allow them to live their best lives," explained Brandi Braun, deputy innovation officer for the city of Columbus. "When you look at many of the challenges we're facing as the 14th-largest city in our country, whether it is the opioid epidemic, infant mortality crisis, or pockets of poverty, transportation and mobility is a piece of the puzzle for solving all of those problems."

The city is looking into electrifying its fleets, supporting EV charging infrastructure, using self-driving vehicles, and equipping buses with technology that can integrate with traffic lights to reduce delays and congestion. Most importantly, Columbus is involving a variety of groups across the city, including health and human service agencies, to build a connected operating system that shares data to learn how to make these transportation options most effective for residents.



> **"Part of our job is to provide [customers] the tools and the infrastructure so they can figure out neat things to do with it."**
>
> STEVE BERNARD, CEO, CEDAR FALLS UTILITIES

Braun and Fenner noted that electrification is an important component to the initiative.

"When you think about the future of mobility and transportation, there are a few key things we know it will be rooted in: Vehicles will be connected, they will eventually be autonomous, they will be shared, and they will be electric," said Braun. "More and more automakers are announcing that they are moving toward producing all-electric vehicles. So, as cities, regions, states, and, frankly, the whole country, we need to think about how we are going to accommodate that shift in the transportation system."

SMART IS CONNECTING

"We have a lot of really smart, digitally savvy customers in town," said Steve Bernard, CEO of Cedar Falls Utilities in Iowa. The utility was one of the first in the country to invest in a high-speed internet system back in the 1990s, and Cedar Falls has since been called a "gigabit city" for further updates made to the network in 2013. Even though the current technology might be the envy of other cities, Rob Houlihan, chief technology officer at CFU, said the utility is now preparing for another upgrade — to 10-GB service.

Bernard says this drive for connectivity comes from the customers, and that CFU aims to stay ahead of what the community wants. "Part of our job is to provide them the tools and the infrastructure so they can figure out neat things to do with it," he said. "They're able to access a world-class broadband system here, at a reasonably low cost, and we think that opens up a lot of doors for our customers."

In addition to providing the electricity for the town, CFU currently serves more than 14,900 dwellings and businesses with high-speed internet, telephone and/or television services. Bernard says the local school district is now the envy of other districts across Iowa, as CFU has allowed local schools to implement online learning initiatives, and connectivity in students' homes has helped diminish the digital divide across the city.

"It's almost a necessity now in daily life to have a good internet connection," said Bernard, who listed the myriad reasons customers tell him why they appreciate the service, from being able to work more efficiently to enjoying better entertainment experiences.

Bernard acknowledged that the service has also allowed CFU to be a smarter utility. For its electric services, CFU is able to connect through broadband to smart meters and remote switching gear, saving meter reading costs and helping minimize outage time.

"Whether it is for utility purposes or for customer purposes, [the technology is] all dependent on the fiber system, which is highly reliable, so we want to be sure we maintain it and continually upgrade it," added Bernard.

The city of Longmont in Colorado has also focused on building broadband connectivity in becoming a smart city. The city-operated internet service, called NextLight™, was named the fastest internet service provider in the country by PC Magazine in 2018.

Susan Wisecup, acting general manager at Longmont Power & Communications, said

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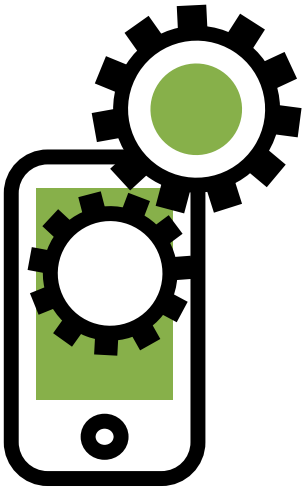


"By coupling electric and broadband together, we're continuing to provide opportunities for the community and becoming more valuable to them."

SUSAN WISECUP, ACTING GENERAL MANAGER, LONGMONT POWER AND COMMUNICATIONS

SMART IS PARTNERING

that putting in the fiber connection resulted in a number of city improvements, from spurring economic development to making schools better and deterring crime. The service has also helped the utility, which does not have advanced metering infrastructure, in monitoring the electric system and analyzing and responding better during outages.

"Many years ago, we as a utility, and maybe as an industry, felt that we were the ones that had to come up with the smart home devices," said Wisecup. She noted that the utility focus has instead been on creating the support infrastructure for those devices. "We don't have to be the ones to invent or provide thermostats or [devices that] monitor water levels in your lawn … we just have the infrastructure in place that supports the private industry products out there."

The utility plans to implement tracking in its vehicles to improve service and efficiencies and is working with a downtown business group to foster an "innovation corridor" for technology businesses.

Gold-Williams described CPS Energy as an "enabler" of San Antonio as a smart city. Converting CPS Energy to a digital network and using AMI increased the amount of information the utility can access. This allowed CPS Energy to get to the preventive, predictive state of operations and look for anomalies so customers could benefit from advance maintenance planning.

The transition to digital was a foundational step to leverage potential benefits with other entities, and it formed the basis for a smart city or community. The utility partners with the city of San Antonio and city entities such as San Antonio Water System, VIA Metropolitan Transit, and the San Antonio River Authority.

The utility has been working with the city manager, mayor, and council members and discussing what San Antonio could look like if they could all look at customers from multiple prisms. Together, they are deciding what the foundation of their smart city could be, according to Gold-Williams.

The utility is talking about how to best optimize and centralize its data, removing sensitive personal information, to allow the community to put the data to use. "We're going to be able to offer the business community another connected platform where people can come in from a tech perspective and help us create new apps, think about where we put new lighting systems in, and all of the things that come along with virtual reality and augmented reality, and on and on and on," Gold-Williams noted.

At CPS Energy, "We've been diligent, and we've been the promoters of the partnerships and the supporters, and if somebody wants to talk to us about it, we're there," she said. "If they don't want to talk to us about it, we go and introduce the concepts to them and start talking about the possibilities."

Public power is in the best trusted position to promote partnerships, talk about possibilities, and build support to put options on the table. Public power can ask the community, "What do you want your smart city to be?"

San Antonio's Office of Innovation has also been a key player in advancing smart city efforts. The office held a smart cities readiness workshop in March 2017 to discuss and develop a roadmap to San Antonio's future. More than 100 participants, including CPS Energy, attended.

"We don't just advance to advance; it has to make sense with our network, with our customers."

ROB HOULIHAN, CHIEF TECHNOLOGY OFFICER, CEDAR FALLS UTILITIES.

In January 2018, San Antonio Mayor Ron Nirenberg announced the creation of the Innovation and Technology Committee, to be made up of public and private citizens who would build on smart city solutions that modernize the way San Antonio tackles growth challenges. The committee was asked to assess the impact of emerging trends and technologies and recommend how to advance smart city goals by enhancing cybersecurity, promoting digital inclusion, improving mobility, expanding municipal broadband, and pursuing economic opportunity.

"We knew that for us to be successful, it takes an ecosystem, it takes all of our sectors working together," said Columbus' Braun. From the beginning of the application process for the Smart City Challenge, the city worked with other public entities, academics in the area and the private sector, including the investor-owned utility that also serves customers in the city, and car dealerships to promote EVs. Braun pointed out that the city also engaged with residents through surveys, focus groups, and one-on-one meetings to listen to and understand their specific needs.

Community involvement is also important for Longmont. "When we first began looking at the fiber side of things, we held focus groups [and did] lots of community outreach through many different sources so people were aware of what we were doing," said Wisecup. In these and other initiatives, such as integrated resource planning, Longmont has held community town halls, conducted surveys, and provided opportunities for people to give feedback through its social media.

"We're always trying to serve our customers and provide them what they need, and even what they don't know they need or want yet," said Wisecup. "By coupling electric and broadband together, we're continuing to provide opportunities for the community and becoming more valuable to them. We continue to show that we are their neighbors, they're our owners, and that we are the community."

SMART IS FLEXIBLE

"At your base, you have to be flexible. We've learned that you have to be careful about technology planning — you have to be open for it, you have to look for it, you have to do pilots and see what else is going on," said Wisecup. "And with technology, you have to be aware and searching, but you cannot home in on any technology that's up and coming — you can't hold onto it too tight — because things will change."

Rob Houlihan, chief technology officer at CFU, agreed. "When we look at new technology, especially when we're on the leading edge of it, it is hard to know sometimes when to pull the trigger. Because you might think you have really cool technology, but it's either really expensive or it is not fully baked," he said. "In a number of cases, we've delayed decisions just because there wasn't enough certainty that the money would be well spent. We don't just advance to advance; it has to make sense with our network, with our customers."

SMART IS SUSTAINABLE

Smart cities are also about planning for future growth. This growth might be most acutely felt by midsized cities, which, according to the Department of Transportation's Smart City Challenge report, are expected to grow at three times the rate of the rest of the country over the next three decades.

Columbus' Fenner noted that the Division of Power is making a concerted effort to increase the proportion of renewables in its portfolio from 20 percent to 50 percent within the next few years.

"As a municipal utility, we have always wanted to support the sustainability goals of

our mayor," said Fenner. "Yes, we can continue to deliver power as usual, how it has been for a hundred years, but we see that our customers and communities — they want to see renewable and sustainable technology, and they are driving this as well. We believe in evolving with what is being asked for in our community."

This focus is about more than just using renewables. It also considers how the city can use energy more wisely. "It is all a circle — use less energy, make sure that it is renewable, and try to make sure our systems are working as efficiently as possible," she said. As one example, the city switched to LED streetlights, and is working to add connectivity to make the lights "smart."

"We also have to anticipate capacity. We need to be proactive in assessing areas we are serving, making sure our equipment and infrastructure can withstand the new loads that we will be taking on," said Fenner, "making sure transformers are working properly, that our circuits are working to full capacity, so that we can take advantage of all the new technology that will be using our load."

SMART IS FOCUSING ON CUSTOMERS

Patti Austin, administrator of the Columbus Division of Power, acknowledged that focusing on smart city initiatives can be a challenge, especially for smaller utilities that face more urgent challenges concerning finances, infrastructure, or personnel. But "you have to make it a priority to get it done," she said. "You have to keep your focus and look at where the next opportunity is every day."

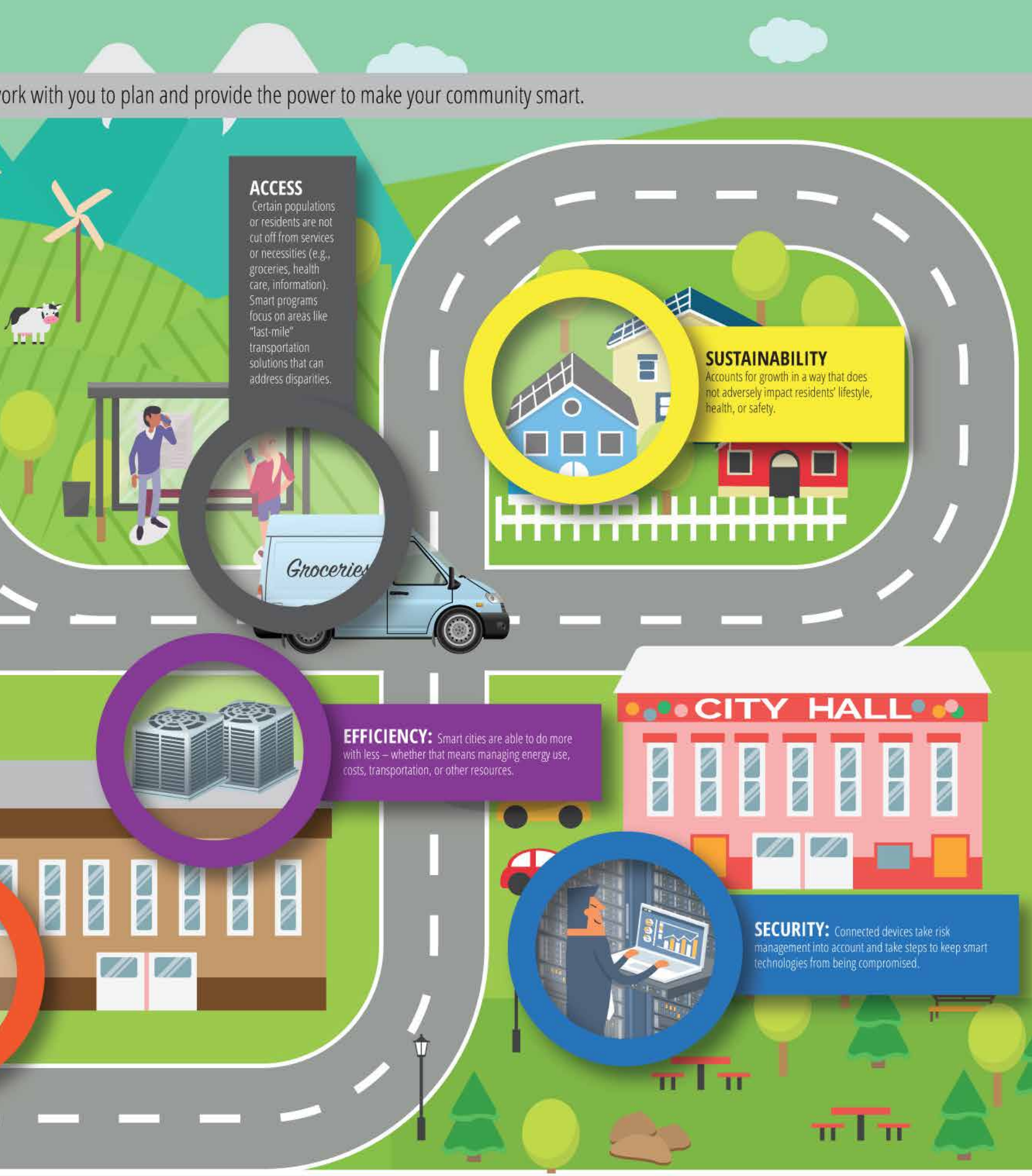
"We're here for our customers. That's our focus. We always go back to customer service, reliability, and low cost. You have to be innovative and look for opportunities and be open to all possibilities, but if you have those as your base, you will be successful," advised Wisecup.

7 Ways to Spot a Smart City

60% of Americans report wanting to live in a smart city. But what does it mean to be a smart city? It is about more than implementing technology, but can include the following factors.

Electricity makes smart cities possible. Your community-owned utility is ready to w

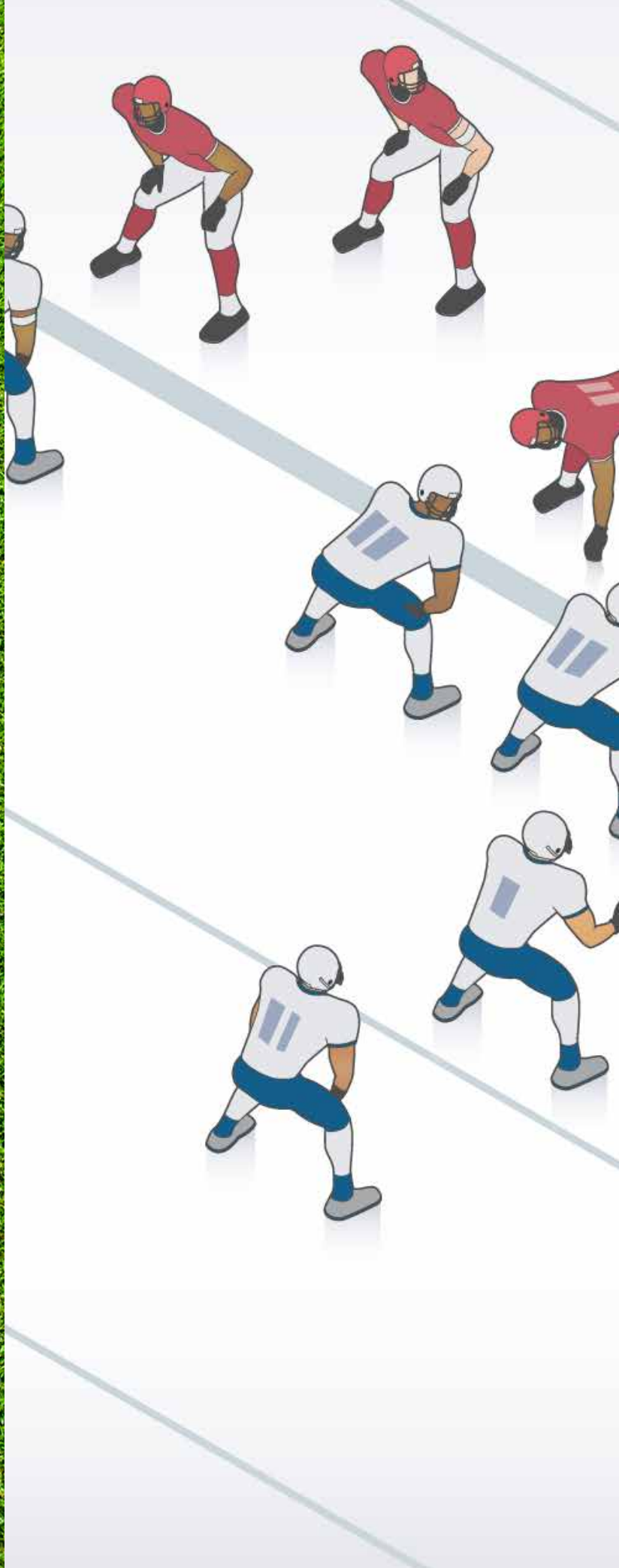
ork with you to plan and provide the power to make your community smart.

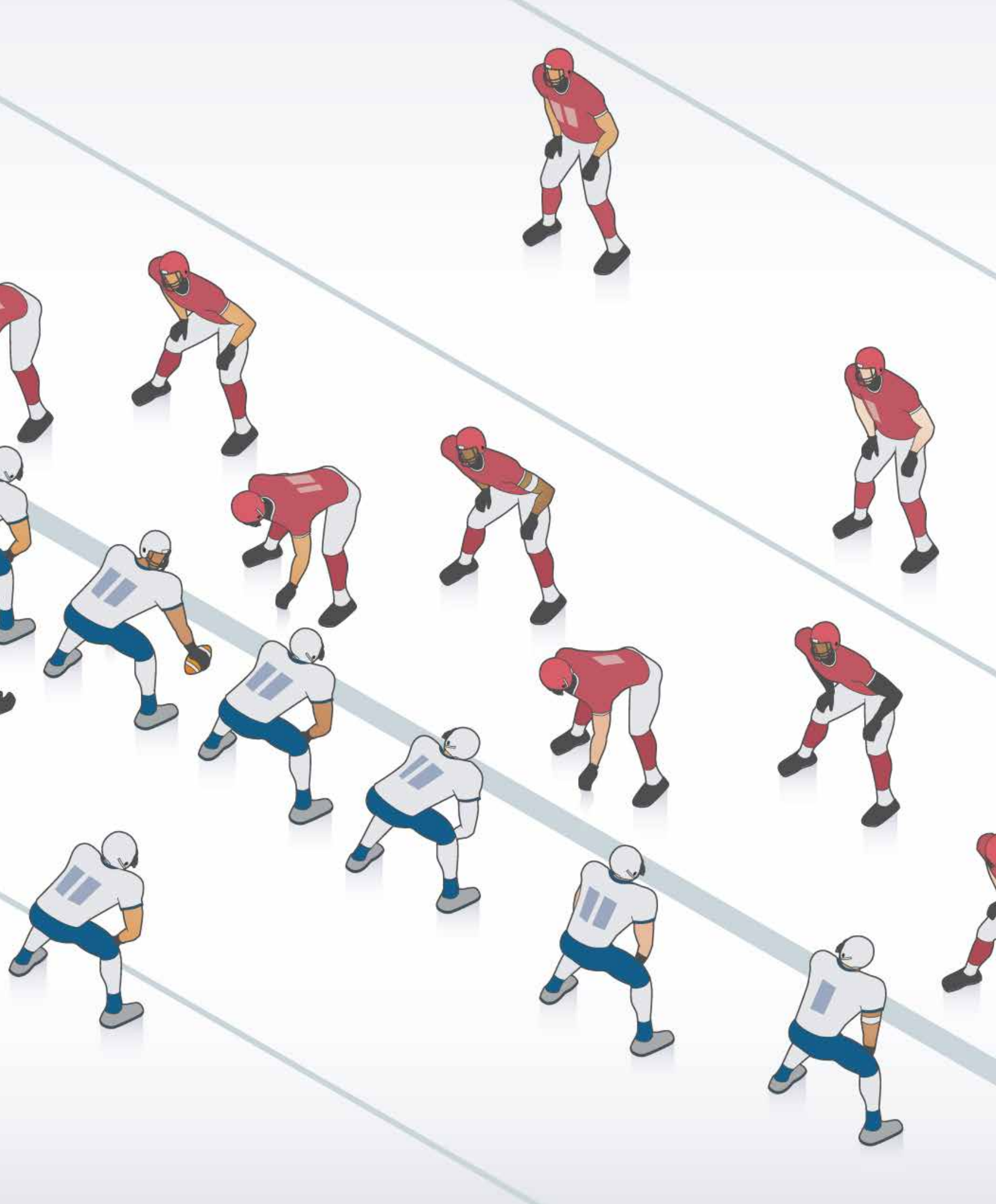


#PublicPower

SMART UTILITIES MOVE FROM DEFENSE TO OFFENSE WITH DIGITAL TOOLS

BY **STEVE ERNST**, CONTRIBUTING WRITER





Ricardo da Silva began his career with the New York Power Authority in the waning days of what could be described as the dark ages of the utility industry.

Da Silva started as project manager with NYPA in 2003, when the industry was operating very much as it had for the last 100 years. Remote, baseload power plants generated electricity that was sent hundreds of miles across transmission lines to customers. Engineers watched and waited to react when a power plant tripped offline or a transmission line dropped out of service.

But today, NYPA's investment in smart grid technology is shining a light into the utility's generation and transmission assets, revealing an unprecedented amount of information and revolutionizing how the utility manages its network.

"We are now able to do better planning and spot issues before they become issues," da Silva said. "We are controlling our own destiny, which translates into better use of resources, human capital as well as financial."

"We are controlling our own destiny, which translates into better use of resources, human capital as well as financial."

RICARDO DA SILVA, VICE PRESIDENT OF STRATEGIC OPERATIONS, NEW YORK POWER AUTHORITY

NYPA has been working toward becoming a "digital utility" since 2014, when it started implementing its Energy Vision 2020 plan. Today, the utility has deployed thousands of sensors at many of its 16 hydroelectric facilities and at key points along its 1,400 miles of transmission lines.

The array of sensors delivers 26,000 data points in near real time to NYPA's new Integrated Smart Operations Center, or iSOC, at the utility's headquarters in White Plains, New York. The utility uses GE's predictive analytics software and other applications to monitor equipment performance and look for anomalies in the system to help predict and avoid problems. NYPA is in the process of deploying an additional 1,000 sensors into the field by the end of 2019 that will provide more than 100,000 data points.

In addition, new sensors and software can alert engineers to negative trends. For example, observations with a transformer at the Niagara power plant recently raised concerns. The gas entrained in the oil tells the history of the transformer, da Silva explained, because the oil absorbs all the stress a transformer goes through.

Historically, technicians checked transformer oil by taking samples that were then sent to a lab for analysis, and the results were sent back to engineers for review. It was a time-consuming process.

But now, a view into oil chemistry is nearly real time, giving them a head start on solving a potential problem before it affects the transformer.

"It forced us to take a long look at the resource, and we concluded there was no immediate risk," da Silva said. "But because of this information, we were able to do some robust planning for when we take that resource offline for maintenance. We're able to line up vendors and plan in advance for what needs to happen."

Smart grid technologies are allowing NYPA to proactively spot potential asset health issues and be much more efficient with its operating and maintenance budgets. So far, the smart grid initiative has helped save the utility $7 million in avoided costs.

In July 2016, NYPA launched the first-of-its-kind monitoring and alert system to protect the Long Island Sound Cable, a 600-megawatt submarine transmission line running from New Rochelle to Hempstead Harbor under the Long Island Sound. A smart beacon system uses satellite-based marine navigation technology to monitor and communicate with ships that come near the cables and automatically sends alerts if a vessel appears to be preparing to drop anchor.

An anchor strike ruptured the line in 2014, causing 66,000 gallons of nontoxic cable insulating fluid to leak into the sound. Now every ship that maneuvers over the line gets a warning, and NYPA's engineers can see which ships are anchoring near the cable.

"Smart grid technology is giving us a situational awareness that we've never had," da Silva said. "It's giving us actionable insights into what's happening on the system … It's really transforming the way we operate."

PLAYING OFFENSE

Twenty-eight hundred miles west of NYPA, in Portland, Oregon, the Bonneville Power Administration has spent $50 million to deploy phaser measurement units at substations and generating facilities that now give the federal power marketing agency a nearly real-time glimpse into the performance of its hydroelectric units and 15,000 miles of high-voltage power lines.

Every second, BPA's control room receives a PMU signal with 60 data packs — lists of measurements and the time they occurred — that show what's happening across the agency's network.

Gordon Matthews, an engineer in the technology innovation group at BPA, says the data the PMUs deliver is "granular imagery." The old system delivered information every two seconds. "In the electricity world, two seconds can be an eternity," he said.

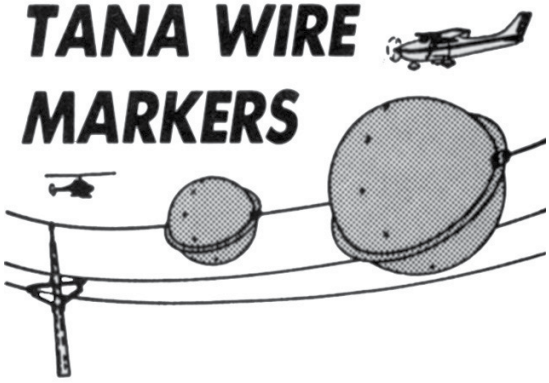
Matthews compares the difference in smart grid technology versus the old system to having a photo of a mountain. The old system delivered just a photo of the mountain, but now BPA gets a high-resolution photo of a mountain that shows trees, leaves, trails, rocks, and streams.

The PMUs give system operators the ability to detect "oscillations" in specific generating units in real time and adjust their output, depending on the situation, to lessen the wear on units.

BPA can see if a hydro generator is running in a rough zone and react accordingly, said Jeff Anderson, software developer at BPA. "To avoid wear and tear, or even failure of an asset, we can now see those oscillations as they are happening and immediately take action."

The data gathered from the PMUs have allowed BPA to go on the offensive to protect its assets, said Tony Ferris, electrical engineer in BPA's measurement group.

"In the past, we only played defense, but now that we see what's happening on the grid, we are playing offense by building in automation in response to what's happening that helps further enhance reliability."



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ANTICIPATING THE FUTURE

For the Emerald People's Utility District in Eugene, Oregon, the decision to invest in smart grid technology was about remaining competitive in the 21st century.

The utility is investing $4 million to swap out 21,800 aging automatic meters with advanced metering infrastructure. As of September, the utility had installed new meters for about three-quarters of its 18,000 residential customers, and it hopes to have commercial, industrial and irrigation customers updated in the next two years.

Over the next 10 years, Emerald PUD will invest $11 million into building out its AMI network and add a geographic information system, meter data management system, and an outage management system.

"We've tried to anticipate where the industry is going, and in our minds, we see the utility industry as being ripe for potential disruption from more competition and new technologies, and we want to remain viable in that world," said Kyle Roadman, power resources manager at Emerald PUD.

Roadman said the AMI meters will allow the utility to deliver more services to customers while giving it deeper insight into usage. The utility is already starting to see some benefits from its investment.

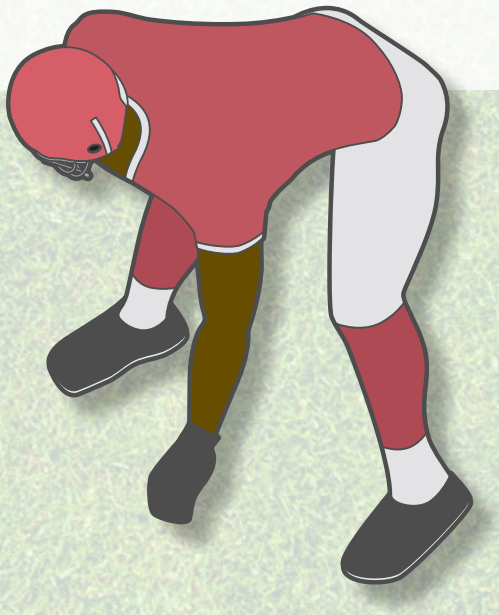
Using data from AMI equipment already in the field, Emerald PUD engineers were able to quickly pinpoint the cause of an outage after a section of the distribution system went out in March. The information saved time and manpower by directing crews to the location of the outage.

Engineers have also used data from smart meters to spot three separate incidents of voltage fluctuations that would have otherwise gone undetected.

"Voltage is a tricky thing; customers would never notice unless they have equipment damage, and we wouldn't notice, either, until a transformer goes out," Roadman said. Thanks to the

"In the past, we only played defense, but now that we see what's happening on the grid, we are playing offense by building in automation in response to what's happening that helps further enhance reliability."

TONY FERRIS, ELECTRIC ENGINEER, BONNEVILLE POWER ADMINISTRATION



new source of data, Emerald PUD tuned in to the troublesome transformers and decided to pre-emptively replace three transformers before they affected service.

"AMI has just been huge for us," Roadman said. "We get much wider visibility into our system. It's already changing the way we dispatch crews, and we'll fine-tune that as more meters come into service."

The utility used a grant from the American Public Power Association's Demonstration of Energy and Efficiency Developments program — DEED — to contract with The Energy Authority, a public power-owned nonprofit corporation, to manage the mounds of new data generated from its smart grid investment.

"That's what we are really excited about," Roadman said. "We've gotten a little taste of what the advanced analytics can do, but once we are fully installed, we can start to talk about some really exciting programs."

Demand at Emerald PUD has increased 10 percent since 2015, and the utility doesn't see that slowing down. At the same time, the PUD's contract with BPA expires in 10 years. To stave off having to potentially invest in new generating resources, Emerald has made energy efficiency and conservation its priorities.

The data gathered from the utility's AMI meters could help design an energy efficiency program that could cut customer usage dramatically.

" AMI has just been huge for us. We get much wider visibility into our system. It's already changing the way we dispatch crews, and we'll fine-tune that as more meters come into service."

KYLE ROADMAN, POWER RESOURCES MANAGER, EMERALD PEOPLE'S UTILITY DISTRICT

"That is a big deal for us," Roadman said. "The energy efficiency analysis is a new space that we are extremely interested in. We have lots of load growth, and energy efficiency is our resource of choice to meet that demand."

Like most utilities in the Pacific Northwest, Emerald PUD is a winter-peaking utility, and the use of smart grid communications could also form the foundation of a demand side management program that could trim that winter peak.

"It really gives us one more tool in our chest to maybe close those gaps when we see them coming," Roadman said.

The utility is probably several years away from designing a DSM program, but Emerald has already seen the benefits of DSM in several pilot projects that allowed for central control over water heaters and thermostats. Roadman said that the data gathered from its smart grid investment could also help shape the utility's rate design — for example, through time of use rates — to help curb demand.

Smart grid technologies are opening a new era for the industry where engineers, asset managers, and planners can be proactive and creative. The industry's transformation isn't something da Silva imagined when he started at NYPA in 2003.

"For technology geeks like me, this is truly exciting," da Silva said. "To see this technology begin to take hold and to see the level of information it provides is just incredible."

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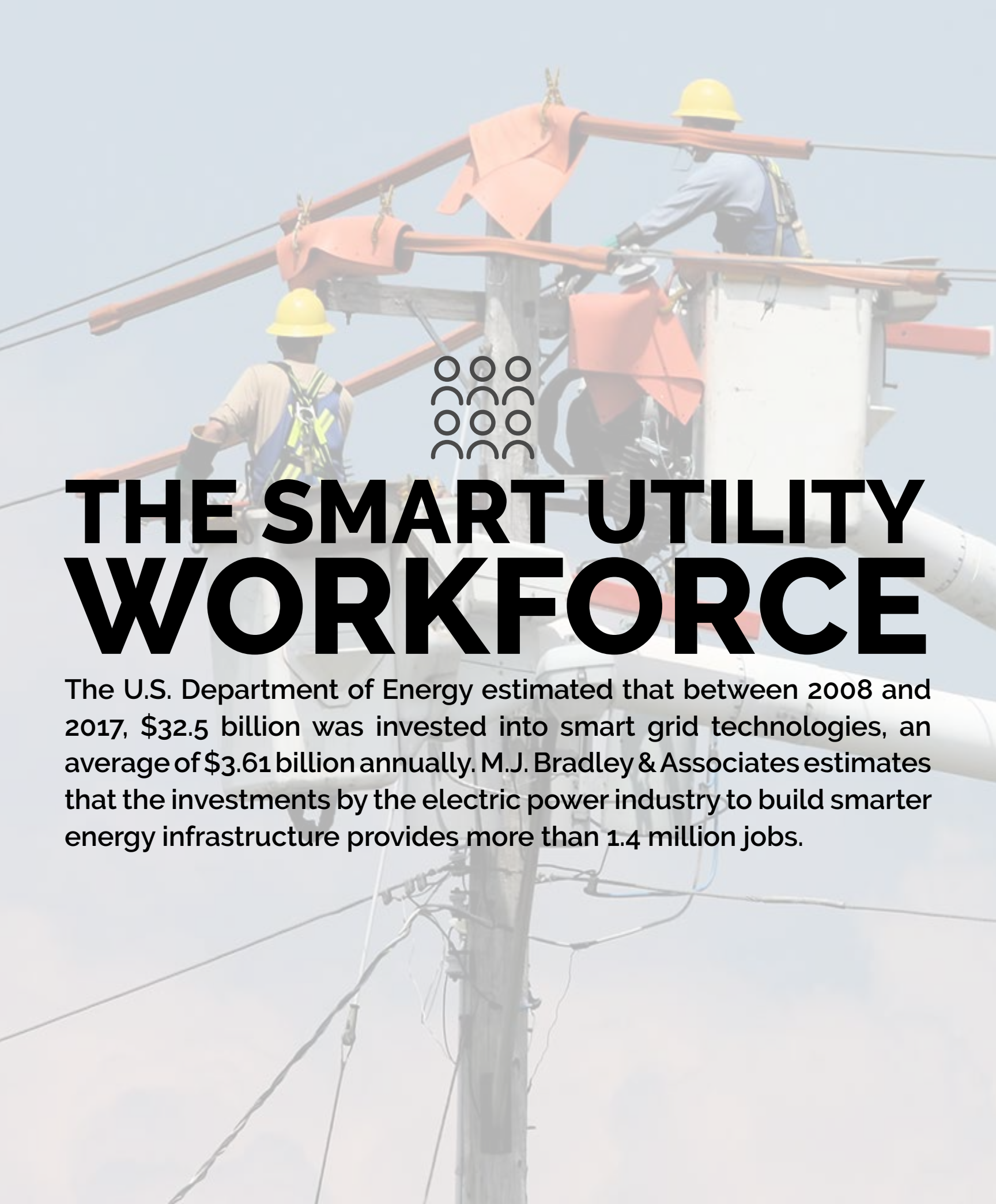


THE SMART UTILITY WORKFORCE

The U.S. Department of Energy estimated that between 2008 and 2017, $32.5 billion was invested into smart grid technologies, an average of $3.61 billion annually. M.J. Bradley & Associates estimates that the investments by the electric power industry to build smarter energy infrastructure provides more than 1.4 million jobs.

ESSENTIAL SKILLS FOR THE FUTURE WORKFORCE

As electric utilities use more digital tools to increase reliability and operate more efficiently, the utility workforce must adapt as well.

CUSTOMER SERVICE

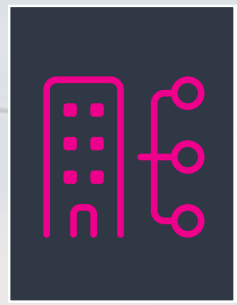
When customers can get more attuned to their energy use, they'll have more ways (and more reasons) to connect with the utility. That's why the Center for Energy Workforce Development lists customer service skills as important for an array of utility jobs, including lineworkers and technicians.

COMMUNICATION

Customer communication is also expected to be two-way. In Utility Dive's State of the Electric Utility 2016, utilities reported to expect increasing communication with customers across six of eight categories, such as billing, energy use, rates, and new services.

DATA ANALYSIS

More devices creating data means more people can use data to help their work, if they can critically analyze data sets to identify problems and opportunities.



TECH-SAVVY

With more devices comes the need for the workforce to be ready to use, repair, replace, and explain these technologies.

INCREASING FOCUS ON ENERGY EFFICIENCY & RENEWABLES

DOE's January 2017 US Energy and Employment Report notes that:

- 2.2 million Americans are employed in the design, installation, and manufacture of energy efficiency products and services
- 42% of the 1.9 million workers employed in electric power generation in 2016 held jobs in low carbon emission generation technologies, including renewables, nuclear, and advanced/low emission natural gas
- The solar workforce increased by 25% in 2016, and wind employment increased by 32%

INSIGHTS

INNOVATION

Collaboration Fosters Innovation

BY MICHELE SUDDLESON, DIRECTOR, DEED PROGRAM, AMERICAN PUBLIC POWER ASSOCIATION

Moving through our busy lives, it can be hard to stop and take a look at what is changing in our industry. From distributed generation to electric vehicles, the marketplace is filled with technologies that are bringing new momentum to electrification. Taking a walk around the expo floor of the Electric Power Research Institute's inaugural Electrification Conference this summer, I was inspired by the possibilities — the range of companies and institutions interested in a more electric future, and by all the innovation with a technology that has been around for 150 years.

Similarly, public power's own research program, Demonstration of Energy & Efficiency Developments — DEED — has evolved since 1980, and there has been an increase in the types of companies and organizations that members work with on innovative projects.

In managing the DEED program, much of what I do is to foster this matchmaking between utilities, universities, and companies. From startups to associations and like-minded utilities, collaborative projects help bring new perspectives that make for more compelling innovation.

The diversity of collaborations reflects our shifting interests as an industry. Once every two years, we survey DEED members on topics of most interest to pursue through research and development. While energy efficiency and demand response have remained at the top of the list, other key areas show progress in the field. Ten years ago, renewables topped the list. Today, top interests are distributed energy resources, storage, and smart grid.

One of the exciting things about DEED grants is that they allow utilities to work with smaller companies to test a technology or innovation they might be trying to bring to market. Often, this is a win-win: The public power utility gets to be on the leading edge and the company gains valuable insights into real-world implementation.

Public power utilities can also act as connectors for innovation. For example, Austin Energy in Texas is developing an incubator lab and conference center focused on new energy. By building a space to bring people together, they are spurring innovation in the community — allowing people to get enthusiastic about energy opportunities and careers and coming up with ideas that could impact the industry.

DEED also becomes a springboard for larger projects. For example, in 1995, we supported the Power Systems Engineering Research Center, a consortium of academic, industry, and government entities to develop a software to model power systems. Over the years, additional public power utilities received funding to enhance the software. The software eventually took off as the PowerWorld Simulator, which is now used by companies in 68 countries.

DEED members have completed several projects with EPRI, with which we have built a good relationship over the years (in fact, EPRI's senior vice president of research and development, Arshad Mansoor, entered the energy industry thanks to a DEED scholarship). One such collaborative project is with the New York Power Authority and EPRI to use a software tool to figure out where storage infrastructure or technology development might be needed or most useful from both a cost-benefit and grid impact perspective.

In public power, joint action agencies and state associations continue to play an important role in fostering innovative projects. The agency or association can recruit members for pilot projects, and then share key findings with other members. For example, American Municipal Power is teaming up with the Smart Electric Power Alliance to develop an EV program planning toolkit, which will focus on creating an easy way for public power utilities to either assess the economic impact of electrifying its fleets or show customers the cost of purchasing an EV.

It's good to pause and reflect on all the change in the electric industry. Together, we can stay ahead of change and continue to foster collaborations for innovation.

Q&A

Public Power Is a Great Cause

Ben Kostick has served as a commissioner of the Lewis County Public Utility District in Washington state since 2007 and serves as chair of the American Public Power Association's Policy Makers Council. The interview occurred in conjunction with the Policy Makers Council Summer Fly-In meeting in late July.

Why are groups like the Policy Makers Council important for public power?

We're told that being elected officials talking to other elected officials is more impactful and effective than a paid staff person doing the same thing. Their constituents are our constituents, we share that common bond.

I feel like this is an effective group. Since we meet in small groups, the summer fly-in feels like both sides are more relaxed and more willing to listen and interact.

Meeting two times a year (at the fly-in and the Legislative Rally), they get to recognize us and know us, and that makes conversations easier. Members and their staff usually are engaged and already informed on the topics we bring to them. If not, they are not afraid to ask questions.

We should be the people they come to if they have questions on energy issues. In my follow-up emails, I tell them that: "Please think of us first."

How important is the relationship between the public power utility and local elected boards/commissions?

People have a wide range of thoughts on how the board should interact with the staff and management of the utility. I think it is important that we keep in touch. They know much more about the inner workings than any commissioner ever could.

In Washington state, the board has the responsibility for three employees at the utility — the general manager, the auditor, and the comptroller/chief financial officer. For some commissioners, those are the only three people they have any contact with. I try to interact with employees but not micromanage the utility. I don't mind sitting down and having a cup of coffee with a tree trimmer or an IT department. Before I came to the summer fly in, I sat down with our power supply manager who is directly involved with Bonneville Power Administration to ask about specific issues, so that I could have more intelligent questions for our representatives.

Are there any legislative or regulatory concerns that keep you up at night?

It is our job to defend the principle of what public power stands for. Our job is really to fend off all the attacks on public power — and we're getting attacked from many different sides.

Selling the power marketing agencies is a topic that won't go away. Every administration seems to think it is a big, juicy apple hanging low on the tree. But once you pick that apple, it is gone. It is a one-time shot to the treasury, and then you don't have that asset anymore.

The latest discussion around pole attachments is another attack on our philosophy. We own the poles, and we rent space on the pole at a rate based on our cost. Each utility is going to have a different cost. The effort to get the [Federal Communications Commission] to have a standard rate for every pole in the country takes away our local control and this cost-based approach.

How does your background as a CPA help when it comes to advocating for public power?

When I started coming [to Washington, D.C.] 11 years ago, being a CPA, I was asked to talk about the preservation of the tax-exempt status of municipal bonds. I can give examples of bond owners that aren't rich millionaires. After about seven years, I asked the executive director of our state association if I was being effective. And his response was, "They are still tax exempt, right?"

Having a utility board made up of people with varied backgrounds makes a more well-rounded board. If you had a three-member board and all three were CPAs, I think you'd be in trouble. You need people with different backgrounds to bring different perspectives to each issue.

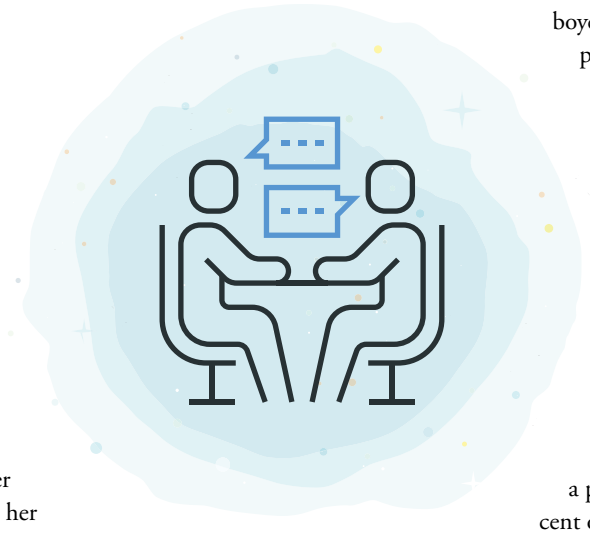
Our newest board member is the administrator of a nonprofit hospital. That's a great background for a commissioner because they have seen both sides of the boardroom table.

I truly believe in the philosophy of public power — it is a great cause and it's easy to advocate for.

GOING PUBLIC

Smart Is Talking Back

BY MEENA DAYAK, VICE PRESIDENT, INTEGRATED MEDIA AND COMMUNICATIONS, AMERICAN PUBLIC POWER ASSOCIATION



I still call the device I carry a "smartphone," but to my 16-year-old, it's just a phone. She knows no other kind. She rarely makes or gets calls, but she expects her phone to talk back to her, to give her (and her parents) usage data, and to tell her how to get somewhere or what social channels her friends are on.

Similarly, our current and future customers — the millennials and post-millennials who are entering the workforce and paying bills — expect communications from any device or organization they deal with to be smart. "Smart" is not the term they'd use, but **two-way communication** is a fundamental expectation. Generations Y, Z, and others that follow respond best to communications that give them options, allow them to interact, and are worthy of sharing with friends.

In this evolving "smart age," what new generations expect can shape public power communications in three critical ways.

1. Community

Generations Y and Z have a strong sense of community and like to feel connected to the products and services they buy. They like to buy local and will consider spending more at the store down the street than they might with a large, national corporation. Like the farm-to-table trend, knowing where products and services are coming from is important. Many in this group distrust large businesses and corporations. Small, community-based organizations are more likely to be seen as authentic.

Imagine the impact we can make if we remind them that their electric utility is community-owned and that they have a stake. That's why the national public power awareness campaign rolled out in October 2018 is based on the theme Community Powered. **Learn more and join the campaign at www.WeAreCommunityPowered.com.**

2.Value alignment

A recent study by the public relations firm Edelman showed that today's consumers favor brands that stand for something. They weigh a brand's principles before buying its products. Nearly 64 percent of consumers around the world will choose, switch to, avoid, or boycott a brand based on where it stands on the political or social issues they care about.

Nike's new commercial featuring Colin Kaepernick, as controversial as it is, drew a loyal following and boosted sales because the company took a stand. National Public Radio offered stainless steel straws for donors during its fall membership drive, knowing that its listeners are likely to care about saving the turtles by eliminating plastic straws.

New generations are more likely to buy something after viewing a message focused on a brand's stand than they are after viewing a product-focused communication. And 60 percent of consumers say brands should make it easier to see their values and positions on important issues at the point of sale.

This is good news for public power. Our values are simple and reflect those of the communities we serve, of our friends and neighbors. So, let's make that clear in all our communications — from bill stuffers to websites.

3. Co-creation

Younger generations are not content to passively observe and absorb. They engage best with something they are involved in creating.

Behavioral economist Dan Ariely talks about the "Ikea effect," the joy and engagement that people feel when they assemble their furniture after a struggle with instruction manuals that seem to be written in code.

Social media has fostered this culture of co-creation and involvement in powerful new ways. Platforms that cater to the collaborative urge include Kickstarter, the crowdfunding platform that involves people in the creation of something from the get-go, and Wikipedia, the "encyclopedia written by the people who use it."

Public power has an advantage here too. Remind customer-owners that they have a voice in making decisions about their community-owned utility's future. Instead of you, the utility, saying how awesome you are, motivate customers to claim pride of ownership and brag about living in a public power community. If they are involved, they will share with their friends and neighbors. They will be public power's best ambassadors.

Again, our #CommunityPowered awareness campaign has many opportunities for customers to engage and share. To learn how you can get involved, email us at Communications@PublicPower.org.

MARKETS

Demand Response in Wholesale Electricity Markets Helps Public Power Save

BY ELISE CAPLAN, DIRECTOR, ELECTRIC MARKET ANALYSIS, AMERICAN PUBLIC POWER ASSOCIATION

Demand response plays an important role as an energy resource for both local utilities and regional grid operators. It is a unique resource, as it is created not by construction of a power plant, but instead by a customer agreeing to reduce their use of electricity.

A central advantage of demand response is that it can reduce electricity costs by obviating the need to turn on more expensive sources of generation during peak demand or even avoid the construction of additional power plants over the long run. It is also an important asset for electricity markets, as it can mitigate electricity price spikes and reduce price volatility.

For public power utilities participating in regional transmission organization-operated markets, demand response is an important means to manage costs. RTO market rules and incentives should be designed to allow for and encourage the participation of this important resource.

According to the Federal Energy Regulatory Commission, about half of the demand response in the U.S. is provided through the wholesale markets operated by RTOs, and half comes through utility-operated retail programs. Public power can also offer demand response into the wholesale markets to mitigate the costs and volatility of the wholesale energy and capacity prices.

A key to demand response participation is accurate measurement and verification of when load reductions can be attributed to it. An important component of such measurement is obtaining an accurate determination of a baseline of energy use for a similar time and day.

In the wholesale markets, curtailment service providers, CSPs, or load-serving entities, such as public power utilities, can aggregate the demand response of factories, businesses, and homeowners and can sell that aggregated resource into the RTO markets. Homeowners may participate by allowing the CSP direct load control, such as making small adjustments in air conditioning use. Factories may participate by shifting production to a different time or by turning on behind-the-meter generation to replace the electricity no longer being purchased from the wholesale market. Public power-owned generation can also provide demand response.

Different markets, different incentives

All RTOs allow demand response to participate in the energy and ancillary services markets and in the capacity markets for the four RTOs that operate such constructs (PJM Interconnection, ISO-New England, New York ISO, and Midcontinent ISO). In those RTOs, almost all demand response is sold through the capacity market.

Demand response participation in the energy and ancillary services markets can be on an economic or emergency basis. Economic demand response involves the submission of an offer to reduce consumption when the locational marginal price rises above a selected threshold. Emergency demand response is only called upon during times of system stress, such as extreme weather events or transmission outages. In these markets, payment for demand response only happens if it is called upon and reduces load — and there is no penalty if it does not.

In the capacity market, demand response resources can offer an amount of load reduction for sale as capacity, as do physical supply resources. If the offer clears the auction, then the resource is obligated to curtail if called upon during a given time frame. In exchange, the resource receives a capacity payment regardless of whether it is called upon.

Demand response participation varies by RTO

The table below shows the amount of demand resources available in 2017 in each RTO and as a percentage of peak demand. The amounts are the availability of demand response, not the actual amount curtailed.

As shown, there is significant fluctuation in the availability of demand response, and the percentages are higher in the capacity markets. This is logical, as these markets provide payments for availability, not only when load is curtailed.

Other factors that might influence the amount of demand response in the wholesale markets may be the types of end users in the region, the activity of CSPs, energy and capacity prices, and the availability and attractiveness of utility programs.

RTO/ISO	Demand Resources (MW)	Percent of Peak Demand
CAISO	1,293	2.6%
ERCOT	2,258	3.2%
ISO-NE	2,657	11.1%
MISO	11,682	9.7%
NYISO	1,219	4.1%
PJM	9,520	6.6%
SPP	0	N/A
Total ISO/RTO	**28,629**	**6.5%**

The difference a **bulb** makes

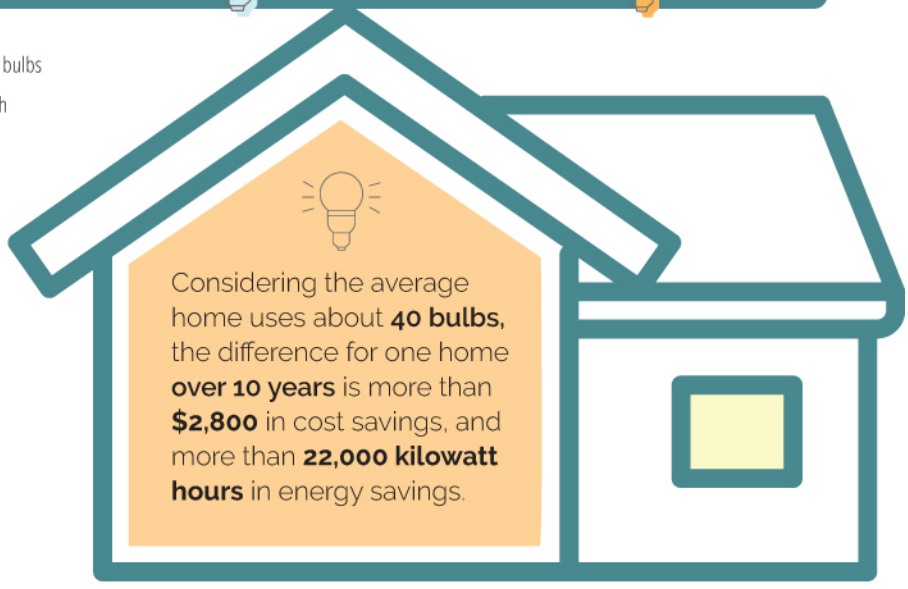
Just how much difference does choosing a different kind of light bulb make on how much you spend on energy? Here's a quick comparison of key stats about incandescent, compact fluorescent (CFL), and light-emitting diode (LED) bulbs.

	INCANDESCENT	CFL	LED
Brightness	800 lumens	840 lumens	840 lumens
Energy used	60 watts	13 watts	9 watts
Cost per bulb*	$1.49	$2.49	$1.37
Yearly energy cost**	$7.55	$1.64	$1.13
Estimated lifespan	1.8 years (2,000 hours)	11 years (12,000 hours)	13 years (15,000 hours)
Total cost over 10 years	$83.78	$18.89	$12.67

*Prices quoted all come from the same large retailer for comparably sized and style bulbs

**Assumes use of 3 hrs/day at average public power bundled rate of 11.5 cents/kwh

Want to customize and share this graphic with your customers? Download it at www.PublicPower.org/Communication-Templates



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