The Edison Foundation
INSTITUTE for ELECTRIC INNOVATION

INNOVATIONS ACROSS THE GRID

Partnerships Transforming The Power Sector

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DECEMBER 2013

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Published by:
The Edison Foundation
701 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2696
Phone: 202.508.5440
Web site: www.edisonfoundation.net/iei

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INSTITUTE FOR ELECTRIC INNOVATION PARTNER ROUNDTABLE

The Partner Roundtable is a select group of innovative technology companies dedicated to advancing smart technologies with electric utilities. The roundtable is a platform to share information, ideas, innovations, and results as utilities and technology companies work together.

- **ABB**
- **Accenture**
- **Aclara**
- **Alstom**
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- **Broadscale Group**
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Introduction

by Lisa Wood

Electric utilities and technology companies are joining together to position the electric power grid for the 21st Century and beyond. Power companies and their technology partners are deploying digital communications, sensors, control systems, and millions of digital "smart" meters. In doing so, they are merging previously separate power, information, and telecommunications systems into an intelligent, resilient, modern, and digital grid. The result: a two-way power and information highway.

Innovations Across the Grid gives you an inside look at more than 70 utility-technology company partnerships now underway across the country. The partnerships and collaborations described in *Innovations Across the Grid* will play a key role in meeting the challenges and capturing the opportunities ahead – greater customer engagement, more distributed energy resources, and the need for increasingly clean power sources.

In fact, these partnerships already have begun to fundamentally change how we deliver, manage, and even use electricity. Through an inside look at seven key areas of grid development, *Innovations Across the Grid* shows you how putting entrepreneurial thinking, new technology, and engineering know-how to work are optimizing grid resources on both the supply- and the demand-side of the electric meter:

- Grid Edge Optimization – Increasing visibility at the edges of the traditional electricity distribution network to improve service reliability and increase grid efficiency.
- Grid Resiliency, Reliability, and Restoration – Making the grid less vulnerable to weather-related outages and reducing the time it takes to restore power after an outage does occur.
- Grid Visibility and Asset Management – Deploying distribution automation and advanced metering infrastructure, and linking systems to improve asset management and the operational efficiency of electric distribution systems.
- Grid Analytics – Using information from smart meters, grid sensing devices, and asset monitoring for end-to-end data analytics to optimize the transmission and distribution systems and improve grid performance.
- Renewable Energy, Distributed Generation, and Storage Integration – Integrating distributed generation resources into the power grid, deploying micro-grids, and utilizing electrical energy storage devices effectively in a robust, flexible, and reliable grid.

- Customer Engagement – Educating and empowering electric utility customers to manage their energy use more strategically and efficiently.
- Demand Response and Energy Management – Using technology to simplify and automate customer involvement in peak demand response events, and using demand response to manage renewable energy integration.

Understanding how the grid is changing and recognizing the critical importance of what we do are the driving forces behind the partnerships and projects demonstrated in *Innovations Across the Grid*. Every day, electric utilities supply the power for our economy and our way of life. And as the world is changing, we – and the almost 500,000 people in our workforce – are changing with it, reinventing ourselves, our businesses, and the way we go about every aspect of our work.

Innovations Across the Grid shows that by working together, electric utilities and technology companies are increasing customer engagement, improving energy efficiency, integrating renewable and distributed resources, expanding opportunities for electric transportation, and building a more resilient, flexible, visible, and reliable 21st Century power grid. In doing so, we are enabling electricity to deliver even more value – to grow the economy, protect the environment, and provide a platform for the innovations of the future.

—Lisa Wood
Executive Director, Institute for Electric Innovation
Vice President, The Edison Foundation

About The Institute for Electric Innovation

The Edison Foundation Institute for Electric Innovation focuses on advancing the adoption and application of new technologies that will strengthen and transform the power grid. The Institute's members are the investor-owned electric utilities that represent about 70 percent of the U.S. electric power industry. The membership is committed to an affordable, reliable, secure, and clean energy future.

The Edison Foundation Institute for Electric Innovation promotes the sharing of information, ideas, and experiences among regulators, policymakers, technology companies, thought leaders, and the electric power industry. It also identifies policies that support the business case for the adoption of cost-effective technologies. Visit us at www.edisonfoundation.net/iei.

Foreword

by Peter Delaney

The growing reliance of our economy and our everyday lifestyles on electricity presents opportunities and challenges for our industry. Challenges are the flip side of opportunities, and what determines the difference is preparedness. In this case, our ability to innovate operationally, transform culturally, and reinvent our business model is creating these opportunities.

The one energy source dense and fast enough to answer our customers' needs for speed and density is electricity. Today, advances in technology that enable more and more power to be delivered through smaller and smaller devices are driving the demand for electricity. Our tagline at OGE Energy is: "Power at the speed of life." And the speed of life is certainly increasing.

It's no secret that consumers want more and more information, faster and faster, and with the ability to act on that information at their fingertips. *Innovations Across the Grid* showcases just some of the many examples of how utilities and their technology partners are responding to this need.

Our greater reliance on electricity reinforces, among other things, the importance of reliability, power quality, and affordability. The challenge is clear—to improve the level of service and product offerings, while also keeping cost increases to a minimum and enhancing the value of the distribution grid.

At OGE, our 800,000 customers are all now on the smart grid network with the ability to review their hourly energy usage and other analytics with only a 30-minute delay. Moreover, 80,000 of these customers are part of our Smart Hours Program that incorporates communicating thermostats programmed by the customer to respond to our price signals. Prices range from 9¢ to 46¢ per kilowatt-hour during the summer peak hours from 2:00 p.m. to 7:00 p.m. Our Smart Hours customers have reduced our peak load requirements by about 120 megawatts and have, at the same time, reduced their bills by 15 to 20 percent. Equally important is the resulting improvement in our customer satisfaction, which is now at an historic high. For the second year in a row, OGE was rated number one in residential customer satisfaction by J.D. Power among large utilities in the southern region.

At the onset, a principle objective of our smart grid development was to improve customer engagement through educating and partnering with our customers to achieve our demand response goals. Accordingly, only voluntary, customer-controlled demand response strategies, as opposed to utility-controlled programs, will engage customers. We are just in the initial stages of using the smart grid as a platform to offer customers better information and more options for

managing their energy usage in ways they are accustomed to in managing other parts of their lives.

Our deployment plans for 2014 provide for a mobile option to allow customers to receive energy usage information, as well as to control key energy usage devices in the home. While much innovation historically has been at the generation level and invisible to the customer, these innovations are taking place close to the customer. The smart grid is making a big improvement in the customer experience.

On the operational side, the industry's efforts to produce value from the additional information provided by the smart grid network are bearing fruit. Power restoration is one area where the ability to more quickly access storm damage has reduced outage times and improved the accuracy of estimated restoration times. At OGE, we are just beginning to leverage our smart technology investment and to transform the distribution grid from a one-directional energy delivery system to an information system that integrates and optimizes distributed and centralized energy supply devices.

Of course, innovation often requires investment, which, in turn, requires an appropriate risk-adjusted return opportunity. The three basic elements of the business model: the *customer* model – the products/services we sell and how they are delivered and priced; the *operating* model – the structure, processes and core competencies that produce our products and services; and the *regulatory* model – how we recover our investment; will need to change to provide for an appropriate risk-adjusted return. For example, integrating distributed supply resources will require utilities to unbundle and price products such as back-up service, storage, and other ancillary services in addition to offering new products in a timely manner to meet the rapidly evolving demands of customers. The current regulatory process does not align with the rate of innovation and product development demanded by today's market.

I am very excited about the smart grid investments now underway at OGE and around the country. They are creating momentum that is expected to grow at an increasing rate over the years to come. *Innovations Across the Grid* provides just a snapshot of some of the transformative work happening in the utility industry today. I hope that you will enjoy reading these stories, and I expect that you may even be surprised to learn how innovative our industry is right now. It's not a story that we often tout. We look forward to continuing to work closely with our technology partners to help us make today's vision of the power grid tomorrow's reality.

—Pete Delaney
Chairman, President, and CEO
OGE Energy Corp.

Co-Chair, Institute for Electric Innovation

About OGE Energy Corp.

OGE Energy is the parent company of Oklahoma Gas and Electric Company, a regulated electric utility serving more than 801,000 customers in Oklahoma and western Arkansas. In addition, OGE holds 50 percent of the general partner interest created by the merger of OGE's Enogex LLC midstream subsidiary and the pipeline and field services businesses of Houston-based CenterPoint Energy. www.oge.com.

Foreword

by Robert Rowe

You're going to like what you're about to read. *Innovations Across the Grid* succinctly tells the stories of utilities and their technology partners pursuing different paths, appropriate to their circumstances, to deploy technologies that increase reliability, resiliency, security, communications, and efficiency – all ultimately intended to enhance service to the customers we have the honor to serve.

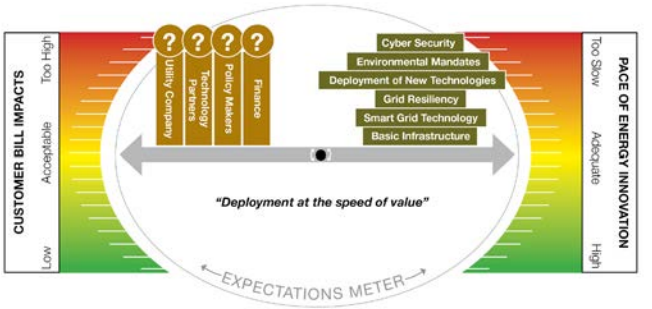
Innovations Across the Grid marks the continued evolution of an organization that began as the Institute for Electric Efficiency. We continue our commitment to cost-effective energy efficiency as a great resource for customers and our support for policies that enable its achievement. More recently, we've coupled this with an expanded focus on the myriad technologies through which utilities are achieving results, including those that are specifically related to efficiency. Now, more clearly identified as the Institute for Electric Innovation, we've developed a great process for utilities and their technology partners to communicate – and sometimes even celebrate – the great things they are getting done, producing real value for customers.

The electricity grid has always been an engineering marvel. Now, as energy technology meets information technology, the situation is getting even more interesting – and complex. Coupled with foundational infrastructure investment, new technologies are making the system more reliable, more efficient, and more productive. While much of the initial excitement among the public and policymakers was on the "customer side" of the meter, most of the clear early gains from investments in new technologies tend to be upstream, on the "utility side" of the meter.

There is broad support for transforming the nation's electricity transmission and distribution systems in order to maintain and enhance reliable and secure electricity infrastructure: infrastructure that can meet current and future demands (including capacity and ever-higher reliability) and that can also achieve the broader policy goals that together define a "modernized grid." Smart grid technology is opening the door to new energy management and delivery processes, more complex customer relations issues, significant infrastructure investment requirements, and regulatory questions that are best addressed in advance of major initiatives. The list of unintended consequences is significant. The need to coordinate initiatives is acute.

So-called "basic infrastructure" – poles, substations, transformers, underground and overhead cable – remains the essential foundation of grid innovation. Another essential component is a secure and flexible wide-area communications network. To maintain a reliable, resilient, and secure "21st Century grid" and to continue to enhance that grid, regulators and utilities need to focus on and balance two interlocked areas: basic infrastructure and grid modernization technology.

Any major capital or operational commitment is challenging. Experience suggests that this is especially true with technology initiatives. Ask anyone who has worked on a major IT project. For utilities, there is a basic question about balancing customer bill impacts over time with the pace of innovation. Technology investments are layered on, and related to, investments in basic infrastructure, "smart grid" projects, grid resiliency, environmental mandates, and cybersecurity, to name only a few. Because most utilities are investor-owned and under the jurisdiction of multiple regulators, our investments must make sense operationally to our boards, to our investors, to policymakers, and especially to our customers.



Each company makes decisions most appropriate for its circumstances, for its network, and ultimately for its customers. We all seek to "deploy at the speed of value," but our speeds will vary depending on the "driving conditions" in each of our territories. The great opportunity, which the Institute for Electric Innovation works to enhance and which *Innovations Across the Grid* represents, is to share our successes, our challenges, and our lessons learned.

It's important for utilities to clearly explain the benefits, the challenges, and realistic timelines for our initiatives to ensure all stakeholders are aware of the changes and understand – in their terms – the reasons for moving ahead in particular ways. Doing so, we can help realistically set the expectations meter so that we can make the right investments, at the right times, and in the right sequence to meet the reasonable expectations of all of our stakeholders – investors, employees, policymakers, and, especially and most important, the customers we have the privilege and responsibility to serve.

It's up to us in the utility industry, working with our technology partners, to design and build the innovations that will keep our nation and the world supplied with secure, reliable, affordable, and increasingly clean energy. Technologies and innovations yet to be introduced will transform our energy-using world in ways we cannot even imagine.

—Bob Rowe
President and CEO
NorthWestern Energy

Co-Chair, Institute for Electric Innovation

About NorthWestern Energy

NorthWestern Energy is both an electric and natural gas company, serving Montana, Nebraska (gas only), South Dakota and a spectacular corner of Wyoming. We serve both Yellowstone and Glacier national parks, the crown of the Continent, and the majestic Great Plains. Lewis and Clark traversed much of our service territory, and the Missouri River ties us together. www.northwesternenergy.com.

Grid Edge Optimization

Increasing visibility and control over voltage at the edges of the electricity distribution network improves service reliability and increases grid efficiency. Optimized voltage across a distribution feeder reduces the amount of energy required, thus reducing customer energy consumption while maintaining the same level of service. This chapter provides examples of how this technology, referred to as both Volt/VAR optimization and conservation voltage reduction (CVR), results in customer energy savings without direct customer involvement. In addition to the energy savings benefits, grid edge optimization supports a changing distribution system.

AEP OHIO

VOLT/VAR OPTIMIZATION

Technology Partner(s) - GE, Utilidata

Project Highlights

- Applied communications and technology to substation and line devices to control voltages to be more closely aligned to the design voltage of customers' electrical devices, which increases the efficiency of customers' electric usage.
- Established Volt/VAR Optimization on 17 circuits out of six substations.
- Produced a two to three percent energy reduction benefit for customers (across the 17 circuits) without behavioral changes.
- Helps AEP Ohio meet state energy efficiency targets.
- Favorable total resource costs compared to other energy efficiency programs.

Project Description

Through its Volt/VAR optimization (VVO) implementation during the gridSMART Demonstration Project, AEP Ohio's goal was to achieve energy efficiency by improved control and monitoring of the voltage level on 17 distribution circuits, ultimately reducing customer energy consumption. With VVO, customers experienced reduced energy consumption while maintaining the same level of comfort and service. Optimizing the voltage supplied reduced the amount of capacity and energy required on the AEP Ohio system, yielding an average energy reduction benefit of two to three percent across the 17 circuits.

Specifically, VVO is an electrical process that automatically controls voltage levels on distribution circuits to more closely match the design voltages of customers' equipment. Operating this equipment with voltages closer to the specified voltage achieves energy efficiency with no difference noted by customers.

VVO control systems receive near real-time information about voltage levels on the circuits and automatically operate voltage regulating devices to more tightly control voltage levels in the lower portion of the acceptable range, which ultimately reduces customers' energy consumption.

In addition to voltage level data, the distribution SCADA system also receives and displays load and operational data that provides dispatchers with visibility of the system conditions and the ability to remotely operate devices.

Project Contact

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Company Description

AEP Ohio provides electricity to nearly 1.5 million customers of major AEP subsidiaries Ohio Power Company in Ohio and Wheeling Power Company in the northern panhandle of West Virginia. AEP Ohio is based in Gahanna, Ohio, and is a unit of American Electric Power. American Electric Power is one of the largest electric utilities in the United States, delivering electricity to more than five million customers in 11 states. News and information about AEP Ohio can be found at AEPOhio.com.

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy under Award Number DE-OE0000193.

AVISTA

SMART DEVICES IMPROVE ENERGY EFFICIENCY AND RELIABILITY

Technology Partner(s) - Efacec Advanced Control Systems (ACS), Schweitzer Engineering Laboratories (SEL)

Project Highlights

- Installed smart switches, reclosers, breakers, regulators and switch capacitors on 72 of its 350 feeders
- Developed a secured communication network from the operational center to the customer meter
- Reduced outage restorations from hours to minutes
- Obtained conservation voltage reduction (CVR) of about two volts across 72 smart distribution feeders
- Anticipate CVR to reduce load by 1.86 percent across 72 feeders

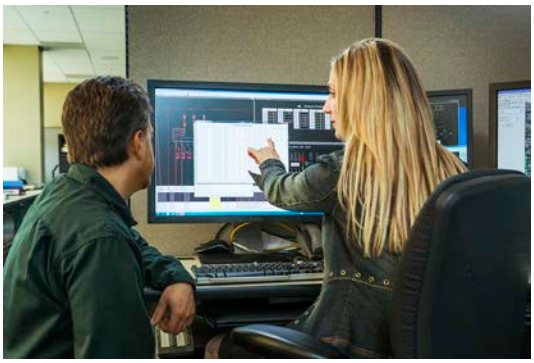
Project Description

Avista Utilities is modernizing the grid by building a solid infrastructure for the energy future to support what's being referred to as the 'grid edge.' Avista has upgraded and automated sections of its existing distribution system by installing smart devices on substations, circuits and meters to upgrade 72 of its 350 distribution feeders. This equipment automatically regulates power quality, allows for rapid response to grid disturbances, and improves reliability. Key benefits include fewer and shorter outages for customers and reduced energy losses on the distribution system.

Sensors along power lines now constantly send real-time information about voltage levels and the state of the distribution system to a central control center via a secure communication network. The data provides Avista with more detailed visibility into its distribution system.

A new platform allows Avista to manage and analyze all the data that's gathered by the smart devices. By using new software applications, Avista can now measure voltage levels, allowing it to regulate and fine-tune voltage profiles across the

entire system by using conservation voltage reduction (CVR). Avista is also pairing the application's functionality with the new smart devices on the circuits to identify and isolate outages in real-time. Outages that used to take hours to restore can now be done in minutes. The entire distribution system's performance is optimized.



The end result – lowering the voltage and reducing the load, along with isolating outages across multiple feeders on Avista's distribution system saves energy and improves reliability. To date, Avista is realizing an average reduction of approximately two volts across the 72 Smart Grid feeders. Avista anticipates that lowering the system voltage by two volts (on 72 feeders) would reduce load by approximately 1.86 percent.

Reducing the amount of load on the system helps Avista avoid the cost of building or acquiring new generation to meet the energy demands of its customers. At the same time, the utility can also support customer growth with the energy that's saved. Those are win-win-win outcomes from modernizing the grid.

Project Contact

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Company Description

Avista Utilities is involved in the production, transmission and distribution of energy. We provide energy services and electricity to 362,000 customers and natural gas to 323,000 customers in a service territory that covers 30,000 square miles in eastern Washington, northern Idaho and parts of southern and eastern Oregon, with a population of 1.5 million. Avista Utilities is an operating division of Avista Corp. (NYSE: AVA). For more information, please visit www.avistautilities.com.

DOMINION

DISTRIBUTION SMART GRID DEPLOYMENT

Technology Partner(s) - DVI, Elster, Landis+Gyr, Silver Spring Networks

Project Highlights

- Installed 160,000 Smart Meters
- Implemented conservation voltage reduction and improved delivery of energy by two to four percent
- Using remote meter turn-on and -off capabilities
- Providing energy information and smart pricing plans to customers
- Healthier environment

Project Description

In April 2007, the Virginia General Assembly enacted a statutory goal for Dominion Virginia Power of ten percent reduction in retail energy consumption over 2006 levels by 2022.[1] To help meet this goal, Dominion Virginia Power has developed a Distribution Smart Grid Deployment plan and upgraded portions of its distribution system through investments in advanced metering infrastructure (AMI) and conservation voltage reduction (CVR) technologies.

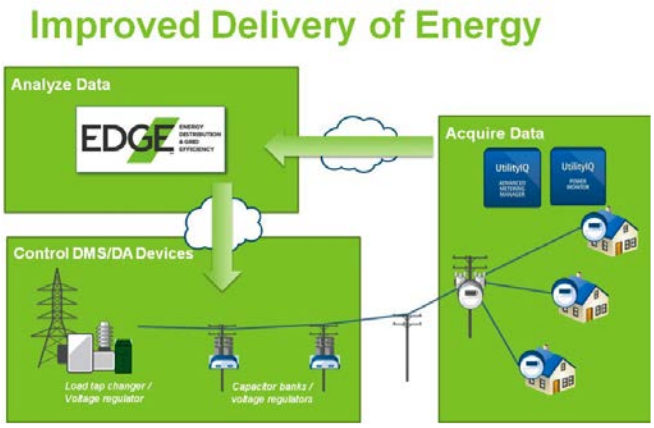
Since 2009, Dominion has installed more than 160,000 smart meters in demonstration areas of Midlothian, Charlottesville, Northern Virginia, downtown Richmond, Williamsburg and areas of Blue Ridge. In addition, approximately 200,000 customers living inside the Beltway of Northern Virginia, including localities of Falls Church, Arlington, Alexandria and Fairfax will receive an upgrade in metering technology in the next year.

Smart meters automate the collection of customer meter data and enable Dominion to detect unplanned outages, provide customers with energy usage information, and provide remote disconnection and reconnection of electric service at the time of the request at minimal cost. In high turnover areas such as college campuses this feature is a major improvement in service.

Dominion believes that one of the important parts of the distribution smart grid plan is enabling the customer to manage and control costs. To this end, Dominion provides customers with granular information on their energy usage and will begin offering smart pricing options. This is one of the key elements that will enable Dominion and its customers to attain the ten percent reduction in retail energy consumption.

Dominion's distribution smart grid effort is also tightly integrating the AMI technology into its automated distribution controls to enable a significant improvement in the delivery of

energy. Through delivery of more consistent voltage levels, Dominion will save on fuel at generating facilities and operating costs, the benefits of which will be passed onto the customer.



DVI was set up to work with other Dominion business units to develop sustainable alternative energy solutions. DVI evaluated a number of energy conservation programs and focused on implementation of a CVR program that leverages AMI to implement an adaptive voltage control using a practical statistical method to directly meter energy savings and provide circuit level performance verification.[2]

DVI's EDGE® efficiency program uses existing voltage regulation equipment with a more precise set point control that processes AMI data to improve accuracy and provide the adaptive capability.[2] The adaptive voltage control is implemented using AMI technology to collect the needed customer voltage readings, the EDGE® technology to control set point changes, and a Distribution Management System (DMS) or SCADA to control the local substation load tap changer (LTC) controller, circuit voltage regulator and/or capacitor.

Project Contact

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Company Description

Dominion is one of the nation's largest producers and transporters of energy, with a portfolio of approximately 23,500 megawatts of generation, 11,000 miles of natural gas transmission, gathering and storage pipeline and 6,400 miles of electric transmission lines.

Dominion operates one of the nation's largest natural gas storage systems with 947 billion cubic feet of storage capacity and serves retail energy customers in 15 states.

Dominion practices environmental stewardship and contributes more than $20 million annually to the environment, education, arts and culture, and health and human services. www.dom.com.

[1] http://www.scc.virginia.gov/newsrel/ves_launch_10.aspx

[2] Patent Application No. 13/567,473 Title of Invention: Voltage Conservation Using Advanced Metering Infrastructure and Substation Centralized Voltage Control. Date Approved 2/11/2013 United States Patent and Trademark Office.

OKLAHOMA GAS & ELECTRIC

INTEGRATED VOLT/VAR CONTROL PROJECT

Technology Partner(s) - Beckwith Electric Co., The Structure Group

Project Highlights

- Objective to reduce peak demand by 75 MW by 2017
- Install and optimize capacitor control equipment and retrofit load tap changer (LTC) controllers on 400 circuits
- Deploy neutral current alarm functionality on capacitor equipment
- Establish telecommunication network for monitoring and control of field devices
- Deploy DSCADA/DMS system to optimize/minimize losses, manage primary voltage and reduce demand
- Establish maintenance processes for capacitor equipment using neutral current alarm functionality to improve station health and line losses
- Testing has confirmed IVVC impacts, including loss minimization/improved power factor and reduced demand through improved voltage management

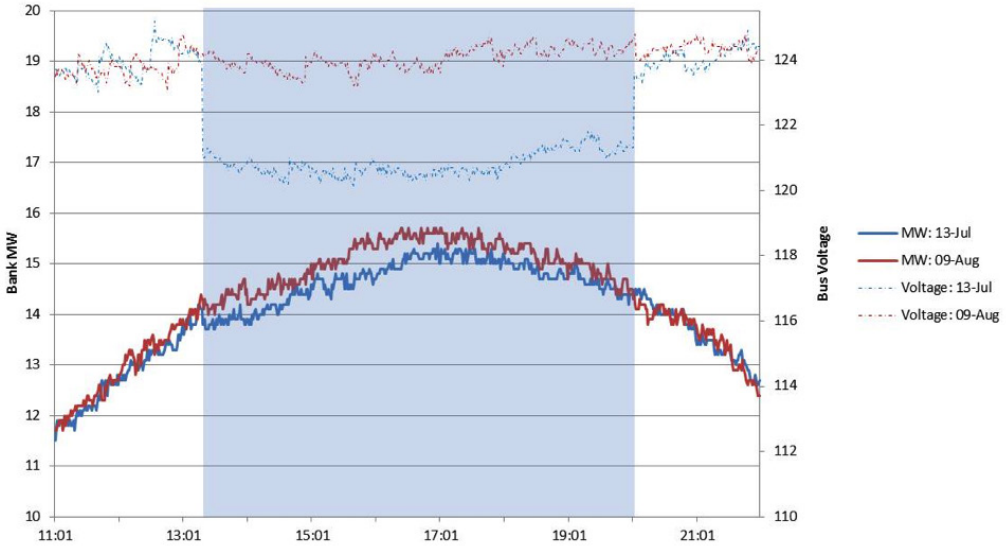
Project Description

Integrated Volt/VAR Control (IVVC) involves near real-time control of distribution circuit devices to minimize losses and manage voltage with greater precision than previously possible.

Demand is reduced by actively managing voltage in a lower, but still acceptable band. This finely controlled voltage management is only possible with modern communication and control systems. Monitoring functionality at each capacitor allows for improved compensation and demand reduction across OG&E's distribution circuits. The capacitor controllers are critical components of the IVVC testing. The controllers provide measurement of local circuit conditions (on one phase), as well as status indication for the capacitor banks, including switch position status and blown fuse indication.

The controllers are equipped with radio communication to provide status and measurement to the SCADA system and for remote control and monitoring of the capacitor banks in response to the Volt/VAR optimization (VVO) applications' output. The controllers also have functions that provide control based on local measurements such as phase voltage, line current, line VARs, temperature, or time of day. The capacitors are expected to operate based on their local control settings during non-test periods.

The voltage optimization portion of the test involved the reduction of the feeder voltage at the substation load tap changer, while maintaining voltage at the "last" customer on the feeder within acceptable range. Performance testing of the IVVC deployment through 2012 has shown a demand reduction of approximately two percent on average across tested substation transformer banks. The figure illustrates IVVC impact showing voltage (dashed lines) and MW (solid lines) differences between an IVVC test day (blue) and a control-day (red). This voltage reduction from IVVC contributes to the overall demand reduction of OG&E's smart grid efforts that provide the opportunity to delay construction of new fossil-fuel power plants until at least 2020.



Sample 2012 Results: an IVVC test day (blue) and control-day (red)

Project Contact

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Company Description

OG&E is a subsidiary of OGE Energy Corp. (NYSE: OGE), and serves more than 800,000 customers in a service territory spanning 30,000 square miles in Oklahoma and western Arkansas. www.oge.com.

SOUTHERN CALIFORNIA EDISON

IRVINE SMART GRID DEMONSTRATION

Technology Partner(s) - Electric Power Research Institute (EPRI), GE, Space-Time Insight, SunPower Corporation, University of California at Irvine, University of Southern California,

Project Highlights

- Completed engineering design and specifications December 2012
- Field deployment and installation complete by December 2013
- Scheduled completion of systems operations, measurement and verification by June 2015

Project Description

Southern California Edison (SCE) is receiving up to $39.6 million in matching funds from the U.S. Department of Energy (DOE), as part of the American Recovery and Reinvestment Act of 2009, to conduct an end-to-end demonstration of numerous Smart Grid technologies which it believes are necessary to meet state and federal policy goals for the year 2020. The Irvine Smart Grid Demonstration (ISGD) project will test the interoperability and efficacy of key elements of the grid, spanning the electricity delivery system and extending into the customer premises. ISGD will verify and evaluate the ability of Smart Grid technologies to operate effectively securely when deployed in an integrated framework. The project provides a means to quantify the costs and benefits of these technologies in terms of overall energy consumption, operational efficiencies, system reliability, and societal and environmental benefits.

The project will demonstrate a number of advanced substation automation and distribution automation capabilities. ISGD will pilot SCE's next generation of Substation Automation (SA-3), an automation and control design based on the open standard IEC-61850, and it will investigate the use of phasor measurement technology to enable deep, substation-level situational awareness. The project will also demonstrate the latest generation of distribution automation technologies, including a looped 12 kV distribution circuit topology utilizing universal remote circuit interrupters, and Distribution Volt/VAR Control (DVVC), which is designed to provide customer energy consumption savings through conservation voltage reduction (CVR).

The project will demonstrate smart grid technologies at the customer premises, including energy management systems, smart appliances, energy storage, and solar photovoltaic systems. The team also plans to assess the impact of device-specific demand response (DR), as well as load management capabilities involving energy storage devices and plug-in electric vehicle charging equipment.

Distribution Volt/VAR Control

In 1992, SCE implemented a capacitor control algorithm for its Distribution Capacitor Automation Project (D-CAP) to optimize regulation of customer service voltage. This capacitor switching algorithm used customer service voltage control points, obtained from Metricom meters installed at selected customers on each circuit, to remotely control switched capacitors through the Metricom packet radio communication system. This was a closed-loop control algorithm that required no operator intervention, except for maintaining Volt/VAR during emergency conditions and during other abnormal system conditions. Two-way communication allowed the control of each capacitor bank, and simultaneous monitoring of customer service voltage. This project proved that SCE could achieve at least two percent voltage reductions, resulting in energy savings of approximately two percent.

The ISGD project will demonstrate the DVVC capability of SCE's new distribution management system (DMS) by leveraging lessons learned from the D-CAP project, leading edge substation automation systems, and an advanced communication network infrastructure. A total of 15 distribution field capacitors on seven distribution circuits and one substation capacitor connected to the same bus at the MacArthur substation will be centrally controlled by the DVVC application.

The primary objective of this application is to optimize overall customer voltage and associated energy use. DVVC is expected to reduce customer energy consumption by between one and three percent, while requiring no change in customer behavior. A secondary objective is to improve operational efficiency by optimizing VAR flow on the substation transformer banks to reduce energy losses, and by providing VAR support to the transmission system.

SCE intends to implement the DVVC capability on a system-wide basis after demonstrating it within ISGD. This implementation will leverage SCE's existing Distribution Automation field equipment including the Netcomm wireless network (approximately 50,000 radios) and existing automated capacitor banks (approximately 10,000).

Project Contact

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Company Description

Southern California Edison (SCE), an Edison International company, is one of the nation's largest investor-owned utilities, serving nearly 14 million people in a 50,000-square-mile service area within Central, Coastal and Southern California. One of the nation's leading purchasers of renewable energy, SCE delivered nearly 15 billion kilowatt-hours of renewable energy to its customers in 2012, enough to power 2.3 million homes. www.sce.com.

SOUTHERN COMPANY

EDGE OF NETWORK GRID OPTIMIZATION

Technology Partner(s) - Varentec

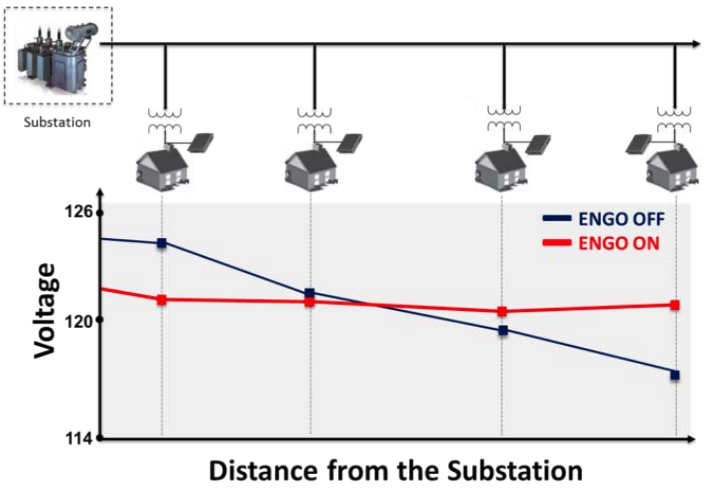
Project Highlights

- Testing a new alternative approach for reactive support on a circuit.
- A single ENGO unit is a voltage controlled, fast-switched capacitive device that can be switched in one kVAR increments from zero to ten kVAR.
- In October 2012, Southern Company became the first utility to install and operate an ENGO unit.
- Installed over 70 of 90 total ENGO units for field demonstration and evaluation.

Project Description

Proper Volt/VAR management is required to operate an efficient and compliant distribution system. At times, maintaining this proper management can be a challenge due to changing load types, distributed generation integration, and dynamic circuit configuration. Southern Company Services Research & Technology Management is investigating the performance and value of an alternative approach of Volt/VAR management by using Varantec's ENGO-V10 in a Day On/Day Off operating scheme.

The ENGO-V10 is a voltage controlled, fast-switched, capacitive device that can be switched in one kVAR increments from zero to ten kVAR. Unlike traditional switched capacitor banks, this device is installed single-phase on the secondary side of a distribution transformer. This approach helps compensate for the varied per-unit voltage drop associated with the distribution transformer and more closely regulates the voltage supplied to the customer. With this smaller and faster operating approach to Volt/VAR control, Southern Company hopes to see efficiency benefits from flattening a circuit's voltage profile.



The image provides a representation of how a distribution circuit's voltage

profile declines as you move farther away from the substation. With the ENGO technology, the voltage is supported when the ENGOs are ON. This "flattening" of the voltage profile provides more control at the substation, as well as along the full length of the feeder.

Working with Georgia Power Distribution, a deployment of 90 of the ENGO devices is underway with 70 of 90 installed.

Southern Company will continue this demonstration for one year to allow for testing during the changing load profile of the seasons. Along with this demonstration, Southern Company is identifying other applications for this technology such as spot voltage support and power quality correction.

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Company Description

Southern Company is one of the largest energy providers in the United States. Based in Atlanta, Ga., Southern Company owns electric utilities in four states (Alabama Power, Georgia Power, Gulf Power and Mississippi Power) and a competitive generation company. Known for generating, transmitting, distributing electricity and providing excellent customer service to its 4.4 million customers, Southern Company is also leading the nation's nuclear renaissance through the construction of the first new nuclear units to be built in more than 30 years and the development of a state-of-the-art coal gasification plant. www.southernco.com.

Grid Resiliency, Reliability, and Restoration

Making the grid less vulnerable to weather-related outages and reducing the time it takes to restore power after an outage occurs provide real value to customers. At the core is the seamless integration and communication between sensors on hardware, diagnostic software, multiple data systems, and human capital deployed in the field. This chapter describes the key technology enablers of a more resilient and reliable grid, including distribution automation equipment (such as electronic reclosers, switches, and circuit breakers) that reroutes the flow of electricity, isolates an outage to the smallest line section, and minimizes the number of customers that experience a disruption. As a result, work crews can be deployed to key areas that need attention.

AEP OHIO

DISTRIBUTION AUTOMATION CIRCUIT RECONFIGURATION

Technology Partner(s) - Cooper Power Systems, G&W, GE, S&C Electric Company, Schweitzer Engineering Laboratories (SEL), Silver Spring Networks

Project Highlights

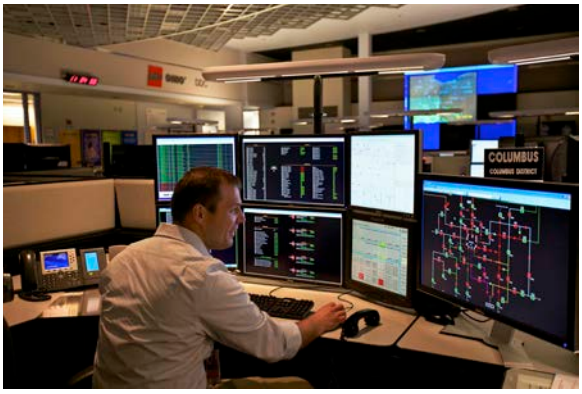
- Installed distribution automation circuit reconfiguration (DACR) on 70 circuits in NE Columbus, Ohio.
- Upgraded distribution management system (DMS) allows for proactive monitoring and control of the distribution line devices by distribution dispatch center operators.
- Integrating DACR and DMS with the outage management system facilitates storm restoration by increasing visibility through two way communications to line devices in the outage areas and more efficient dispatching of line personnel.
- Saved more than 4.6 million customer outage minutes by DACR while 55,400 customers avoided a sustained power outage.

Project Description

The goal of AEP Ohio's distribution automation circuit reconfiguration (DACR) implementation during the gridSMART Demonstration Project was to enhance the customer experience by reducing sustained outages. As part of the project, AEP Ohio installed a new distribution management system (DMS) to improve visibility of the distribution system allowing for monitoring, control and proactive actions by distribution dispatch center (DDC) personnel to optimize service to customer homes.

The DACR, works "behind the scenes" to keep the power on to as many customers as possible following outage conditions. Outages are typically caused by lightning, animal contact, trees falling through distribution lines, automobile/pole accidents, major storms, etc. The 70 circuit DACR system includes two-way communication and control between strategically placed reclosers, circuit breakers and the station based distribution automation controller's (DAC's). When an outage occurs on a distribution circuit the DAC automatically isolates the outage to the smallest line section in a very short time. For customers, this means fewer people experience sustained power outages simply by automatically rerouting the flow of electricity.

The DACR system is monitored by the DMS, or Distribution SCADA system, which provides alarms and visualization of the outage area to the DDC operators. The DMS system provides monitoring and control capability to: circuit breakers, reclosers, regulators, and capacitor banks. This allows visualization of the distribution system conditions at all times and allows for proactive correction activities through remote switching of devices or more efficient crew dispatch to the



outage location to make repairs. For the customers associated with the outage area this results in reduced outage time.

During storms it is necessary to locate multiple fault locations, make repairs, and switch customers back into service after repairs are made. The DACR combined with DMS and OMS enables the DDC operators to visually see where the outages are and how the DACR system has isolated the problem areas. This visualization allows the DDC operators to perform remote switching to restore service above and beyond what the DACR logic was able to accomplish automatically. The remote switching can be done without distribution line crews having to travel to the switch locations and expedites restoration of service to the customer.

The success of the DACR system in NE Columbus is highlighted by the fact that, to date, 55,400 customers have avoided an extended outage which equates to a reduction of more than 4.6 million customer outage minutes.

Project Contact

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Company Description

AEP Ohio provides electricity to nearly 1.5 million customers of major AEP subsidiaries Ohio Power Company in Ohio and Wheeling Power Company in the northern panhandle of West Virginia. AEP Ohio is based in Gahanna, Ohio, and is a unit of American Electric Power. American Electric Power is one of the largest electric utilities in the United States, delivering electricity to more than five million customers in 11 states. News and information about AEP Ohio can be found at AEPOhio.com.

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy under Award Number DE-OE0000193.

ARPA-E (SMART WIRE GRID)

IMPROVING TRANSMISSION SYSTEM POWER FLOW CONTROL

Utility Partner(s) - Southern Company, Tennessee Valley Authority (TVA)

Project Highlights

- Deployed Distributed Series Reactors (DSRs) to effectively control flow on TVA and Southern Company transmission systems. DSRs enabled between 2.5 and five percent change in impedance, ensuring that flows on the lines during normal operation and contingency conditions remain at or below allowable ratings.
- Installed 99 DSRs (TVA) and 36 DSRs (Southern Company) that provide reliability enhancements and congestion management by reporting current, conductor temperature, and other system parameters, enabling greater operational visibility of actual line conditions.
- Enables phase balancing for transposed lines.
- Requires no changes to protection schemes/protective devices.
- Faster and lower-cost solution than alternatives – four days for DSRs versus 90 days for re-conductoring, and eliminates the need for work in substations.
- Enables retirement of substation based flow control equipment, freeing space in the substation for other critical equipment.

Project Description

Transmission systems are being pushed closer to their stability and thermal limits to accommodate the shifting generation landscape. Globally, utilities are seeing a larger range of generation sources and, in many regions, there is a significant redeployment of generation fleets either planned or underway. The magnitude of the problem is significant and expected to grow over the next decade as the generation mix is fundamentally reformulated. Traditionally, utilities have been limited to expensive methods to address overloaded lines and system capacity constraints.

Through the Smart Wire Focus Initiative (SWFI), which is comprised of TVA, Southern Company, Baltimore Gas & Electric, and the NRECA, TVA partnered with Smart Wire Grid, Inc. (SWG) and the U.S. Department of Energy's Advanced Research Projects Agency – Energy (ARPA-e) to deploy a Smart Wire and Distributed Series Reactance (DSR) array testbed to prove that this new technology can address reliability issues in a cost-effective manner with minimal to no outage required. A demonstration of Smart Wire technology began in October 2012 on TVA's power transmission system. Installed on a 161-kilovolt transmission line near Knoxville, TN, the DSR

deployment was designed to improve reliability and provide congestion relief by redistributing power flow onto underused lines, thereby improving transmission system operations.

SWG's DSR technology exhibits several attributes critical to TVA. DSRs greatly reduce engineering time and costs. The ability to be installed or redeployed quickly provides flexibility to address shifting requirements. Because DSRs are installed on existing transmission lines, they have low site costs; fast installation, testing and commissioning; and require no additional space or engineering at substations. DSRs also have low equipment costs, low balance of plant costs, and low ongoing O&M costs. Training of installation crews is quick and can be done at the jobsite, making DSRs integrate readily with utility operations. DSRs can be studied, engineered, procured and deployed in a matter of weeks.

Each DSR, manufactured by SWG, consists of an array of distributed series reactance units that easily clamps onto a transmission conductor. TVA installed 99 DSR units (33 per phase), allowing the operators to manage the current flow on the line by injecting inductive reactance on command. The distributed nature of the DSRs allows the operators to vary the line impedance according to their needs. The DSRs can be programmed to operate autonomously or with full operator control, and provide distributed line sensing and monitoring.

The TVA installation was followed in March 2013 with the installation of 36 DSRs on two of Southern Company's 115 kV lines in Georgia. The goal of this installation was to enable the removal of air core reactors from one of the Southern Company substations, freeing space for new equipment while simultaneously providing greater flow control for the two circuits through the five and ten year planning horizons.

The TVA and Southern Company led projects were supported by funding from the National Electric Energy Testing, Research and Applications Center (NEETRAC) SWFI and ARPA-e.

Project Contact

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Company Description

Smart Wire Grid, Inc. is a mature, fast growing, well-funded start-up company located in the San Francisco Bay Area, producing innovative technology solutions for the transmission and distribution industry. Smart Wire Grid's technology converts the existing transmission system to a "Smart Asset" that can regulate power flow, shifting power from highly loaded segments to under-utilized portions of the system and bring extensive monitoring capability, enhancing system operations. Our dynamic team of scientists, engineers, project managers and professional staff collaborate with universities, utilities and manufactures to deliver ground breaking technology. www.smartwiregrid.com.

CONSOLIDATED EDISON COMPANY OF NEW YORK

NEW YORK CITY SMART GRID PROJECT

Technology Partner(s) - Cooper Power Systems, Elastimold, GE, Thomas & Betts

Project Highlights

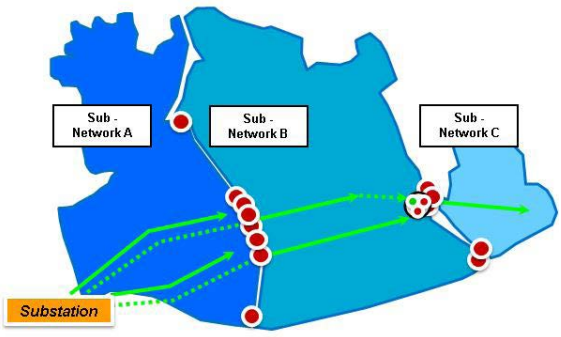
- Increases grid reliability and resiliency
- Nearly doubles the Flushing network reliability in Queens by dividing into three smaller sub-networks using smart switches
- Increases grid flexibility to accommodate customer sited resources
- Provides cyber security for the Smart Grid
- Delivers intelligent control capabilities for distribution operators
- Increases operational efficiency and asset utilization
- Reduces capex and opex
- In future smart grid deployment, micro networks in three lower Manhattan neighborhoods will mitigate the effect of flooding for 92 percent of 34,000 customers
- Micro networks paired with local generation create microgrids

Project Description

The Smart Grid Investment Grant Project provides benefits to customers by improving system reliability, reducing carbon emissions, and lowering costs by increasing system efficiency. Indirect benefits include positive economic impacts on the local economy. This $272 million project includes eleven sub projects that address three major initiatives: Distribution Automation, Dynamic Modeling and Simulation, and Energy Efficiency. The project also addresses Con Edison's ongoing challenges of maintaining service reliability and satisfying the increasing demand on resources.

The project advances new capabilities for Con Edison's electric system and its customers by using advanced system capabilities like rapid restoration and grid reconfiguration, achieving efficient delivery through system losses reduction, enhancing data visualization, and integrating smart grid technologies. The project is optimizing automated system sectionalizing and reclosing for reliability and resiliency, and simultaneously facilitating future micro-grids through creation of micro networks for areas where customers could safely provide their own energy during an outage.

One of the biggest distribution automation projects under the investment grant is to divide the Flushing network in Queens into three smaller sub-networks using smart switches to



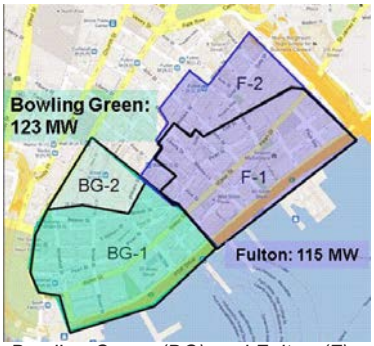
Flushing Network

create an intelligent auto-loop that can isolate outages and keep the rest of the network energized. The goals of this project are to reduce the risk of a large network outage, improve operational flexibility, and enhance reliability. The sectionalizing switches that form the backbone of the autoloop are equipped with supervisory control and data acquisition technology that can open and close them automatically.

Post Hurricane Sandy, smart grid technology is being expanded to increase system resiliency through creation of micro networks. Con Edison is planning an investment of $40 million to install smart switches in lower Manhattan in two networks that were preemptively shut down in the lead-up to Sandy.

The major benefit of this investment is to mitigate customer impact during major flooding. For instance, the new micro networks will insulate the customer impact of flooding, such that 92 percent of the 34,000 customers in Fulton, Bowling Green and Brighton Beach will not be impacted. For the impacted customers (~2,800 customers), the restoration effort will be faster. Upon the receding of the flood water, the networks will be energized within a day and many of the restoration moves will be automated via SCADA controls.

In addition, since all equipment will be submersible, there will be minimal damage to the equipment. This plan will also enable Con Edison to allow critical/essential facilities to remain energized, such as the financial center, specifically the NYSE, Downtown Beekman Hospital, and the Metropolitan Transit Authority (MTA).



Bowling Green (BG) and Fulton (F) Networks

Project Contact

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Company Description

Consolidated Edison, Inc. is one of the nation's largest investor-owned energy companies, with approximately $12 billion in annual revenues and $42 billion in assets. The company provides a wide range of energy-related products and services to its customers through its two regulated utility subsidiaries and its three competitive energy businesses. For additional financial, operations and customer service information, visit Consolidated Edison, Inc.'s website at www.conedison.com.

FLORIDA POWER & LIGHT COMPANY

REAPING THE BENEFITS OF THE SMART GRID

Technology Partner(s) - GE, Honeywell, Silver Spring Networks

Project Highlights

- Received $200 million grant from U.S. Department of Energy.
- Installed 4.5 million smart meters and more than 10,000 intelligent devices on the electric grid ahead of schedule.
- Achieved savings of $3.4 million in productivity and an average annual reduction of 4.3 million minutes of power interruptions.
- Proactively created nearly 20,000 outage tickets for transformers and lateral devices.

Project Description

In April 2009, Florida Power & Light Company (FPL) announced its Energy Smart Florida (ESF) program. Additionally, in November 2009, FPL was one of only six utilities nationwide to receive a $200 million grant from the U.S Department of Energy (DOE). In March 2013, FPL completed its $800 million program – one of the most ambitious smart grid projects in the country –nine months ahead of schedule. Today, these technology investments, which include 4.5 million installed smart meters, make it possible for FPL to give customers more control over their energy usage while providing more than 99.98 percent service reliability.

By year-end 2012, FPL had installed more than 10,000 intelligent devices on its electric grid and added enhanced digital technology to nearly 600 substations. Smart technology has enabled the company to better identify outages, help diagnose their cause and restore power more efficiently.

For example, when a customer reports an outage to FPL, the company confirms if the meter is receiving electricity. Smart meters help FPL better understand the customer's issue and resolve it faster and more efficiently. In 2012, this process improvement resulted in FPL saving $3.4 million in productivity and an average annual reduction of 4.3 million minutes of power interruptions.

FPL's extensive deployment of automated feeder switches has also proven to be a productive investment. Located throughout the electric grid, these switches identify faults, isolate them and, if necessary, automatically switch lines to reroute electricity around problem areas – similar to rerouting traffic around construction on a highway. This translates into fewer and shorter outages for customers.

FPL is putting the smart grid in the hands of field restoration crews by developing mobile applications like the Restoration Spatial View (RSV). This innovative tool, which was developed in-house, combines outage tickets, weather information, electrical network information, customer energy consumption and voltage, restoration crew location, meter status and more – all layered on a map view and available to view on an iPad. RSV makes it easier to diagnose problems accurately, and it provides the right resources to deliver best-in-class operational excellence.

RSV uses smart meter information and telemetry from the substation and distribution automation devices to provide a holistic view of the customer experience. It incorporates features like restoration confirmation, which allows restoration crews to confirm the power status of all smart meters affected by an outage before leaving the area. This has helped FPL identify embedded outages, resolve the problem on the first visit, reduce repeat calls from customers, avoid unnecessary truck rolls and improve customer satisfaction.

FPL has also developed new tools to automatically detect outages and begin restoring power before customers even call to report them. In the past, a customer would report an outage to FPL and a customer service representative would ask questions to identify the problem. Now, FPL's Event Processing Engine (EPE) uses the smart meter's power-on and -off messages to proactively generate outage tickets without customer input. Since the EPE deployment began in June 2013, the company has proactively created nearly 20,000 outage tickets for transformers and lateral devices.

Additionally, FPL is monitoring voltage and energy usage for all distribution transformers. Using smart meter data, FPL has proactively replaced more than 450 transformers over the past year. This preventive maintenance measure has improved overall reliability for customers while reducing restoration costs.

In summary, smart grid technology has helped to spur a new level of collaboration and innovation at FPL. By investing in advanced technologies that create a more reliable and efficient electric grid, FPL is improving its ability to prevent many power outages and, if they do occur, restore service more quickly.

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Company Description

Florida Power & Light Company is the largest rate-regulated electric utility in Florida and the third-largest the United States. FPL serves approximately 4.6 million accounts and employs approximately 10,000 employees. During the five-year period ended December 31, 2012, the company delivered the best service reliability among Florida investor-owned utilities. As of year-end 2012, its typical residential customer bills are the lowest in Florida, and as of July 2012, are about 26 percent below the national average. FPL is a subsidiary of Juno Beach, Fla.-based NextEra Energy, Inc. (NYSE: NEE; www.FPL.com).

GE DIGITAL ENERGY

ADVANCED DISTRIBUTION AUTOMATION SYSTEM

Utility Partner(s) - NSTAR

Project Highlights

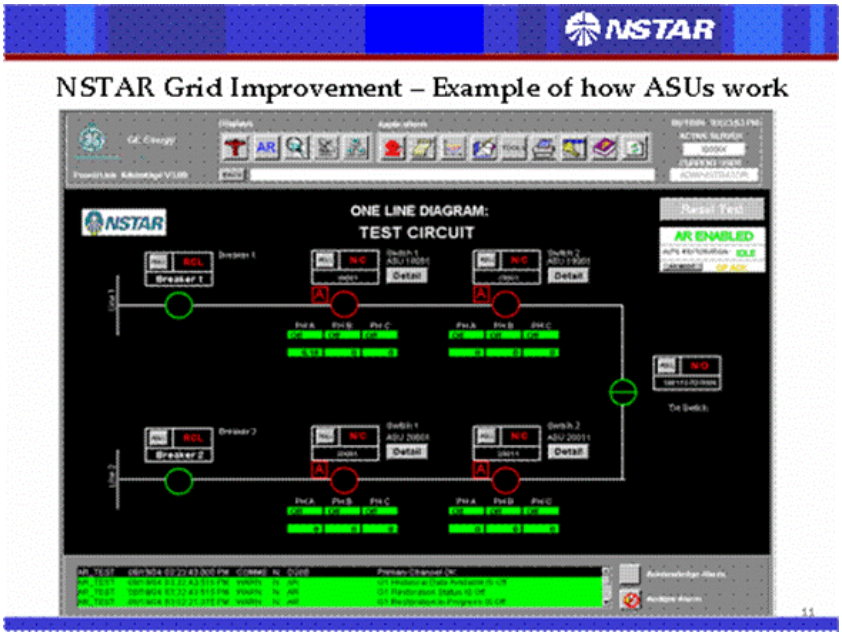
- Since 2004, more than 600,000 customer outages have been avoided due to automated grid sectionalizing.
- During the first nine months of 2012, 71,000 customers avoided a sustained outage and 163,000 customers were restored in five minutes or less.
- In 2012, Superstorm Sandy impacted 400,000 customers and 274,000 customers were restored in the first 24 hours.
- In 2011, Tropical Storm Irene impacted 506,000 customers and 232,000 customers were restored in less than an hour.

Project Description

NSTAR is an operating company of Northeast Utilities that delivers safe and reliable electricity to 1.1 million electric customers in 81 communities in eastern, central and southeastern Massachusetts. NSTAR's grid modernization investments focus on providing safer, more reliable, and cost effective service for customers.

Because of the vulnerability of overhead systems to severe weather, in 2004 NSTAR began deploying a distribution automation (DA) system using GE technology. DA systems can reduce outage times by automatically detecting a fault, isolating the faulted section from the grid and restoring service to unfaulted sections. The distribution operator then directs repair crews to repair the problem, restore the service and return the system to normal. This can reduce the time and frequency of outages and reduce the costs of locating the fault and manually operating switches. These systems can also improve safety for the public and utility worker since faults such as downed wires are cleared quickly and utility workers can efficiently manage their work since they can visualize and control much of the distribution grid.

A key piece of NSTAR's advanced DA system is the Auto-Restoration sub-system, which consists of remote supervisory control of over 2,000 overhead and underground switches. NSTAR's auto-restoration system has three operator modes including: supervisory mode, which leverages remote control of switches and utilizes operator controlled sequences; operator acknowledgement mode, which utilizes computer-simulated restoration sequences and operator validation prior to automated execution; and self-healing mode, which utilizes computer-determined and executed restoration sequences with little human intervention. Nearly 80 percent of NSTAR customers benefit from the DA system.



Project Contact

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Company Description

Digital Energy, a division of GE, is a major solutions provider and thought leader in the effort to modernize and optimize how we generate, move and consume energy. Our global team of more than 5,000 employees are inventing, improving and integrating communications, automation, and power delivery technologies to give the century-old electric infrastructure new capabilities, unheard of just a generation ago. www.gedigitalenergy.com.

NORTHWESTERN ENERGY

SMART GRID DEMONSTRATION PROJECT

Technology Partner(s) - Cooper Power Systems, Itron, Lockheed Martin, S&C Electric Company, Tendril

Project Highlights

- Allows NorthWestern Energy to install, test, demonstrate, inquire & evaluate smart grid technology at a pilot project level.
- Part of a larger, $178 million, ARRA-funded collaboration with Bonneville Power Administration, 11 utilities, two universities, and five vendors.
- Installation of all software and equipment for project is complete.
- Testing phase commenced in fall 2012 and will end in fall 2014.
- Distribution automation circuits allowed rapid restoration on two circuits that experienced outages in 2013 resulting in 41 and 51 second restoration times for large percentage of customers.
- Preliminary data from conservation voltage reduction (CVR) indicates over 19, 000 kWh saved during two test events.

Project Description

NorthWestern Energy (NWE) is participating in a five-year (2010-2014) Smart Grid Demonstration Project as part of a larger region-wide effort. The project is ARRA funded, led by Battelle in collaboration with the Bonneville Power Administration, 11 utilities, two universities, and five vendors. The overall project is a $178 million, five-year cost-shared demonstration. It encompasses 60,000 metered customers in five states.

NWE's project objectives are to deploy, test, and evaluate various equipment, systems and customer services associated with emerging Smart Grid technology. The scope of this effort includes smart grid technologies at the electric utility substation, distribution circuit and customer levels of two unique NorthWestern locations in Western Montana, including "urban" circuits in the center of the City of Helena and a "rural" circuit located in the Georgetown Lake area. The budget for the NWE portion of the overall projects is approximately $4.3 million (50 percent cost-shared with federal ARRA funds). The project concentrates on the various aspects of advanced Volt/VAR control, distribution automation, automated outage restoration, substation capacity, advanced metering infrastructure (AMI), and customer demand response (DR), control and energy management.

NWE's smart grid project will better inform future decision making on widespread smart grid implementation on both the utility and customer side of the meter. In the project area concerned with Distribution Automation, NWE is using S&C Electric's IntelliTeam Volt/VAR software for conservation voltage reduction (CVR) and Cooper Power Systems Yukon Feeder Automation for automated outage restoration on circuits in Helena and Philipsburg.

Distribution automation software and equipment upgrades resulted in rapid restoration on two circuits that experienced outages in 2013. Of the 1,506 customers without power during one outage, 1,250 customers were restored in 51 seconds and the remaining 256 were restored in 119 minutes after the tree was removed. On the second circuit, of the 1,499 customers without power due to an outage, 780 customers were restored in 41 seconds by automation and the remaining 715 were restored in 30 minutes after the squirrel was removed.

Preliminary data from CVR indicates over 19,000 kWh saved during two, week-long test events in July and August 2013.

NWE is using Lockheed Martin SEELoad software to send time of use pricing signals and demand response events to 200 volunteer residential customers and two State of Montana commercial buildings in Helena. The residential customers are using Tendril home management equipment and Itron AMI interval meters and collection units. Volunteers meeting operational requirements are testing in-home equipment that provides real-time consumption information and control aimed at driving behavior changes. These customers have saved over $8,000 on their electricity bills by shifting energy consumption to times when the energy price is low.

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Company Description

NorthWestern Energy provides electricity and natural gas in the Upper Midwest and Northwest, serving approximately 673,200 customers in Montana, South Dakota and Nebraska. More information on NorthWestern Energy is available on the company's website at www.northwesternenergy.com.

ORACLE UTILITIES

ORACLE

GRID EFFICIENCY THROUGH DISTRIBUTION NETWORK MANAGEMENT SYSTEMS

Utility Partner(s) - San Diego Gas & Electric, Southern Company

Project Highlights

- Near real time asset analytics to reduce outages
- Fault location and isolation
- Optimal switching to prevent overloading and outages

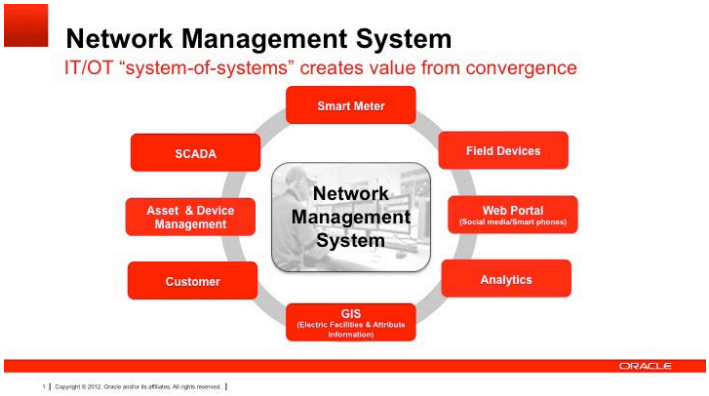
Project Description

Distribution grids need data and software systems to drive safe and reliable operations. A new generation of supervisory control and data acquisition (SCADA), distribution automation, and outage management systems is providing dramatic improvements in grid efficiency and reliability through increased real-time analytics driven by larger data volumes. Utility modernization and related Smart Grid projects increase the volume and variety of available grid management data by hundreds—potentially thousands—of orders of magnitude. Legacy applications for grid operations are generally not equipped to handle even the increase in data from today's smart meters and sensors, much less maximize data use for optimal grid performance.

Oracle Utilities' Network Management System (NMS) is a comprehensive advanced distribution management system, already in use at some of the largest utilities in North America. NMS can be thought of as a software "system-of-systems" that can intersect IT and OT to fill the demands for grid modernization. Utilities can fill the gap between current and emerging grid modernization needs to increase grid efficiency, reliability, and security; defer the need for new grid construction; and respond to new challenges like electric vehicle adoption and efficient use of distributed renewable generation—including operational and forecast modeling.

At Southern Company, near real-time asset analytics can be used with NMS to minimize outages. NMS can gather temperature, loading, and operational history at device locations; use a device's model to recalculate expected life in light of its operational history; and alter grid operations, such as dynamic ratings and load-transfers, in order to minimize negative consequences.

Utilities can automatically minimize the impact of outages using self-healing capabilities like Fault Location, Isolation, and Service Restoration (FLISR). First demonstrated with United Energy, Australia, FLISR reduces the number of customers affected by an outage by automatically sensing faults and circuit lockouts to identify and isolate the faulted circuit sections. It then restores power to all of the unfaulted circuit section's affected customers by automatically switching them to adjacent sections of the line.



San Diego Gas & Electric (SDG&E) is exploring ways for the NMS to integrate with AMI meter data to provide a load profile simulating the circuit's load characteristics during peak hours which can help predict probable overload on equipment or lines. An operator can then use features within NMS to generate an optimal switching plan to relieve the overload by modeling loads transferred to adjacent circuit sections with available capacity. Switching could be achieved through operator notification and with manual switching scheduled and dispatched; with the proper infrastructure, this process can foreseeably be automated.

SDG&E is also evaluating the requirements and benefits of developing Volt/VAR optimization (VVO) processes. Investments in SCADA connected capacitors and regulators would enable the NMS to calculate the amount of active and reactive power on a line, produce a switch plan to switch these capacitor banks "on/off" in locations close to the loads consuming the reactive power (e.g., electric motors, fluorescent lights), and execute the switch plan reducing the effect of the loss-producing reactive power.

Project Contact

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Company Description

With more than 380,000 customers—including 100 of the Fortune 100—and with deployments across a wide variety of industries in more than 145 countries around the globe, Oracle offers an optimized and fully integrated stack of business hardware and software systems. Oracle engineers hardware and software to work together in the cloud and in their customers' data centers—from servers and storage, to database and middleware, through applications.

Hardware and Software, Engineered to Work Together. It's How Oracle Simplifies IT and Powers Innovation. http://oracle.com/us/corporate.

PEPCO HOLDINGS, INC.

IMPROVED SYSTEM RESTORATION DURING MAJOR EVENTS

Technology Partner(s) - Oracle, Silver Spring Networks

Project Highlights

- Realized a reduction in the number of outage orders by 30 percent.
- The overall duration of outage restoration efforts were shorter.
- Restoration verification using advanced metering infrastructure technology reduced the number of outage events dispatched to crews by ten percent, resulting in fewer unnecessary truck rolls.
- Silent restoration verification using smart meters reduced the number of outbound customer calls and customer interruptions, resulting in improved customer satisfaction.
- Precise outage data produced by advanced meters, processed instantly through the outage management system, allowing for optimal allocation of crews during major events.

Project Description

During the restoration activities following a major event, roughly 70 percent of the outage orders consist of small outages affecting one or two customers. Often these smaller outages are actually nested parts of larger outages that have been restored. Previously, customers affected by these smaller outages were interrupted by utility phone calls or crews were dispatched to determine the status of their electric service.

With the deployment of smart meters, outage detection and restoration efficiency has improved. By utilizing the ping functionality of smart meters and integrating that data into an Oracle supported network management system (NMS) Pepco is now able to check whether a meter is energized without contacting the customer or sending a crew. By using AMI during outages, by integrating

meter notifications into our outage management system, PHI has seen significant improvements in the restoration process. This functionality has resulted in reducing the number of outage events dispatched to field restoration crews by ten percent. Overall, Pepco's improved outage management capability has resulted in a reduction in outage orders, faster outage restoration, and increased customer satisfaction.

During a recent storm in the summer of 2013, PHI was able to significantly reduce the number of events found restored when the crew arrived.

Project Contact

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Company Description

Pepco Holdings, Inc. is one of the largest energy delivery companies in the Mid-Atlantic region, serving about two million customers in Delaware, the District of Columbia, Maryland and New Jersey. PHI subsidiaries Pepco, Delmarva Power and Atlantic City Electric provide regulated electricity service; Delmarva Power also provides natural gas service. PHI also provides energy efficiency and renewable energy services through Pepco Energy Services. www.pepcoholdings.com.

PNM

IMPROVING RELIABILITY, PRESERVING A CITY'S HISTORY

Technology Partner(s) - Thomas & Betts

Project Highlights

- Invested $3.3 million over 2.5 years in historic Santa Fe Plaza
- Upgraded single circuit with protected loops for improved reliability
- Replaced 38 obsolete switchgears with 12 state-of-the-art switchgears for outage isolation
- Coordinated with archaeologists and Santa Fe Historic Preservation Division to protect sensitive archaeological sites

Project Description

The Santa Fe Plaza is arguably the epicenter of New Mexico's tourism, an industry that accounts for five percent of the state's gross domestic product and drives Santa Fe's $1 billion-a-year retail industry. Reliable power is an important component of this industry, yet the old PNM system put that reliability at risk. As a result, in 2011, PNM began the Downtown Cable Replacement project to modernize the downtown system.

Two and a half years and $3.3 million later, the underground distribution system serving downtown Santa Fe has changed dramatically. What was once a 35-year-old, single circuit on which outages could not be isolated is now well on its way to becoming a more reliable and workable design. The chief improvement made so far is the replacement of 38 obsolete switchgears with 12 new state-of-the-art switchgears to allow outage isolation by developing single-phase and three-phase protected loops. In general terms, PNM took a system that previously allowed any equipment failure to potentially affect the entire downtown system, and created a system in which equipment failure will only affect a small segment of that system.

The project team, also took pains to avoid unnecessary excavation, and with good reason. Santa Fe has been continuously inhabited for the last millennia, is the oldest European-founded capital in the United States and one of the most historically significant cities in the world.

The city sits atop numerous and expansive archeological sites. Breaking ground with a backhoe is not a step to be taken lightly. To help mitigate the risk of disturbing sensitive archeological sites, the team worked with Thomas and Betts to develop a customized solution that could fit inside the existing underground vaults. When new digging was required, it was done in close consultation between PNM staff archeologist and archeologists from the City of Santa Fe Historic Preservation Division and the State of New Mexico Historic Preservation Division. Archaeologists monitored all excavation to ensure any cultural remains that couldn't be avoided were documented. The Downtown Cable Replacement project is the largest single project undertaken within the Historic Downtown Santa Fe area and has provided a unique opportunity to gain a clearer understanding of the rich history of the area. To date, 17 archaeological sites have been encountered and documented, contributing information about human history spanning the Pueblo Period (A.D. 800), Spanish Colonial era, and through WWII.

The first phase of the project that encompasses the main plaza is scheduled for completion in December 2013. The second three-year phase begins in 2014 and will require an additional $2.2 million investment.

Project Contact

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Company Description

With headquarters in Albuquerque, PNM is the largest electricity provider in New Mexico, serving 500,000 customers in dozens of communities across the state. PNM is a subsidiary of PNM Resources, an energy holding company also headquartered in Albuquerque. For more information, visit PNM.com.

SIEMENS SIEMENS

EAST OAHU TRANSMISSION PROJECT: INTEGRATED AUTOMATION

Utility Partner(s) - Hawaiian Electric

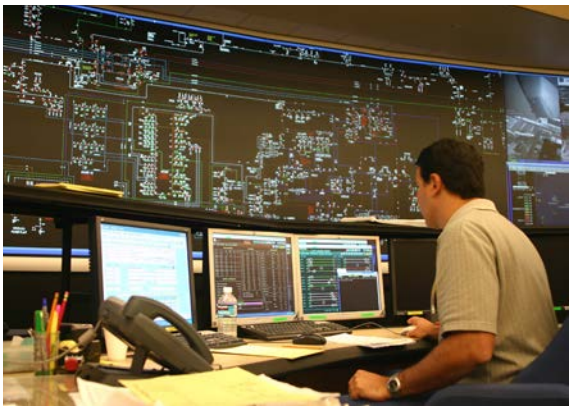
Project Highlights

- Project will cost significantly less than traditional design methods
- Will improve reliability of electric service for more than half of Hawaiian Electric's customers in Oahu
- Greatly reduces outage durations—in many cases from two to four hours down to a few minutes

Project Description

To address reliability concerns in East Oahu, Hawaiian Electric is working with Siemens to establish an intelligent 46 kV substation and sub-transmission infrastructure integrated with the existing control center system as a first step in creating a self-healing grid. The automation project serves as an alternative to construction of new infrastructure and supports environmental care and community values.

In West Oahu, the island's two main transmission corridors are linked by transmission lines between power plants and substations. However, no similar connection exists in East Oahu. Hawaiian Electric's two-phase East Oahu Transmission Project (EOTP) was undertaken to address overload and reliability concerns. The first completed phase included installation of new transformers to shift the load from the north to the south corridor. Initially, the second phase included a plan to install an additional transformer and new under-ground lines in heavily populated areas – an expensive and time-consuming prospect.



With guidance from Siemens and other partners, Hawaiian Electric opted instead to take a Smart Grid design approach and automate high-load distribution circuits to feed sections of East Oahu. The project integrates distribution automation applications and hardware into intelligent hierarchical control systems. Substations and automated devices become intelligent agents supervised by the control center providing robust contingency situations, maintenance switching, fault isolation and restoration.

Project Contact

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Company Description

The Siemens Smart Grid Division supplies products and solutions for intelligent and flexible electrical network infrastructures. To meet growing energy needs, the networks of today and tomorrow must integrate all forms of power generation and ensure bi-directional energy and communication flows. Intelligent networks help make it possible to generate and use power efficiently and on demand. They contribute to the electrification of railroads and also supply industrial enterprises, infrastructure elements and entire cities with electricity. For more information, visit www.usa.siemens.com/smartgrid.

SOUTHERN COMPANY

CENTRALIZED RESTORATION GATEWAY

Technology Partner(s) - Efacec Advanced Control Systems (ACS)

Project Highlights

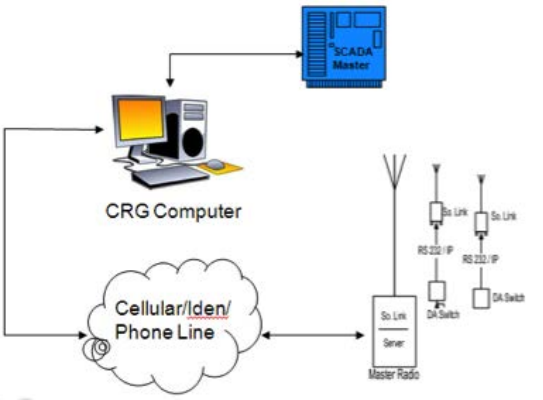
- Centralized restoration gateway (CRG) utilizes electronic reclosers, switches, and relays to rapidly isolate faults and restore service from an alternate source
- 175 feeders currently equipped with CRG (250,000 customers and 1,760 MW)
- 600,000 customer minutes avoided by CRG operations
- Plans to have 470 feeders equipped with CRG by the end of 2014 (800,000 customer and 4,500 MW). Waits on an operator to initiate following transmission events

Project Description

The centralized restoration gateway (CRG) is a smart grid technology that performs self-healing/ fault locating isolating restoration (FLISR) on the distribution system.

In 2011, Georgia Power conducted a pilot program with Efacec Advanced Control Systems (ACS) to implement the self-healing networks with 35 feeder breakers located across its service territory. Smart grid investment grant (SGIG) funds were used to purchase electronic reclosers, switches and other items to support the project. After a year of the pilot program, the project went into full deployment. With many successful isolation and restoration events, the project demonstrated value by improving reliability, minimizing outages, and improving customer satisfaction.

The CRG monitors the system's status by communicating with electronic controlled switches, reclosers, and distribution breakers and centralizing the data to one computer. If a fault occurs on the system, the CRG software determines where the fault is located, transmits commands to open devices to isolate the fault, and sends commands to close devices to pick up customers on un-faulted sections of line. This reduces the time needed to switch and restore the system.



Communication Flows

Currently, 175 feeders serving 250,000 customers (1,760 MW) are connected to the CRG, resulting in 600,000 customer

minutes avoided by CRG operations. The automation supported by the CRG helps distribution operators do their job more effectively following outage events. By the end of 2014, the CRG will monitor and analyze the status across 470 feeders, covering 800,000 customers (4,500 MW). Due to the expanded coverage and size of the load, modifications were made by ACS to wait on operator initiation for transmission events. This helps protect the system during under frequency events and any manual load shed events.

Additional benefits for Georgia Power have been the improvement in reliability tracking numbers SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index).

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Company Description

Southern Company is one of the largest energy providers in the United States. Based in Atlanta, Ga., Southern Company owns electric utilities in four states (Alabama Power, Georgia Power, Gulf Power, and Mississippi Power) and a competitive generation company.

Known for generating, transmitting, distributing electricity and providing excellent customer service to its 4.4 million customers, Southern Company is also leading the nation's nuclear renaissance through the construction of the first new nuclear units to be built in more than 30 years and the development of a state-of-the-art coal gasification plant. www.southernco.com.

UTILITY, INC.

HURRICANE SANDY OUTAGE MANAGEMENT AND STORM RESTORATION

Utility Partner(s) - Central Hudson Gas & Electric

Project Highlights

- Utility's Rocket vehicle router installed in 300 Central Hudson vehicles, improving vehicle cellular connectivity to 98.7 percent.
- Utility's AVaiL mapping software provides real-time tracking and history of assets in the field, improving situational awareness and response.
- Improved response time has increased on-time arrival rate of Central Hudson field crews to 99.7 percent.
- During Hurricane Sandy, with the help of Utility technologies, Central Hudson field crews restored service to 90 percent of 125,000 customers within five days.

Project Description

During Hurricane Sandy, Central Hudson Gas & Electric had 125,000 customers with loss of service. Within 5 days, Central Hudson had restored service to over 90 percent of customers who had an outage. The Rocket vehicle wireless router technology and AVaiL software from Utility, Inc. played a big part in these restoration efforts. By displaying field crews, work orders, and electric network assets on one consolidated, real-time map available to dispatchers in the central office, as well as on field crew laptops out in the field, Central Hudson was able to restore power to customers much faster. Central Hudson was also better able to keep customers informed about when their power would be restored.

Utility's Rocket Vehicle Router is installed in approximately 300 Central Hudson vehicles, providing secure Wi-Fi connectivity for Central Hudson field crews. The Rocket automatically switches between Wi-Fi, 3G, and 4G LTE cellular networks to always provide field crews with the highest-speed data connectivity possible and seamlessly interfaces with the latest generations of GPS and navigation mobile applications.

Central Hudson also integrated Utility's AVaiL secure mapping software with their legacy work management system. Work tickets and customer ESRI GIS data layers show up on the AVaiL map. Crews and dispatchers can see orders and assets on the AVaiL map.

The GPS tracking and history has proven itself quite useful. The ability to have the assets on the map and the location with turn-by-turn directions improves crew productivity in the field and response time to emergencies. Central Hudson now has a 99.7 percent on-time arrival rate on appointment orders and can respond more quickly in the event of an outage.

The Rocket, combined with an optional cellular booster, helps fill in cellular "dead spots" in the Catskill Mountains where Central Hudson never had reliable coverage before. Rockets and cell boosters increased coverage from 93 to 98.7 percent of the Central Hudson service territory.

Central Hudson has the ability to remotely manage their Rockets using Utility's Rocket Configuration Management (RCM) software, and can push updates and configuration changes "over the air" without ever having to go touch a vehicle.

With Rockets and AVaiL mapping, data communication to Central Hudson office systems provides field crews reliable information so they can focus on doing their work efficiently, effectively, and safely. And, they can get service restored to Central Hudson customers as fast as possible.

Project Contact

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Company Description

Utility, Inc. manufactures mobile resource management hardware and software as a service that allows utilities to effectively command, control, and support mobile field operations. Utility's solutions deliver real-time access to virtually any mobile asset, providing a unified operating picture for safely locating, tracking, and managing all aspects of mobile field operations. Utility brings it all together in one cost-effective, enterprise-level view, showing the location and status of all mobile assets to personnel. www.utility.com.

Grid Visibility and Asset Management

Enhanced network visibility improves the asset management and the operational efficiency of the electric distribution system. This chapter describes the benefits of investing in advanced distribution management systems that utilize electric system information captured by sensors and often communicated through advanced metering infrastructure (AMI) to provide grid operators with holistic, real-time, geospatially accurate system conditions.

ALSTOM

PG&E SYNCHROPHASOR PROJECT

Utility Partner(s) - Pacific Gas & Electric (PG&E)

Project Highlights

- Install or upgrade 160 Phasor Measurement Units at 27 key PG&E substations, including communications, and data management infrastructure to improve wide-area situational awareness.
- Integrate a production-grade system using IEEE 1588 microsecond resolution time protocol for clock synchronization.
- Implement IEC 61850-90-5 Publish-Subscribe profile across a wide-area
- Deploy next generation PMU-based operations, protection and engineering tools capable of addressing existing grid challenges such as dynamic instability, congestion management, and renewable integration.
- Comply with NERC CIP and other emerging security standards and guidelines.
- Assure continued compliance with NERC standards for disturbance monitoring.

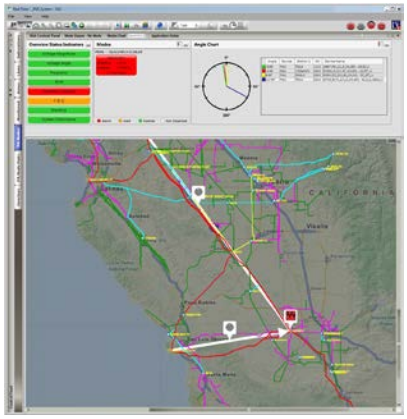
Project Description

Modern electric power grids are closely monitored and controlled for secure and economic operation. Alstom Grid has 30+ years history of providing state-of-the-art energy IT solutions to electric grids globally. Pacific Gas & Electric (PG&E) has been a valued customer and deployed the Alstom Energy Management System (EMS) more than 15 years ago. This EMS manages around 18,600 circuit miles of interconnected transmission lines that serve nearly 5.5 million electric customers.

PG&E's Synchrophasor Project is a gate-funded project under the PG&E and Federal Energy Regulatory Commission rate case approval. The project's overall approved budget is $58 million with $25 million awarded under the U.S. Department of Energy's (DOE) American Reinvestment and Recovery Act Smart Grid Investment Grant (SGIG) initiative. The project has made it possible to deploy a new class of GPS time-synchronized and high resolution grid monitoring devices known as Phasor Measurement Units or synchrophasors, which take grid measurements up to 120 times per second (as as opposed to the four to six second data rate of traditional supervisory control and data acquisition devices that have been in use for the past several decades). This provides unprecedented visibility into power system dynamics and wide-area grid stress indicators across PG&E's footprint. The solution is akin to using MRI technology in addition to traditional X-rays. The synchrophasor technology has allowed PG&E to identify and analyze system vulnerabilities in real time, as well as detect evolving disturbances. Such "early warning" tools enable timely actions to help arrest the system from widespread blackouts such as the 1996 blackout in the U.S. Western Interconnection.

PG&E's Synchrophasor project is about integrating new state-of-the-art synchrophasor applications (such as Oscillatory Stability Monitoring, Disturbance Detection, Islanding & Restoration, Linear State Estimator, Real Time Voltage Instability Indication) and Alstom's software platform that utilizes this new class of "measurement-based" diagnostics, in combination with "model-based" EMS analytics. This is the next generation of EMS for managing and optimizing power grid operations and for to quickly detecting stability problems in real time, assessing available transfer margins across transmission corridors, and more importantly providing corrective actions to prevent potential blackouts.

This approach makes it possible for utilities such as PG&E to tap into latent capacity on their transmission corridors thereby maximizing utilization of existing transmission assets without jeopardizing grid reliability. Alstom's advanced visualization software provides context to system operators and allows them to dive deep into details in order to take decisive action. This enables real "situational awareness" of PG&E's entire footprint.



This PG&E leading-edge project and its chief architect have been recognized by Intelligent Utility magazine for benchmark achievements and contributions in technology advancements in large investor-owned electric utilities. The project is the largest deployment of situational awareness and advance warning system projects co-funded by the 2009 DOE SGIG program and encompasses the largest diversity of innovative solutions in a single facility. For this reason the project has been singled out to be sustained for another three years after 'official' completion by 2013.

Project Contact

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Company Description

Alstom Grid, one of four Alstom sectors worldwide, has over 130 years of expertise in electrical grids. The company designs, manufactures, installs and services the power transmission and distribution solutions that empower the planet's low carbon economy. With an annual sales turnover of more than €4 billion, 19,000 employees and over 88 manufacturing and engineering sites worldwide, Alstom Grid is at the heart of the development of Smart Grid solutions. It is the recognized market leader in Energy Management and Energy Market Systems around the world. In North America, Alstom Grid is number one in these fields and is leading in Distribution Management System deliveries. www.alstom.com.

AMEREN ILLINOIS

ADVANCED DISTRIBUTION MANAGEMENT SYSTEM AND GRID MODERNIZATION

Technology Partner(s) - ABB Group, G&W, S&C Electric Company

Project Highlights

- Monitor, control and manage the distribution system in real time
- Improve safety, service reliability and system performance
- Integrate Adavanced Distribution Management System (ADMS) with intelligent devices, such as smart switches and reclosers
- Reduce outage duration from hours to minutes

Project Description

Ameren Illinois is investing approximately $6 million over the next ten years on software and technology enhancements to improve safety, service reliability and system performance. The integration of advanced meters, remote sensors, remote controlled switching and other advanced technologies across the grid will result in data that needs to be quickly organized, prioritized, and acted upon by the company's operations team.

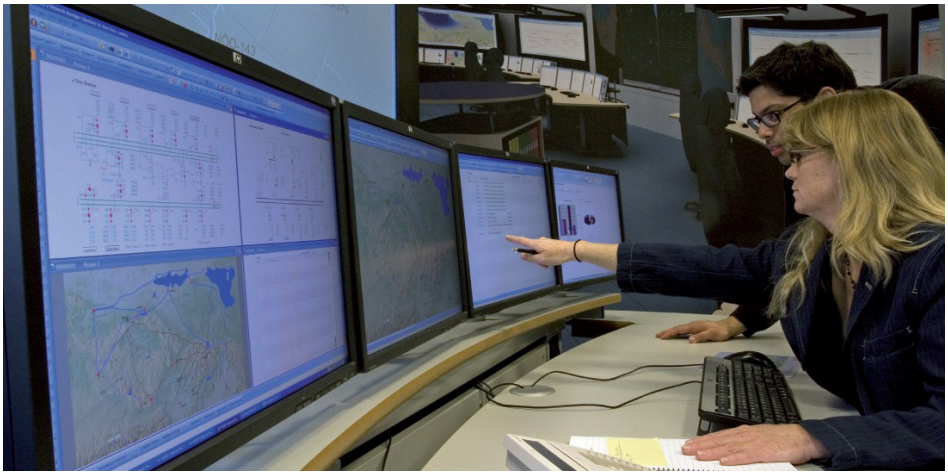
To meet this growing challenge, Ameren Illinois is upgrading and consolidating its various software and hardware platforms into a central system that can automate routine and repetitive tasks, evaluate grid performance, quickly interpret and organize large amounts of data, and then present meaningful information to operators. The Advanced Distribution Management System (AMDS) will be used for real time management of the distribution system.

Using modern digital display technology, Ameren Illinois' ADMS will provide a comprehensive visual display of the current state of the network based on SCADA telemetry and switching information, providing system operators with greater grid network awareness. The ADMS will also accurately model all elements of the grid network for better load forecasting, fault location prediction, energy loss reduction, and equipment failure prevention.

To further improve grid reliability, Ameren Illinois is also installing smart/intelligent devices, such as advanced "Intellirupter" switches (a product of S&C Electric), "Viper" reclosers (a product of G&W), and state-of-the-art microprocessor controls. With this new technology, the company is able to isolate problems more quickly and reroute and restore power to affected customers. These state of the art switches work together as a team, communicating with each other via radio, constantly evaluating the integrity of their supply and distribution lines. If there is a sudden loss of service, these new switches are equipped with diagnostic devices and logic that will send pulses down a line to probe and detect the health of each section.

Ameren Illinois is also implementing an advanced metering infrastructure (AMI) system for a majority of its customers, as part of its ten-year Modernization Action Plan.

Working together, these technologies will reduce the time needed to safely restore power to customers to mere minutes as opposed to the many hours it used to take to dispatch a crew, analyze the problem, and manually operate the switching needed to restore service.



Project Contact

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Company Description

Ameren Illinois delivers energy to 1.2 million electric and 806,000 natural gas customers in Illinois, and our mission is to meet their energy needs in a safe, reliable, efficient and environmentally responsible manner. Our service area covers more than 1,200 communities and 43,700 square miles. For more information, visit AmerenIllinois.com or find us on Twitter @AmerenIllinois.

CENTERPOINT ENERGY

TELECOMMUNICATIONS CONTROL CENTER

Technology Partner(s) - GE, IBM, Itron

Project Highlights

- End-to-end, real-time monitoring and remote control/trouble-shooting: cell relays, IGSD/ DACS, TOP/microwave/ voice radio sites, substation control buildings, service centers, corporate offices
- 65 percent remote resolution rate (2013) for network issues from the telecommunications control center.
- Geospatial and GIS based displays of network topology in near real time
- 63-monitor video wall and 18 console stations
- 25,500 monitored devices at 7,100 sites
- 300 miles of fiber

Project Description

CenterPoint Energy's (CNP) advanced metering system (AMS) of 2.2 million digital meters and growing intelligent grid (IG) system of distribution automation equipment rely on a robust, two-way communications network that empowers consumers while improving power reliability and restoration. CNP, with support from key vendors, designed and built a wireless communications network. Customers' electricity usage data collected by smart meters is transmitted wirelessly through 5,507 cell relays (meter data collectors configured with a primary WiMax connection and a secondary cellular module) mounted on power distribution poles, to 140 WiMax radio tower take out points (TOPs), and lastly over a microwave and fiber optic network to the company's data center, which processes 220 million meter readings per day. Current successful meter read rates of 99.9 percent on daily register reads and 99.7 percent on 15-minute interval reads testify to the reliability of the network.

CNP's telecom team has managed the company's SCADA, microwave, and fiber optic network for years, but with the advent of AMS and IG, and the associated premium on network reliability and resilience, it became imperative to develop the tools and facilities to closely monitor, control and troubleshoot the company's new smart grid network. Thus CNP built a telecom control center (TCC) consisting of 18 console stations and a 63-monitor video display wall to provide end-to-end network monitoring and management of the communication components of the AMS and IG.

As the network expands with the addition of cell relays and radio tower TOPs, the TCC follows a standard acceptance process for the new sites and equipment they will manage and maintain.

Field techs perform acceptance tests on radios, batteries, and all other network related equipment and as a final step to ensure visibility at the TCC, the equipment is configured in the monitoring/management/alert systems. These systems provide near-real-time performance characteristics of the equipment.

Based on the TCC's requirements, CNP's smart grid data analytics team developed Google Earth-based applications to graphically depict the near-real-time status of TOPs, cell relays and remote IG WiMax radios. These displays provide clear visibility into the network and significantly increase operational effectiveness through early alerts of potential communications issues. Large color-coded displays give a quick indication of whether the primary WiMAX and secondary (cellular) communication paths are up and the operational status of IGSDs and individual radios and routers. If TCC technicians see an issue or get an alert, they can drill down to the individual equipment level, diagnose and troubleshoot the issue remotely, or dispatch a field crew if necessary. In addition, the redundancy of the network allows the TCC team to prioritize work rather than react immediately to issues at single points of failure. The TCC's management tools provide the real-time reporting necessary for proactive network management. The TCC monitors 7,100 sites and the 25,500 components making up the sites. Network visibility can range from the broad network view down to individual components at cell relay sites, substation control houses, TOP site communication towers/buildings along with the LAN/WAN, SCADA and fiber environments. Monitors can even tell when an Ethernet cable is unplugged, the room temperature has increased, or a door or gate is open.

Technology and processes depend on people. The successful operation of CNP's TCC and the smart grid communications network has been built on personnel with initiative, dependability, a love of learning, and an eagerness to collaborate with vendors and each other in building and transferring knowledge of new technology and systems. Their work is transforming the industry and bringing electricity into the digital age.

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Company Description

CenterPoint Energy's electric transmission and distribution unit serves over 2.2 million consumers in a 5,000 square-mile area including Houston, the nation's fourth largest city and a consistently growing market. As a regulated "wires" utility, we neither generate power nor sell it to end-use consumers. We instead own, operate and maintain the poles, wires and substations that safely and reliably deliver electricity from power plants to consumers. With over 3,700 miles of transmission lines and 49,000 miles of distribution lines, we deliver electricity on behalf of 75 Retail Electric Providers. www.centerpointenergy.com.

CISCO

CONVERGED FIELD AREA NETWORKS

Utility Partner(s) - BC Hydro with technology partner Itron

Project Highlights

- Full standards based deployment at all layers of the IPV6 stack, allowing unprecedented interoperability
- Graphic, map based network management allows for visual outage indication, troubleshooting, and manageability, including alarm filtering, pinging directly to the meter or endpoint
- Addition of select transformer monitors to the AMI network allows for theft detection/ reduction
- Future-ready, modular network allows transition of communications technology (i.e., some carriers are talking about the end of 3G, what comes after 4G/LTE, etc), and addition of multiple IP endpoints without proprietary networks
- Lowers the hurdle rate for additional business cases

Project Description

In justifying the Cisco true multi-service network, BC Hydro is using a single network solution to not only read meters, but to reduce electricity theft and optimize voltage resulting in significant cost savings. Using transformer monitors riding on the Cisco network, for example, BC Hydro expects to reduce electricity theft by over $700 million.

Cisco Systems is working with BC Hydro and other utilities globally to converge traditionally separate networks with manageability and security top of mind. Cisco's unique approach to traffic segmentation and data prioritization allows utilities to manage the distribution network more efficiently. By managing data for different grid applications like distribution automation, digital meter reading, Volt/VAR control, and distributed generation all on the same network, Cisco is able to increase the value of BC Hydro's smart meter investments, lower the barrier to entry for additional use cases, and improve the business case for additional applications. One of these applications is voltage optimization, which BC Hydro expects to achieve savings of over $200 million.

With a complete Network Management System (NMS) and unique "zero touch deployment" of the network, Cisco has reduced the complexity of deploying and maintaining the communication link, allowing BC Hydro to roll out over two million meters on a very short timeline, with less network-specific staff needed. Updating firmware and software control security is key to the

deployment, and can all be accomplished via the secure Cisco network. Finally, data on the network can be identified and prioritized, so that AMI traffic, for example, never interferes with critical distribution automation messages. Even for applications like voltage optimization, these segmentation and Quality of Service (QoS) features can allow separation of customer data from voltage optimization readings to control who within BC Hydro has access to various pieces of data.

Cisco lends its unique architectural approach to designing an operational network to handle thousands if not millions of endpoints, including cyber and physical security requirements.

Project Contact

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Company Description

Cisco, the worldwide leader in networking, is helping the energy industry modernize the electrical grid from generation to distribution to consumption - with highly secure, reliable and scalable communications solutions. Cisco's Connected Grid portfolio includes:

- GridBlocks™ Architecture that provides a forward-looking view of integrating digital communications and the electrical grid.
- Transmission and Substation solutions that reduce service disruptions and lower operating expenses.
- Field Area Network solutions that lower total cost of ownership with a multiservice communications platform.
- Grid Security solutions that address physical and cyber security compliance needs for critical infrastructure.
- Data Center and Grid Operation solutions that enable scalable data collection and storage for analytics and management systems

www.cisco.com.

CLECO

DISTRIBUTION AUTOMATION

Technology Partner(s) - Landis+Gyr, S&C Electric Company, Schweitzer Engineering Laboratories (SEL)

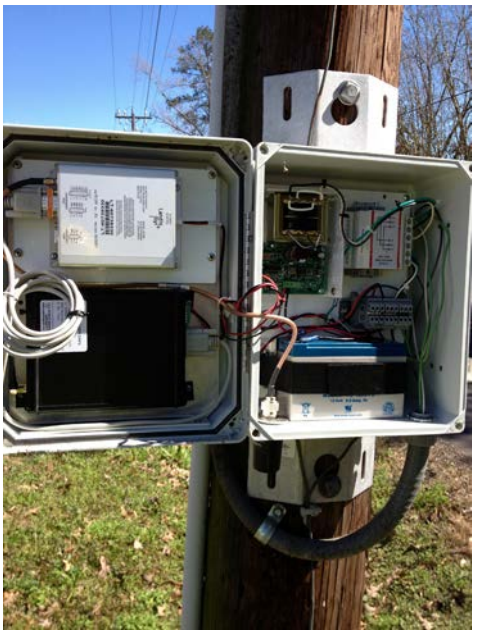
Project Highlights

- Implemented AMI, enabling remote reading of 99.7 percent of meters
- Avoided over 200,000 truck rolls annually
- Integrated OMS with AMI and GIS
- Using AMI network to support Distribution Automation and Distribution SCADA functionality

Project Description

Cleco began introducing automation in its electric distribution network in the late 80s, replacing recloser controls to address maintenance and operational issues, and adding radios in anticipation of future remote control. Now, nearly 20 years later, Cleco is seeing full distribution automation (DA) and distribution SCADA (DSCADA) reach maturity.

Cleco began implementation of a wireless automated metering infrastructure (AMI) in 2010, in an effort to reduce operating costs and improve efficiencies within the metering and billing processes. Field operations also improved through fewer truck rolls, made possible through remote connect and disconnect capabilities. Part of the project included the wireless AMI backhaul network, which not only provided the foundation for the meter data, but also had the capacity to support other field applications such as DA and DSCADA. About the same time, the AMI system was moving into production, Cleco started deploying DSCADA systems in distribution substations to provide remote monitoring and control of reclosers, breakers, and other substation equipment. These deployments continue today and are scheduled to continue in 2014.



With the foundation set, it was time to put the pieces together. The newly implemented AMI system is now integrated with the outage management system

(OMS), which utilizes a graphical information system (GIS), to provide dispatch personnel with more accurate and timely outage indication and the ability to dispatch personnel to the likely source of the outage. Cleco also is deploying radio transmitting faulted circuit indicators (FCIs) to guide dispatchers on fault locations to further improve restoration times.

One next step in the project, scheduled for 2014, is to implement the SCADA portion of a distribution management system (DMS), which will provide dispatcher operators full visibility into the electric distribution network. This too will integrate with the OMS to provide additional information in determining the exact cause of an outage sooner. The next step will be to automate the isolation and restoration process, at least to the point leading to actual line and equipment repairs. Supporting this effort is an enterprise asset management study underway to help Cleco best utilize both financial and human resources in the most efficient manner possible.

The final component of this strategy involves the customer experience. Cleco is in the final testing stage of its new Cleco.com website, set to roll out in December 2013. This new site will include typical account access and management features, in addition to a new notifications section. Building on the new AMI system, customers can elect to receive notifications via email or text when their power is out and when it is restored. In a hurricane-prone area like Louisiana, this is a vital service as many customers evacuate their homes and wait to be notified when power is restored before returning.

Project Contact

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Company Description

Cleco Corporation is an energy services company based in Pineville, Louisiana that has been in business since 1935, with approximately 1,200 employees serving approximately 280,000 customers. Cleco Corporation includes subsidiaries the primary utility business operating as Cleco Power LLC, an unregulated midstream business, and a support organization.

Cleco Power is a regulated investor owned electric utility, operating five generating stations utilizing coal, petroleum coke, lignite and natural gas. Cleco's service territory includes 11,830 miles of distribution and 1,300 miles of transmission circuits serving industrial, commercial and residential customers. www.cleco.com.

COMMONWEALTH EDISON COMPANY

INTELLIGENT SUBSTATION

Technology Partner(s) - Dynamic Ratings, OSISoft, Schweitzer Engineering Laboratories (SEL)

Project Highlights

- Digitalizing the system by moving from analog to digital relays
- Monitoring and alarm notification for transformer temperature and gas
- Automatic fault location
- Visual real-time monitoring for predictive maintenance (Substation Dashboard)
- Dynamic voltage regulators

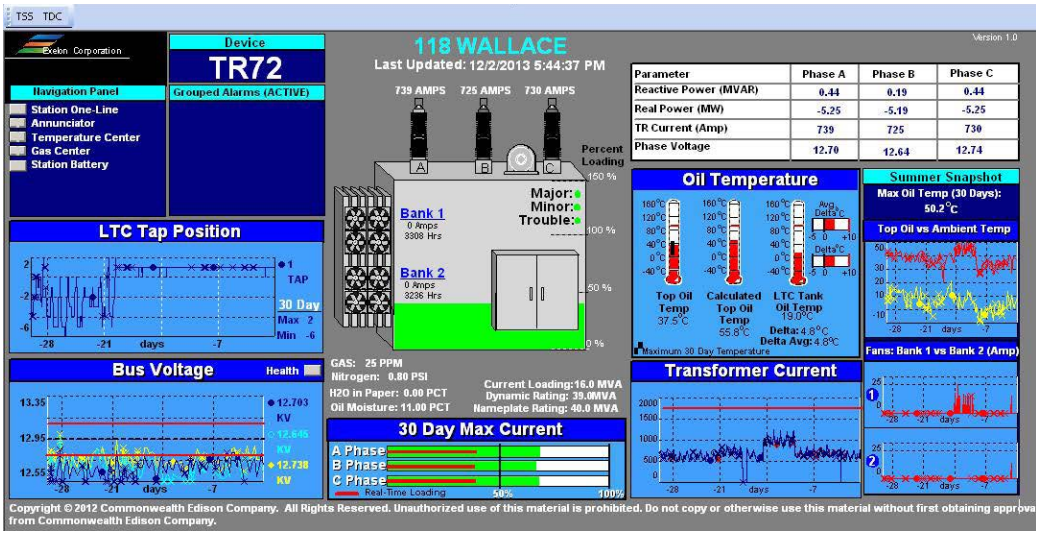
Project Description

ComEd's Intelligent Substation projects consist of a construction component with upgrades to station hardware devices such as breakers and transformers, and a smart grid component which upgrades the station from a reactionary, manually operated and un-informative analog system to a proactive, automatic and visual, real time digital system.

The construction side of the project applies needed replacements to field devices. The new devices have the same functionality as the old, but have better response times and environmental protection technologies, such as gas and oil level monitoring.

The smart grid side of the intelligent substation includes replacing all electro-mechanical analog protective relays with microprocessor digital relays. This replacement allows the integration of the monitoring capabilities that looks at operation times for breakers, and provides a wealth of data points for predictive analysis. The microprocessor digital relays allow for transformer paralleling and bushing pot device analysis, reduces the need of manual operations, and provide automatic system controls that operate based on system condition, diminishing the need of field fault locating efforts while providing specific fault location mapped to the ComEd system.

With these capabilities, T&S engineering and IT partnered together and moved to a new era of analytics and system monitoring by developing a visual, real time, proactive system monitoring tool, 'Substation Dashboard'. The substation dashboard serves as a real time analysis tool that is continuously looking at the station health and proactively and predictively identifying any device performance concerns such as transformer paralleling accurate functioning, transformer fan operations, breaker wear and operating times, as well as the overall health of the station. An automatic email notification system initiates and sends an e mail for any alarming or threshold approaching conditions. The e-mails are directed to device experts with severity level of such alarms.



Project Contact

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Company Description

ComEd is an energy delivery company that covers over 11,000 square miles and over four million customers in northern Illinois including Chicago metropolitan area. ComEd has been committed to safely deliver reliable electricity to its customers for more than a century and continue to enhance its services and workforce to generate smart ideas. www.comed.com.

Copper Development Association Inc.
Copper Alliance

European Copper Institute
Copper Alliance

COPPER DEVELOPMENT ASSOCIATION

NEW AND REFURBISHED OVERHEAD LINES WITH MICRO-ALLOYED COPPER CONDUCTORS

Project Highlights

- High mechanical strength of micro-alloyed copper (relative to aluminum) reduces cross-section of overhead lines
- High electrical conductivity substantially reduces line losses and lifecycle costs
- Increased maximum operating temperature means lines can operate at higher load above nominal capacity before reaching safety limits
- High annealing temperature (> 300°C) allows several types of coatings to be applied without disrupting the mechanical properties of the material, further reducing corona losses, noise levels, & ice loads

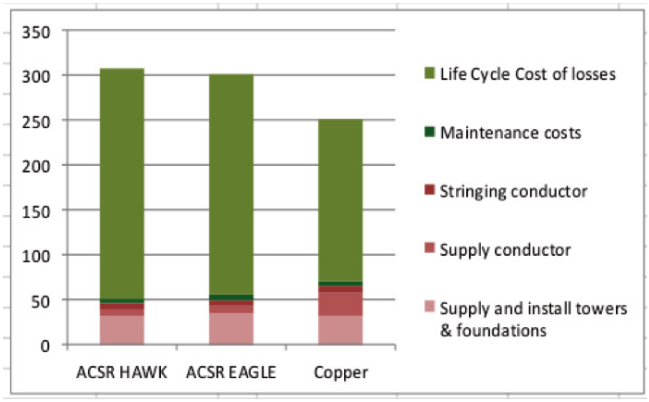
Project Description

In today's energy landscape, transmission network operators are facing substantial and sometimes contradictory challenges in ensuring system reliability on the grid. There is a need for a conductor that is able to increase energy efficiency, meet high capacity demand, and address the load shifts of a line, both in applications on new lines and in the replacement of old conductors on existing rights of way.

New micro-alloyed copper conductors address all of these concerns. Traditionally, overhead line conductors are made from aluminum, using either steel reinforced aluminum or aluminum alloys. Copper was not seen as optimal due to its weight. However, the strength of the towers for overhead lines is not always determined by the weight of the conductor, but often by the forces created by wind and ice loads along the lines. Reducing the cross section of the conductor reduces these forces. Because micro-alloyed copper has sufficient mechanical strength to operate without the need for steel reinforcement, the strength of alloyed copper combined with its high electrical conductivity requires a smaller conductor cross-section versus that of aluminum or aluminum/steel construction for the same line capacity.

Additionally, the high electrical conductivity of copper results in substantially lower energy losses than with aluminum when operated at a similar temperature. This results in lower life cycle costs despite the higher initial investment cost of copper conductor relative to aluminum. As demonstrated by the graph below, the life cycle cost of copper is minimal due to the energy loss of other metals.

The most important feature of copper conductor for overhead lines, however, is that the maximum operating temperature is far higher than that of its aluminum counterparts. The copper alloy also provides higher temperature resistance against creep (> 150°C), which means that the line can



operate at a higher load above its nominal capacity before reaching its safety limit.

Another advantage of the high annealing temperature of the copper alloy (> 300°C) is that several types of coatings can be applied without disrupting the mechanical properties of the material. This surface treatment can reduce corona losses as well as related noise levels. They can also make the material hydrophobic, or water-shedding, reducing the risk of ice loading and making the micro-alloyed copper conductors particularly suitable for overhead lines in cold climates.

In sum, new micro-alloyed copper conductors with surface treatment reduce energy losses and life cycle costs of overhead lines, increase the capability of the line to withstand electrical loads far above nominal values, increase the reliability of lines by reducing the risk of ice loading, and reduce noise levels. They are the most viable alternative for installation of new overhead lines and retrofitting existing ones.

Project Contact

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Company Description

The Copper Development Association (CDA) is the market development, engineering and information services arm of the copper industry, chartered to enhance and expand markets for copper and its alloys in North America.

Membership in CDA is open to copper producers worldwide and to brass mill, wire mill, and foundry fabricators of copper and copper alloys with production facilities in the USA.

Membership provides the opportunity to be part of an industry wide market development and technical service program so large and diverse that no one company would be prepared to undertake it alone. www.copper.org.

GEORGIA POWER

A SOUTHERN COMPANY

GEORGIA POWER

DISTRIBUTION FAULT LOCATION ANALYSIS

Technology Partner(s) - Alstom, Esri, Live Data, Oracle, Schneider Electric, Schweitzer Engineering Laboratories (SEL)

Project Highlights

- Rapid, accurate location of distribution faults within one minute
- Utilizes smart grid technologies – microprocessor-based relays, advanced distribution management system software
- Provides geospatial (map) and tabular views
- Shortens outage durations
- Improves customer satisfaction
- Lowers cost of operations (decreased outage restoration labor)

Project Description

Improving reliability, minimizing outages, shortening outage durations, and improving customer satisfaction are some of the most important objectives of Georgia Power's distribution organization. Developing and deploying smart grid technologies has helped Georgia Power achieve these goals. One very successful deployment is the Fault Location Analysis system in service today.

In the late 2000's Georgia Power began to replace electromechanical relays on 2,000+ distribution feeder breakers. Replacing electromechanical relays with microprocessor based relays provides a wide array of data not available before, including fault current. Integrating fault current data with the Distribution SCADA system provides Southern Company a new way to view and manage its distribution system.

A one year pilot was performed to determine if fault magnitude data from microprocessor relays could accurately predict the location of faults on the distribution system. The pilot indicated that faults could be accurately predicted within a few spans of the actual location more than half the time, often within a hundred feet. Based on these results, a decision was made to proceed with a more automated system.

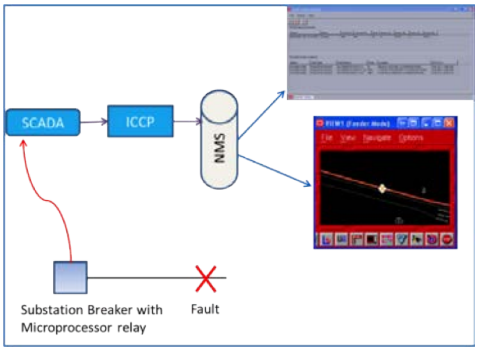
Working closely with Oracle, Georgia Power helped refine and implement the Fault Location Analysis module of the network management system (NMS) suite. Utilizing conductor information from the Distribution geographical information system (GIS), along with impedance characteristics of the distribution lines, the NMS can accurately and dynamically model faults on the distribution system. By integrating the fault currents from the microprocessor based

relays via the Distribution SCADA system, using Live Data's ICCP solution, the NMS recognizes a fault within seconds.

The NMS displays the predicted fault locations either geospatially (on a map of the distribution system) or in a tabular format with distance from key elements of the system (e.g. 322 feet from switch A1234). These locations appear in the NMS in less than 60 seconds of the fault, and take into account any off-nominal conditions of the distribution system configuration.

Experience has proven that the Fault Location Analysis system is providing accurate locations in a very high percentage of faults. Distribution control center operators are using the information daily and conveying this to the field with very positive results. To improve accuracy, ongoing work is in progress to address incorrect predictions often due to system data quality (incorrect wire sizes, inaccurate source impedance data, etc.), high impedance faults, or high DC offset in the first few cycles of a fault. A detailed analysis of fault prediction vs. actual location is being performed to quantify accuracy and total value.

An additional and valuable benefit is the ability to easily locate intermittent momentary outages. Using the predicted fault locations, field personnel have identified partially failed insulators, slack phase conductors slapping together, and tree conditions. Previously, miles of line would be investigated to try and locate the problem, often unsuccessfully. By narrowing the search area, finding the problem, and making appropriate repairs, long duration outages have been averted.



There is no doubt that the Fault Location Analysis system is achieving faster location of faults by first responders and shorter outages.

Project Contact

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Company Description

Georgia Power is the largest subsidiary of Southern Company, one of the nation's largest generators of electricity. Committed to delivering clean, safe, reliable and affordable energy to its 2.4 million customers at rates below the national average, Georgia Power maintains a diverse, innovative generation mix that includes nuclear, 21st Century coal, natural gas, and renewables such as solar, hydroelectric and wind. Consistently recognized as a customer service leader, Georgia Power was recently ranked highest in overall business customer satisfaction among large utilities in the South by J.D. Power and Associates. www.georgiapower.com.

GRIDSENSE

LARGE SOUTHEASTERN UTILITY MONITORS FLEET OF DISTRIBUTION VAULTS

Utility Partner(s) - a large Southeastern utility

Project Highlights

- Implements comprehensive monitoring across a fleet of over 2,200 transformers in over 750 vaults
- Proactively prevents issues and outages
- Leverages existing communications network to minimize project cost and maximize ROI

Project Description

GridSense is working with one of the largest electric utilities in the Southeast to support a smart grid program aiming to promote energy efficiency and greater use of renewable energy, while improving infrastructure reliability. To achieve these goals, the utility is incorporating advanced sensing, communication, control and analytical capabilities into the grid.

The utility owns and operates thousands of transformer vaults ranging from 500 kVA to five MVA, which transform power from the 15 kV class distribution voltage to 480 V three phase for large institutional customers like hospitals, universities, and large commercial centers. Failure of equipment at these vaults could be catastrophic and could disrupt critical operations of these institutions, affecting many people. Spare transformers and a throw-over switch designed to reroute power in the event of primary transformer failure were originally installed at these locations.

The utility lacked the sensing and communications equipment within these vaults to collect and transmit real-time transformer conditions information back to the control center. To correct this, the utility developed a plan to implement comprehensive monitoring across a fleet of over 2,200 transformers in over 750 vault locations in one major metropolitan area. To improve visibility, the utility developed unique DNP3 device addresses for each physical asset. This is in contrast to existing monitors or RTUs that return an undifferentiated list of data points pertaining to all equipment in the vault.

It was also important for the monitoring solution to be less than two percent of the replacement cost of the equipment being monitored, and for the installation process to be simple, with minimal onsite engineering, and without disrupting operations or requiring outages. In order to maximize ROI, the solution had to leverage the existing Silver Spring Networks radio system.

The utility found its solution by deploying GridSense TransformerIQs across its fleet of vault transformers. This solution provided access to an impressive volume of data for less than $1,000

per transformer in larger vaults. In retrofitting over 750 vaults in a major metropolitan area, the utility can now monitor and proactively prevent issues and outages related to transformer health.

Plans were made to expand the program into vaults with transformers previously thought too small to include cost-effectively. These transformers only require sensing vault switch, voltage, and power quality monitoring.

Project Contact

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Company Description

GridSense develops innovative, practical and cost effective monitoring solutions for the power sector.

GridSense provides technology and services that help their customers address the limitations of an old and aging infrastructure. Since the company's beginnings, GridSense has developed and successfully commercialized 'world first' technology, such as continuous sampling and adaptive sensing into advanced line sensors. GridSense pioneered advanced, affordable remote monitoring solutions for distribution transformers, as well as underground and other hard-to-reach network assets. Combining deep industry experience and technical knowhow with creative ideas, GridSense creates intelligent, reliable, and leading-edge technologies that add value to customers' businesses and shape the future of the modern power system.

Working in partnership with customers and other trusted industry professionals, GridSense provides a range of monitoring solutions from portable rugged devices through to some of the world's most complete, powerful network monitoring systems. Integrating advanced sensing and measurement capabilities with remote communications and computing technologies, GridSense has developed a range of offerings that address all the critical points along the electricity delivery system. Their growing product and services portfolio is driven by the passion of their employees to continue creating solutions that comprehensively meets and exceeds the current and future needs of the industry. www.gridsense.com.

INDIANAPOLIS POWER & LIGHT

SMART ENERGY INDIANAPOLIS

Technology Partner(s) - Beckwith Electric Co., Ecologic Analytics, GE, Itron, Schweitzer Engineering Laboratories (SEL), Silver Spring Networks

Project Highlights

- Implemented a Smart Grid program that is benefitting over 470,000 customers.
- Developed distribution automation system capabilities by investing in 2,400 smart devices
- Deployed 10,400 smart meters to residential, commercial, and industrial customers.
- Initiated public EV rates for all EV owners in Indianapolis metropolitan area

Project Description

Indianapolis Power & Light Company (IPL), a subsidiary of The AES Corporation, is integrating advanced technologies through its Smart Energy Project to improve customer satisfaction, distribution reliability and operational efficiencies. The project, partially funded through the U.S. Department of Energy Smart Grid Investment Grant, includes advanced meters, two-way communications equipment, enhanced energy management software tools, electric vehicle charging equipment, and automated distribution field devices.

IPL undertook a holistic approach to improving its system and customer offerings, implementing sustainable solutions that provide customers with improved service delivery, increased reliability and cost savings, and energy management programs that help participants reduce energy consumption. The main features are advanced metering infrastructure, distribution automation systems, customer energy technologies, and an electric vehicle pilot.

IPL has increased automated meter reading (AMR) functionality by integrating the AMR "last gasp" information into IPL's outage management system (OMS) to optimize outage prediction and improve service restoration. IPL recently added advanced metering infrastructure (AMI) to support two-way communication with 4,000 residential and 6,400 commercial and industrial smart metered customers to provide more robust remote reading capabilities and allow IPL to send pricing information directly to the meter for future time-based rates. Two-way communication also enables remote service disconnection and re-connections.

As one of the first US utilities to deploy commercial and industrial AMI meters, IPL jointly developed new interfaces with three vendors (Ecologic Analytics, Silver Spring Networks, and Itron) to integrate the AMR and AMI systems with a meter data management system (MDMS),

which is integrated with IPL's billing system and provides fifteen minute interval meter data for customer energy websites.

New software systems and two-way communicating devices automate data collection for predictive conditions management, helping to avoid equipment failure and minimize response and restoration times through a "self-healing" system. IPL has upgraded or added nearly 2,400 devices ranging from relays, load tap changer controls, capacitor controls, transformer online monitors, reclosers, fault indicators and substation monitoring equipment to reach nearly 95 percent of its customers. These devices are monitored and controlled 24x7 to detect irregularities before problems occur; reducing equipment failures and operations and maintenance costs.

Through the use of communicating fault indicators on underground cables and communicating network protector relays, IPL can detect faults through handheld equipment and restore service more quickly and safely. In addition, information collected from these assets is helping to enhance asset management policies.

IPL provides customers with online information on interval data, usage history, energy analysis and self-service energy management tools. Enhanced website functionality was developed to educate customers and offer "one-stop shopping" for options such as energy audits, energy rebates, electric vehicle charging stations, etc. Customer-specific energy consumption data is available online on a one-day delay, providing customers the ability to manage their energy consumption and costs.

Through close collaboration with various stakeholders including the State of Indiana, Purdue University, the City of Indianapolis and vehicle manufacturers, IPL initiated an electric vehicle (EV) program. IPL estimates these EVs will reduce greenhouse gas emissions by more than a ton per vehicle year when fueled by electricity from its mix of renewable and fossil fuel generation instead of petroleum fuel. IPL was the first investor-owned utility to initiate public EV rates, including a flat fee of $2.50 per charging session at eight sites, for all EV owners, which was important to alleviate "range anxiety" in the Indianapolis metropolitan area where many IPL customers reside and work.

Project Contact

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Company Description

Indianapolis Power & Light Company (IPL) is a distribution company and part of The AES Corporation, a Fortune 200 global power company with operations in 21 countries over five continents. IPL provides retail electric service to more than 470,000 residential, commercial and industrial customers in Indianapolis, as well as portions of other Central Indiana communities surrounding Marion County. During its long history, IPL has supplied its customers with some of the lowest-cost, most reliable power in the country. For more information about the company, visit www.IPLpower.com.

ITRON

MULTI-APPLICATION IPV6 ARCHITECTURE ENABLES SMARTER GRID PROGRAMS

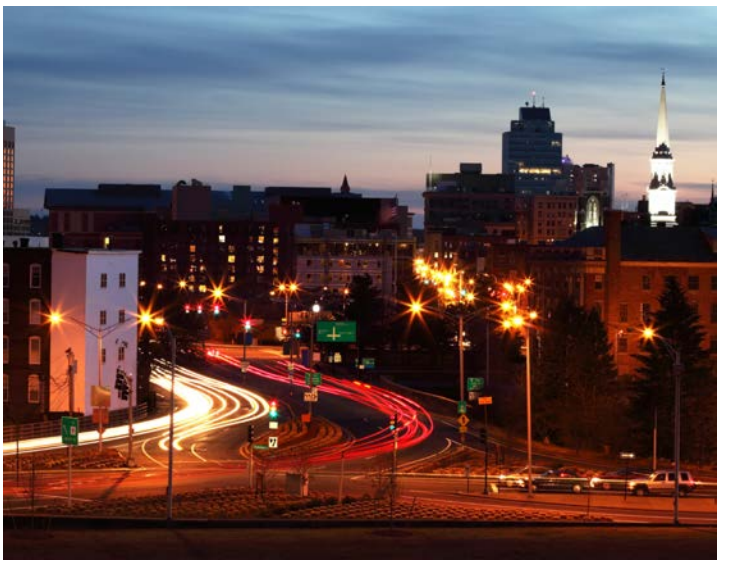
Utility Partner(s) - National Grid

Project Highlights

- Unique combination and integration of customer-facing and grid-facing applications
- Utilizes multi-application IPv6 network architecture by Itron and Cisco
- 14,500 meter endpoints installed by end of 2013; "zero-touch" deployment
- Successful remote technology upgradability over the air, network load balancing, monitoring, and secure end-to-end system reliability
- Improved visibility to customer power outages and restoration
- Increased customer awareness, enabling better control of energy usage
- Improved electrical system resiliency through advanced distribution automation

Project Description

In 2012, National Grid embarked on a project to build and evaluate an advanced smart grid network in Worcester, Massachusetts. The Smart Energy Solutions project incorporates a combination of advanced and integrated customer and grid facing applications. An integral part of the project is a multi-application IPv6 network architecture provided by Itron and Cisco. This innovative approach to deploying smart grid technologies allows National Grid a complete, secure, scalable solution in support of the project goals. National Grid tested and demonstrated the networks multi-application capabilities in various ways, including home energy management and distribution automation (DA).



Because National Grid has implemented a standards-based IP network, they can cost-effectively achieve these objectives within a multi-

service communication architecture that delivers both customer and grid applications on the same communications platform. Leveraging this infrastructure, third party providers bring consumer engagement, demand response and energy efficiency to nearly 15,000 homes across the targeted project footprint. Several devices, including Ceiva® Homeview™ displays and SafePlug™ smart plugs, are used behind the meter to deliver home energy management capabilities. Customers get a choice of rates and enabling technology in the home to manage, load control, thermostats and provide visibility to dynamic pricing and consumption information. By giving customers a new level of choice and control over their energy use through this advanced technology and information access, they are better enabled to be aware of and make informed decisions regarding energy use. National Grid and their customers also realize benefits from improved grid reliability and operational efficiency.

The project also allows National Grid to evaluate applications that support conditioned-based maintenance and grid awareness.

Project Contact

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Company Description

Itron is a global technology company. Itron builds solutions that help utilities measure, manage and analyze energy and water. Their broad product portfolio includes electricity, gas, water, and thermal energy measurement and control technology; communications systems; software; and professional services. With thousands of employees supporting nearly 8,000 utilities in more than 100 countries, Itron empowers utilities to responsibly and efficiently manage energy and water resources.

Itron smart grid solutions have been designed from the ground up to address the challenges facing electrical grids around the world. From smart meters and control devices to communication networks and application software, our complete solutions will help you optimize the delivery and use of electricity, paving the way for a more secure, efficient and reliable grid. With tools that enable greater visibility and insight, you can turn data into actionable intelligence for the benefit of all stakeholders.

https://www.itron.com/na/solutions/Pages/Smart-Grid.aspx.

SAN DIEGO GAS & ELECTRIC

CONDITION-BASED MAINTENANCE

Technology Partner(s) - Dynamic Ratings, GE, OSIsoft

Project Highlights

- Monitor substation equipment for near real-time conditions
- Data collected on a centralized server for analysis
- Alerts are generated when threshold levels are exceeded
- Maintenance personnel notified of potential issues requiring attention
- Uses equipment condition data to assess criticality, health, and risk of asset for prioritizing maintenance

Project Description

To proactively address the challenge of aging infrastructure, San Diego Gas & Electric (SDG&E) embarked on a condition-based maintenance (CBM) program back in 2009. With this system in place, the utility can evaluate the health of the transformer bushings, cooling fans and pumps, load tap changers (LTC), core temperatures and dissolved gases of its substation transformers. The system consists of sensors placed at strategic locations physically on the transformer main tank, high voltage bushings and the LTC with the data transmitted to a central monitor mounted adjacent to each transformer. From there, the data is transported via SDG&E enterprise gateways to back-office analytic software configured to generate alerts and send notifications with varying levels of criticality. The gas monitor, also mounted adjacent to each transformer, extracts oil samples through lines that tap directly into the transformer oil valves. The oil sampling is configured to sample as frequently as once an hour (based on the rate of gassing) with the data on dissolved gas concentration levels and rate of change in those levels over time transported to the back office for analysis.

The discrete alerts generated by the CBM system send individual notifications directly to the maintenance group. These notifications provide crews more detailed information about the necessary maintenance before they even arrive on site and allows for better productivity.

For example, the CBM system notifies technicians if it detects the loss of cooling fans or pumps. The loss of current to the fans triggers an auxiliary relay contact tied to an input on the CBM monitor. This input triggers a notification to the maintenance group with an alert level based on criticality. A fully functioning cooling system is essential to preventing the transformer from overheating, therefore lowering load capacity.

The LTC is another important component of the transformer being examined. The LTC motor energy is monitored to determine the necessary amount of current to advance the LTC through each tap position, which provides insight into the health of the motor and operating mechanism. Temperature differentials between the LTC oil and the main tank oil are indicative of the LTC contact condition. For more critical banks, dissolved gas analysis (DGA) monitors are used on the LTC tank as well as the main tank.

One of the most critical benefits of CBM is that engineers, technicians and maintenance professionals can obtain real-time data, view the analysis and make timely decisions to save the asset from premature failure and/or extend the life of the asset. In the past, technicians manually extracted transformer oil samples on an annual basis, and sent them to the lab for DGA. Now, gas analysis is performed automatically at regular intervals and the results are immediately available. Viewing the rate of change of the gases to understand the nature of the problem and correlate it to conditions on the system allows for more informed decisions as opposed to reacting to a potential bad read.

Another benefit of the CBM system is that in the past, technicians had to take an outage to test the bushings. Now, tests are automatically run every hour, and an outage is only required for the initial monitor installation.

The CBM program has already saved the utility a significant amount of expense. For example, an energized 12 kV capacitor caused a six MVA transformer to overload and produce heating gases in the oil. The capacitors were de-energized resolving the overload condition and preventing premature aging of the transformer.

In another 69kV distribution bank, the CBM system alerted a technician to an escalating current imbalance on the high side bushings as it exceeded thresholds set at three percent (level three) and then six percent (level four) alert mode. These alarm levels occurred concurrently with higher transformer winding temperatures, prompting the technician to take the bank out of service and replace the bushings. Through the analysis, SDG&E discovered that the partial discharge was from the bushing and not from the transformer. The technician was able to detect the problem early on before it translated into a major failure.

Moving forward, the utility is considering using the CBM strategy across other pieces of equipment, such as gas circuit breakers and substation batteries. The company wants to be proactive to reduce SF6 greenhouse gas emissions and prepare for new regulations for batteries at 110 kV and above distribution substations.

Project Contact

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Company Description

San Diego Gas & Electric is a subsidiary of Sempra Energy, with customers in 26 cities and two counties in a service area that spans 4,100 square miles. SDG&E is a regulated utility that serves 1.4 million electric customers. www.sdge.com.

SENSUS

COMPREHENSIVE SMART METER DEPLOYMENT IMPROVES GRID OPERATIONS

Utility Partner(s) - NV Energy

Project Highlights

- NVEnergize program will deploy 1.4 million smart meters by the end of 2013 (1.3 million currently deployed)
- Eliminated nearly 17 million manual meter reads
- Avoided more than one million truck rolls per year by utilizing remote connect and disconnect
- Net operational savings of approximately $25 million annually

Project Description

As a part of the American Recovery and Reinvestment Act of 2009, the U.S. Department of Energy granted $4.5 billion for smart grid investments. NV Energy received $139 million of this funding to launch its NVEnergize project, a comprehensive smart meter deployment with an associated suite of programs designed to leverage the smart meter network and offer customers more choice through enhanced technology, tools, and energy efficiency information.

In 2010, NV Energy chose Sensus to be its communications network partner. As part of NVEnergize, Sensus and NV Energy will deploy approximately 1.4 million smart meters by the end of 2013, providing increased service reliability and operational and energy management benefits for customers. More than 1.3 million smart endpoints, which include 156,000 gas modules, have already been deployed, encompassing 98 percent of Nevada's population. In addition to Sensus testing all meters before installation, NV Energy tests all meters again and works with the University of Nevada, Reno to conduct independent lab tests on the meters to confirm they meet ANSI accuracy standards.

NVEnergize uses Sensus' FlexNet multi-application, two-way wireless communications system. FlexNet is based on open standards, interoperability, and Federal Communications Commission-(FCC)-licensed spectrum. Key features of FlexNet include reliability, meter accuracy, and applications such as remote connect/disconnect, demand response, and distribution automation.

Consumer participation in NVEnergize has been strong, with approximately 50 percent of account holders doing business with NV Energy through their MyAccount web portal, and NV Energy is already realizing benefits.

Although the installation of meters will be completed this year, Sensus and NV Energy will

continue their efforts to enhance cost savings and benefits for Nevada consumers through changes to the smart grid network. Future operational and customer benefits include an improved awareness of system reliability by integrating outage and restoration data with outage management systems and processes. NV Energy will realize improved asset utilization when AMI data is integrated with operations and distribution planning tools, including an expansion into distribution automation.

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Company Description

Sensus is a leading utility infrastructure company offering smart meters, communication systems, software and services for the electric, gas, and water industries. Sensus technology helps utilities drive operational efficiency and customer engagement with applications that include advanced meter reading, data acquisition, demand response, distribution automation, home area networking and outdoor lighting control. Customers worldwide trust the innovation, quality and reliability of Sensus solutions for the intelligent use and conservation of energy and water. Learn more at www.sensus.com.

SILVER SPRING NETWORKS

NETWORK FIRST APPROACH TO GRID MODERNIZATION

Utility Partner(s) - NextEra Energy with technology partner GE

Project Highlights

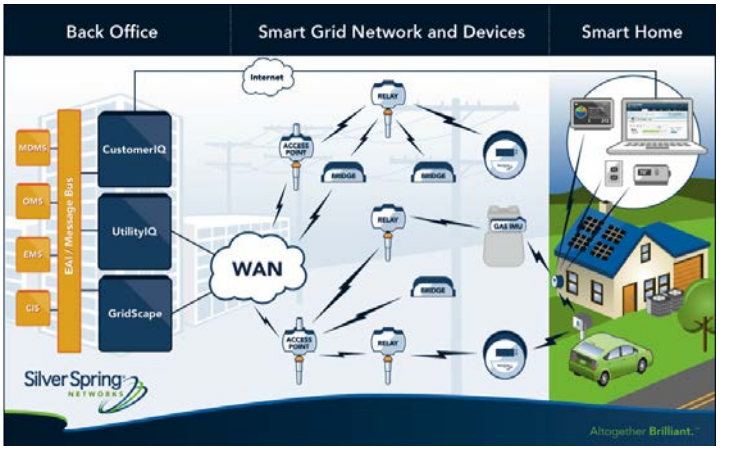
- In 2012, instead of dispatching crews, Florida Power & Light resolved 42,000 issues remotely, reducing the duration of outages by about two hours in each case.
- Networked sensors monitoring transformer health and performance identified 400 ailing neighborhood-level transformers before they failed.
- During Tropical Storm Sandy, FPL leveraged the network to automatically confirm power was on, reducing calls by 51 percent.

Project Description

Many utilities are installing smart meters, but the flexibility and resilience that the smart grid promises depends on networking those meters together with thousands of sensors at key points in the grid—substations, transformers, local distribution lines, and high voltage transmission lines. Through their "Energy Smart Florida" program, Florida Power & Light (FPL) has installed 4.5 million smart meters and more than 10,000 intelligent devices on its grid. As a partner in the $800 million program, Silver Spring Networks is enabling FPL's "network first" approach to grid modernization.

FPL was one of the first utilities in the country to finish a rollout of a smart grid modernization program, and is now leveraging the network platform to expand to applications beyond Advanced Metering Infrastructure to provide Florida residents more reliable and smarter energy services.

Silver Spring's networking platform unlocks value by enabling FPL to operate multiple smart grid applications atop a single network, including: energy billing, grid reliability, restoration acceleration, customer engagement and advanced smart grid analytics solutions. This unified platform approach expands the functionality and performance of FPL's distribution system,



resulting in increased reliability, additional energy efficiency opportunities, and reduced operations and maintenance costs. In addition to providing proactive, automated outage detection, restoration duration on average improved from two hours to less than two minutes. As a result, FPL logged fewer service complaints and increased customer satisfaction.

The project reached full production in 2013; however, some components of the system that have been operational for a year or more are already generating system-wide benefits. Customers access their smart meter data through a personalized web application, helping them understand and manage their energy use. The standards-based IPv6 network reduces both the frequency and duration of outages as utility crews can often identify and resolve issues remotely, avoiding the need for over 42,000 truck rolls in 2012. The utility also installed GE sensors that can continually monitor gases produced by transformers to determine whether the transformer is healthy, is becoming sick, or is about to experience an outage. GE's sensors allowed the utility to identify 400 ailing neighborhood-level transformers before they failed.

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Company Description

With more than ten years of experience, Silver Spring Networks is the leader in networking technologies that modernize today's power grid. They have delivered more than 17 million Silver Spring-enabled devices, in concert with software and services, to improve grid operations, energy management and efficiency. Silver Spring securely connects consumers and utility providers through powerful and proven energy networks that can be easily expanded as needs evolve. www.silverspringnet.com.

SOUTHERN COMPANY

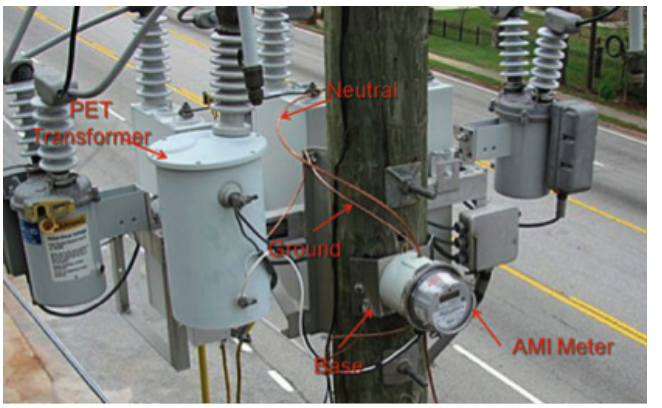
CAPACITOR BANK MONITORING USING AUTOMATED METERING INFRASTRUCTURE

Technology Partner(s) - Marvell

Project Highlights

- Developed and demonstrated a low-cost, innovative way to monitor distribution capacitor banks.
- Using a modified AMI meter, traditionally un-monitored capacitor banks will now report when a failure occurs.
- Identified more than 650 problems in the first six months and changed the inspection schedule from once a year to once a day, saving $175,000 per year.
- Demonstrating how an AMI monitor can be used as a controller for a switched capacitor bank.

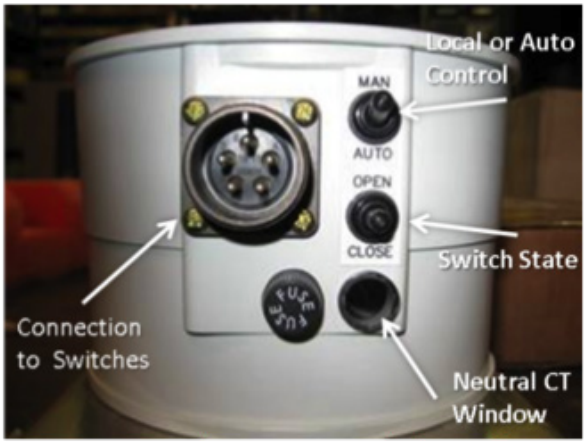
Project Description



Installation of the Advanced Meter Capacitor Bank Health Monitor

With more than 8,000 installations of fixed or switched capacitor banks, Southern Company relies on the proper operation of the devices for voltage and VAR support. Previously, Southern Company relied on physical inspections once a year to determine the health of the banks. This process was costly and there was no guarantee that the device would not fail after the inspection was finished. Southern Company identified the potential to use our low cost automated metering infrastructure (AMI) monitors as a health monitor for capacitor banks and has installed these monitors on all capacitor banks. In fact, Georgia Power Company has done away with the physical routine inspections because of the success of this project. As shown in the image above, the capacitor bank health monitor consists of a pole mounted meter base with an embedded neutral current transformer, an advanced meter, and a 120 V power source.

Moving forward Southern Company is investigating the potential to use the AMI monitor as a capacitor controller. By adding an AMI meter with remote disconnect capabilities and a



Capacitor Controller and Health Monitor AMI Meter Base

centralized Volt/VAR application, the adapter serves as both a health monitor and a control for switch capacitor installations. Replacing the local controller with an AMI meter, provides a low cost solution to what is today an expensive installation for a SCADA controlled switched capacitor bank. Shown in the picture (left), the meter base is modified to accept the five pin connector from a switch capacitor installation and still provide local control to field personnel.

Both applications are innovative solutions that leverage the existing AMI system. With better visibility over capacitor banks, Southern Company has been able to manage assets more effectively. Moving forward Southern Company will continue to identify other applications that can leverage this technology and develop other innovative solutions.

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Company Description

Southern Company is one of the largest energy providers in the United States. Based in Atlanta, Ga., Southern Company owns electric utilities in four states (Alabama Power, Georgia Power, Gulf Power and Mississippi Power) and a competitive generation company. Known for generating, transmitting, distributing electricity and providing excellent customer service to its 4.4 million customers, Southern Company is also leading the nation's nuclear renaissance through the construction of the first new nuclear units to be built in more than 30 years and the development of a state-of-the-art coal gasification plant. www.southernco.com.

SOUTHERN COMPANY

DISTRIBUTION AUTOMATED METERING INFRASTRUCTURE – OUTAGE MANAGEMENT SYSTEM INTERFACE

Technology Partner(s) - Microsoft, Oracle, Sensus, Ventyx

Project Highlights

- Power Off (outage) and Power On (restore) data from AMI meters flows directly into OMS
- Complex integration of numerous systems – AMI, advanced distribution management system software, Work Management system
- Faster identification of isolated customer outages
- Improved outage restoration process shortens outage durations
- Improves customer satisfaction
- Lowers cost of operations (decreased outage restoration labor)

Project Description

Customer satisfaction is the primary objective to Southern Company's four operating companies: Georgia Power, Alabama Power, Gulf Power and Mississippi Power. Quick and cost-effective power restoration plays a big role in providing world class customer service. Utilizing both new and existing technologies has helped Georgia Power achieve these goals. One very successful deployment is the automated metering infrastructure outage management system (AMI-OMS) integration that is in service today.

In 2007, Southern Company embarked on a project to install a Sensus AMI system and 4.4 million smart meters. The primary drivers for this program were to reduce costs of meter reading, enable demand-side programs by expanding customer rate options, including time-of-use, and improve our environmental stewardship by reducing miles driven for meter reading. While not a formal part of the original business case, numerous operational benefits were envisioned by utilizing the data available from the smart meters and the AMI system. One such type of data that proved particularly valuable to Southern Company was the power on/power off capabilities at each meter location.

Working closely with Oracle, Southern Company helped refine and implement the AMI-OMS capabilities of the network management system (NMS) Suite in place for outage management at Georgia, Gulf and Mississippi Power. Similar efforts were done for the in-house developed OMS at Alabama Power. With a framework established for an AMI-OMS integration, Southern Company undertook additional steps to realize the full benefit of the available AMI data. Five key functions were identified:

- Manual "Pinging": Ability to ping a meter from within OMS to verify individual meter power on/off status;

- Power Outage Detection: AMI meters will communicate power outages to OMS;
- Service (Single Customer) Outage Verification: Automatic validation that there is power outage (not a customer problem) after a single customer calls in an outage;
- Power Outage Restoration Verification: After power is restored to a large area, automatically ping meters downstream of the device that has been reenergized to determine if all customers are on, or if there are still pockets of outages remaining;*
- Predicted Device Outage Verification: Automatically validate and/or refine the location of an outage prediction that is based on customer calls.*

*Not developed for Alabama Power

Functions one through three were deployed in 2011 and are providing operational value every day. Distribution Control Center operators see the information or perform actions such as meter pinging directly in the OMS, without having to go to a different application. Functions four and five have been tested, however are awaiting planned AMI system enhancements before large scale deployment scheduled for 2014.

Another key component for success was integrating information from the Georgia Power Mobile Work Management system. In the course of regular business every day, thousands of meters are de-energized for scheduled work such as service disconnects, meter testing, maintenance work, etc. The AMI meter will transmit an outage signal regardless of why it was de-energized. It is essential that AMI meters reporting outages due to scheduled work do not flow into the OMS. A Biz Talk communication bus and comprehensive integration middleware was developed by Southern Company Services IT to interface with the work management system and filter out outages due to scheduled work.

There is no doubt that the AMI-OMS system is providing the ability to restore service quickly by more accurate and timely outage notification and identification of outages that still exist after area restoration. Since 2011, customer satisfaction and reliability continue to improve at Georgia Power, and the AMI-OMS system is contributing to these results.

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Company Description

Southern Company is one of the largest energy providers in the United States. Based in Atlanta, Ga., Southern Company owns electric utilities in four states (Alabama Power, Georgia Power, Gulf Power and Mississippi Power) and a competitive generation company. Known for generating, transmitting, distributing electricity and providing excellent customer service to its 4.4 million customers, Southern Company is also leading the nation's nuclear renaissance through the construction of the first new nuclear units to be built in more than 30 years and the development of a state-of-the-art coal gasification plant. www.southernco.com.

Grid Analytics

As data streams in from multiple points across the grid, data analytics can help utilities identify and act on otherwise unrecognizable or undetectable customer and system patterns. This chapter shows how utilities are using information from smart meters, customer information systems, grid sensing devices, and asset monitoring for end-to-end data analytics that improve grid performance. Grid analytics help utilities reduce system costs through theft detection, improve situational outage awareness, and provide opportunities for new and tailored customer services.

accenture ACCENTURE

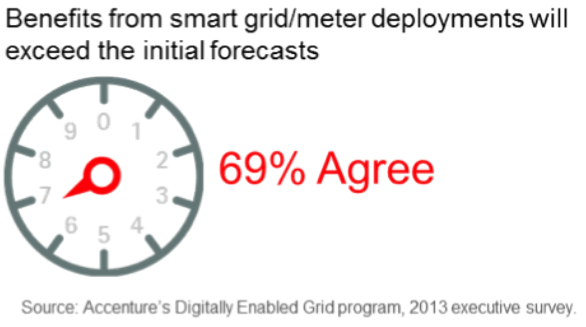
High performance. Delivered. **INSIGHTS FROM THE DIGITALLY ENABLED GRID**

Project Highlights

- Accenture's Digitally Enabled Grid program provides insight on the emerging landscape of the digital grid.
- 69 percent of utility executives in Accenture's survey believe that smart meter/smart grid benefits will exceed original industry forecasts.
- Nearly two-thirds of utility executives surveyed indicate that analytics solutions will be their highest priority smart grid investment in coming years, but only 25 percent feel they are currently very well positioned to compete for analytic skills in the market.
- More than 80 percent of utility executives surveyed say that current analytic capabilities need some or significant improvement.

Project Description

The benefits of new smart grid technologies are set to exceed industry forecasts. As utilities face mounting challenges from new market entrants, smart grid solutions have the potential to provide networks with a diverse, valuable set of tools that can help utilities address these challenges. Accenture's recently launched Digitally Enabled Grid program provides insights and recommendations around challenges and opportunities utilities face along the path to a smarter grid, including views from utility executives around the world.



Source: Accenture's Digitally Enabled Grid program, 2013 executive survey.

More than two-thirds of utility executives believe that the benefits of smart grids and smart meter deployments – which include improved customer service, reliability and outage response will exceed original industry forecasts, according to Accenture's global survey of 54 global utility executives in 13 countries.

The survey found that for 98 percent of the utilities represented, the smart grid is a natural extension of the ongoing upgrades to the electricity network, confirming that smart grid technology has become a core part of utility investment strategy. Eighty-five percent also expect the industry's competitive intensity to increase in the next five years, with more new entrants in the areas of energy efficiency and demand response, data services, and distributed power generation.

Nearly two-thirds of the executives said that, for their company, analytics solutions will be the highest priority smart grid investment in the coming years. Among North American executives surveyed, that number is even higher at 75 percent.

Utility executives globally view access to the right IT skills as the most critical factor to building their analytics capabilities and only 25 percent feel they are currently very well positioned to compete for analytic skills in the market. In addition, more than 80 percent say that current analytic capabilities such as data governance, data integration, and analysis toolsets need some or significant improvement.

Source: Accenture's Digitally Enabled Grid program, 2013 executive survey.

The findings from the global survey and Accenture analysis have been infused into four reports to help utilities identify specific requirements and define a roadmap for the future digital grid:

- *Forging a Path toward a Digital Grid* assesses the drivers for smart grid adoption and the approach to defining an optimal route toward a future digital grid
- *Realizing the Full Potential of Smart Metering* investigates the critical factors for the deployment of smart meters and the extraction of greater value through the adoption of advanced solutions
- *Optimizing Grid Performance through Advanced Operations* considers the impacts of changing energy requirements on grid operations and the role smart solutions can play in cost-effectively delivering reliable electricity supplies
- *Unlocking the Value of Analytics* examines the central role that analytics will play in extracting value from smart solutions and a detailing of the key factors utilities must address to enable this vital capability.

Review the key findings and all material at www.accenture.com/digitallyenabledgrid.

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Company Description

Accenture is a global management consulting, technology services and outsourcing company, with approximately 275,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. The company generated net revenues of US$28.6 billion for the fiscal year ended Aug. 31, 2013. www.accenture.com.

C3 ENERGY

REVENUE PROTECTION AND AMI OPERATIONS AT BALTIMORE GAS AND ELECTRIC

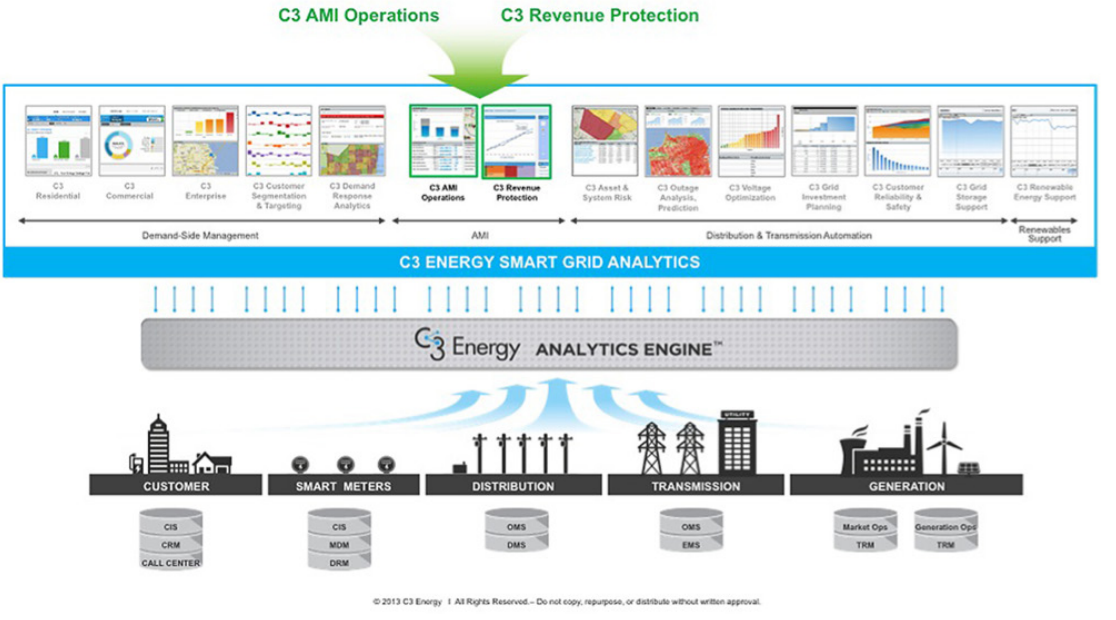
Utility Partner(s) - Baltimore Gas & Electric

Project Highlights

- C3 Revenue Protection and C3 AMI Operations analytics solutions for two million BGE electric and gas meters in Maryland
- Secure, scalable, SaaS-based technology platform for big data integration and analysis
- Integration of terabytes of data from internal and external systems
- Pre-built, configurable analytics solutions that deliver actionable business insights

Project Description

Baltimore Gas and Electric Company (BGE) considers its smart grid analytics software strategy to be central to the success of its overall Smart Grid rollout. As part of its deployment of two million smart meters across its entire Maryland customer base (1.3 million electric and 700,000 gas meters), BGE is deploying C3 Energy Smart Grid Analytics™.



C3 Energy's Smart Grid Analytics solutions integrate high volumes of detailed data from a broad range of data sources to create actionable insights that improve financial, operational, and environmental outcomes for BGE. Interval data feeds from BGE's two million meters, comprising terabytes of data, are being integrated with data from multiple, siloed internal and external applications and data sources. These data are being federated into a single, secure, scalable cloud image and undergo sophisticated, flexible analyses that produce transformative business insights. By streamlining and optimizing business processes, BGE is able to ensure efficient service delivery to our customers and increase their satisfaction while simultaneously realizing millions of dollars of annual, recurring economic value.

Project Contact

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Company Description

C3 Energy is an enterprise application software company that harnesses the power of big data, smart grid analytics, social networking, and cloud computing to improve the safety, reliability, and efficiency of power delivery. C3 Energy's family of utility-tested and proven smart grid analytics products deliver end-to-end solutions across the entire smart grid, from energy grid capital asset allocation, transmission, distribution, and advanced metering, to the customer experience and energy efficiency programs. C3 Energy products enable utility operators to realize the full benefit of their smart grid and energy system investments. www.c3energy.com.

CENTERPOINT ENERGY

END-TO-END DATA ANALYTICS: SITUATIONAL OUTAGE AWARENESS

Technology Partner(s) - eMeter, Itron

Project Highlights

- Big storms can generate more than two million Power-Off Notifications and Power-On Notifications in two hours
- Outage cases created, localized and dispatched without customer calls
- Real-time view of all outages, truck locations
- Avoided more than 27 million customer outage minutes since 2012
- Improved reliability by 25 percent
- Voltage alerts discover transformer aging, vegetation, loose lugs/clamps, tampering, bad T-saws

Project Description

Data analytics takes static and dynamic data from disparate sources and turns this data into meaningful information that drives better business decisions and enables automation. CenterPoint Energy (CNP) always believed that analytics would be a part of its overall smart grid but did not fully appreciate the magnitude of the impact. Now, analytics is a part of virtually every CNP discussion regarding smart grid operations and future plans.

CNP's has used data analytics, advanced metering system (AMS) and intelligent grid (IG) technologies to significantly improve distribution controls' ability to manage electric outages. For unprecedented power-off and power-restored (PON/PRN) notifications, CNP uses extensive analytics to understand the PON/PRN life-cycle, network traffic, and throughput impacts of activating outage alerts for 2.3 million smart meters. CNP's analytics & data services team developed a situational awareness platform integrated with smart meters, distribution switching devices, communication infrastructure, mobile data, and an outage analysis system to publish near-real-time status on telecom and intelligent grid switching device availability, individual outage cases, and crew availability and location.

A near-real-time (five-minute delay) situational awareness graphic display provides the details of each outage case and available restoration resources in tabular and geospatial formats so that controllers and managers can more quickly, efficiently, and effectively identify trouble spots and route or reroute the right crew to the right place at the right time to improve response time and customer satisfaction. Displays specific to each CNP service center allows service area directors to tackle their most challenging work much more efficiently.

Real-time geospatial awareness displays automatically track SAIDI and SAIFI for both system and individual cases. Email alerts to support teams in bad weather (as well as mobile displays for iPhone and iPad) include outage statistics and a summary of system resources, while estimated on-time (EOT) expiration alarms reinforce for crews the importance of expeditious electric service restoration.

Geospatial display of outages.

Since March 2013, using PONs, CNP has detected and restored power to 15,500 outage cases, impacting 378,000 customers, none of whom called to report the event. Previously, understanding outage scope could take 15 minutes to two hours depending on customer calls. In a sample month of fuse- and transformer-level outages, localization by customer calls took over 23 minutes compared to nine minutes by PON, a 62 percent improvement.

CNP developed a change management plan to teach impacted operations teams to understand and trust the massive new data. The team also implemented instant replay on all the displays in the distribution and telecom control centers. This allowed operators to learn and train using information from actual events and begin to develop predictive recovery scenarios which will help improve the response to future events.

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Company Description

CenterPoint Energy's electric transmission and distribution unit serves over 2.2 million consumers in a 5,000 square-mile area including Houston, the nation's fourth largest city and a consistently growing market. As a regulated "wires" utility, we neither generate power nor sell it to end-use consumers. We instead own, operate and maintain the poles, wires and substations that safely and reliably deliver electricity from power plants to consumers. With over 3,700 miles of transmission lines and 49,000 miles of distribution lines, we deliver electricity on behalf of 75 Retail Electric Providers. www.centerpointenergy.com.

COMMONWEALTH EDISON COMPANY

HARNESSING AMI DATA ANALYTICS FOR REVENUE PROTECTION

Technology Partner(s) - DataRaker, Silver Spring Networks

Project Highlights - Year-to-date findings through September 2013 on approx. 130,000 AMI meters

- Identified 228 meters with jumpers or tampering
- Detected 71 stolen meters used in place of disconnected meters
- Resolved 53 meters with wiring / equipment issues
- Determined that 25 meters are missing in the field
- Identified 14 locations for New Business to resolve

Project Description

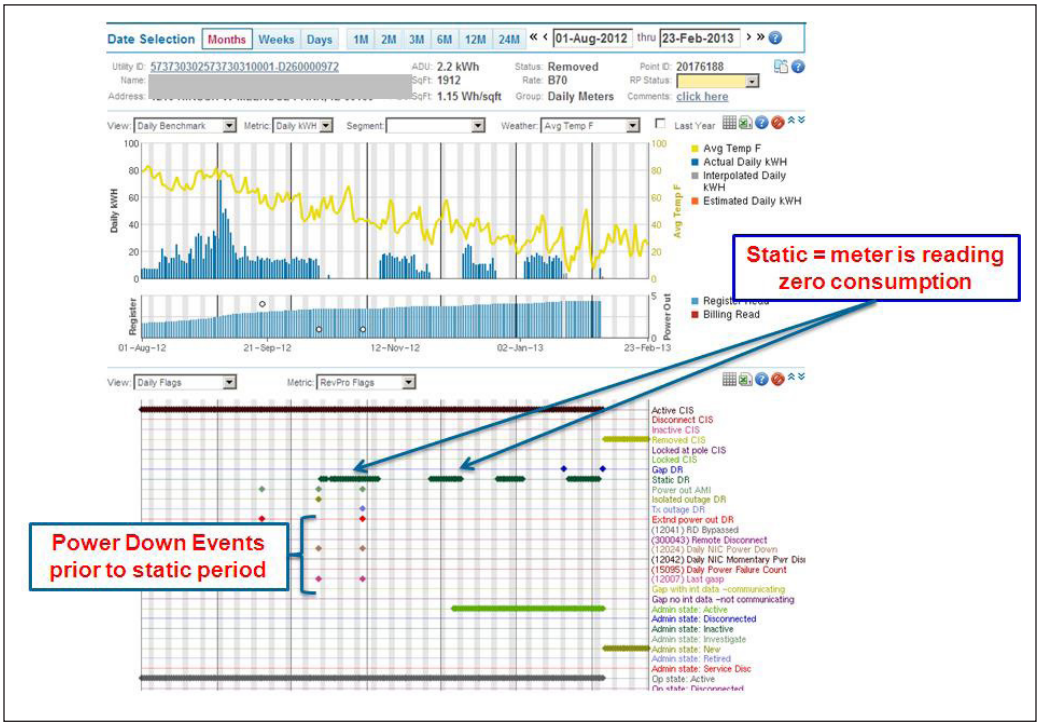
Smart Grid legislation in 2011 in Illinois requires ComEd to meet metrics to reduce bad debt, to reduce kWhs lost to inactive consumption, and to reduce unaccounted for energy (UFE). Successfully meeting these metrics allows ComEd to bill for previously unbilled kWhs, which will reduce costs that are otherwise socialized to our customers. Data analytics allow ComEd to deliver on the legislated metrics, enable the utility to become more efficient, and provide reliable service to its customers at the lowest possible cost.

ComEd uses a variety of tools and data analytics to help identify theft leads and unmetered current. ComEd is in the early stages of an automated metering infrastructure (AMI) deployment with approximately 130,000 AMI meters on the system. With the onset of smart meters and the elimination of most manual meter reading, data analytics help the utility "see" what is going on in the field.

ComEd is working with Silver Spring Networks to investigate and field all meters that 1) cease communication after being remotely disconnected and change to an unreachable status, or 2) have a meter condition of bypassed (senses load side voltage of a disconnected meter). A total of 331 orders were completed for unreachable and bypassed meters through September 2013. The hit rates of finding theft associated with unreachable and bypassed meters are 95 and 91 percent, respectively. Common findings from these leads include illegal jumpers used to bypass the meter, and stolen meters used in place of the disconnected meter.

ComEd recently partnered with DataRaker (now Oracle) to further develop its AMI data analytics. Information such as usage and AMI meter events is passed to DataRaker daily to identify theft leads. DataRaker out-of-the-box scripts allow for detailed insight into pattern theft, gaps in consumption, and meters with multiple events suggesting possible tampering. Even though the hit rate for the DataRaker analytics through September 2013 is only 57 percent, these leads

have provided invaluable insight into pattern theft and tampering. In addition to the out-of-the-box scripts, DataRaker also created ComEd specific scripts to help identify stolen meters, tampering after a disconnect contributing to a low reconnect rate, and reverse energy. The ComEd specific scripts built by DataRaker have transformed a very manual process of data mining from multiple systems into an automated process. The hit rate for these ComEd specific scripts through September 2013 is 89 percent.



Project Contact

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Company Description

ComEd is an energy delivery subsidiary of Exelon Corporation and one of the largest utilities in the United States. Headquartered in Chicago, ComEd provides service to approximately 3.8 million customers across northern Illinois, or about 70 percent of the state's population. ComEd is committed to be the best electric delivery and energy information company. This includes providing safe, reliable service for all customers at affordable rates. www.comed.com.

PACIFIC GAS & ELECTRIC COMPANY

BUSINESS ENERGY CHECKUP: DRIVING GREATER ENERGY EFFICIENCY IN SMALL-AND-MEDIUM BUSINESSES

Technology Partner(s) - C3 Energy

Project Highlights

- Leverages interval data to help customers visualize and understand their energy usage and associated costs
- Provides pre-populated customer profile information to provide actionable insights without requiring a long customer questionnaire
- Learns from additional information the customer provides, allowing for deeper engagement
- Provides customers with tailored energy savings recommendations across general conservation practices, energy efficiency, demand response, and distributed generation
- Encourages continuous efficiency improvement through an interactive energy savings plan

Project Description

Pacific Gas & Electric Company's (PG&E's) Business Energy Checkup is an online energy audit tool serving 325,000 small and medium business (SMB) customers. The Business Energy Checkup was created in partnership with C3 Energy to help SMB customers visualize and understand their energy usage and spend, complete an energy profile of their business, receive tailored energy savings recommendations, and create an energy savings plan which can then be acted against to encourage continuous improvement. With the Business Energy Checkup, SMB customers benefit from a solution specifically designed to help them overcome the challenges of understanding their energy usage behavior and implementing energy saving projects. The Business Energy Checkup is in use by commercial, industrial, and agricultural customers as well as in agricultural classrooms helping PG&E to further educate current and future customers on demand side management.

The Business Energy Checkup is an interactive, web-based energy management portal that puts customers in control of their business' energy usage and provides customized recommendations for saving energy and money. The Business Energy Checkup enables SMB customers to:

- Understand their energy usage and the associated cost
  - View gas and electricity usage and spend by facility in annual, monthly, and daily views
  - Compare current energy usage and spend to that of previous periods
  - Understand how their usage breaks down into various end uses

  - Review benchmarks showing how their facility compares to both an efficient and an average facility of the same type and size, in a similar climate zone

- Answer business profile questions, get tailored recommendations, and create a savings plan
  - Update an energy profile with information about their operations, building(s), and equipment – information that is used to provide targeted energy savings recommendations.
  - Review and select energy savings recommendations, rebates, and behavior tips to conserve energy and save money.
  - Create a customized energy savings plan in minutes and track progress against the plan

- Understand the impact of specific renewable options
  - Review the possible costs and benefits of energy efficiency on installing solar solutions for their business. The tool estimates the cost, savings, and payback of installing solar – calculations that consider the customer's usage and planned energy efficiency actions to help the customer understand the impact that energy efficiency can have on their solar system cost and size.

Business Energy Checkup

The Business Energy Checkup is fully integrated within the My Energy customer portal. This links the tool to many of the most common features customers come online for, such as paying their bill. All of the information customers provide in the tool is linked back to PG&E, helping to generate customer insights that influence program design, create targeted marketing initiatives, and to aid the evaluation of energy savings potential by our regulatory and measurement partners.

Project Contact

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Company Description

Pacific Gas & Electric Company, a subsidiary of PG&E Corporation (NYSE:PCG), is one of the largest combined natural gas and electric utilities in the United States. Based in San Francisco, with 20,000 employees, the company delivers some of the nation's cleanest energy to 15 million people in Northern and Central California. www.pge.com.

Renewable Energy, Distributed Generation, and Storage Integration

Balancing the need to provide high quality reliable electricity 24/7 with the opportunities and challenges of evolving distributed technologies and renewable resources requires a robust and flexible power grid. This chapter describes how utilities are integrating both large- and small-scale distributed generation resources into the power grid, deploying micro-grids, and utilizing electrical energy storage devices. By doing so, utilities are supporting customer preferences, supporting markets for new technologies, and meeting environmental goals.

DAYTON POWER & LIGHT

TAIT ENERGY STORAGE ARRAY

Technology Partner(s) - AES Energy Storage; Carrier Corporation; HMT, Inc.; Parker-Hannifin

Project Highlights

- Developed 40 MW advanced energy storage resource in Ohio
- Provides fast response frequency regulation to the PJM Interconnection
- Reduces overall system emissions and water use, while optimizing grid generating sources
- Achieved new milestone for grid storage with more than 100 MW of resources operating in PJM

Project Description

The Tait Energy Storage Array provides fast, accurate power for critical grid reliability services. Located at AES Corporation subsidiary Dayton Power and Light's (DP&L's) Tait generating station in Moraine, Ohio, the project provides fast-response frequency regulation services to PJM Interconnection to help stabilize the grid.

The facility is the largest of its kind in Ohio and can offset power generation from inefficient or retiring power plants, reducing overall system emissions and water use while optimizing existing grid resources.

Advanced energy storage resources can uniquely maximize the performance and efficiency of the grid through their ability to act as both generation and load. With the commercial operation of the Tait Energy Storage Array, AES is now providing more than 100 MW of energy storage resources in the PJM market.

This facility is managed using the AES Storage Operating System. This patented operating system, called sOS™,

is a fast-response control architecture that applies patented performance algorithms to automate the operation of battery-based energy storage arrays, optimizing performance and efficiency for customers, and extending the life of the battery.

The Tait battery array includes more than 800,000 battery cells and connects through DP&L Tait station's transformers, operated by DP&L and DPL Energy, LLC, through an independent agreement with PJM. The project was engineered, constructed, and commissioned in less than nine months.

AES has more than 174 MW of grid-scale, power plant equivalent flexible resources in operation. AES storage resources are currently deployed in the United States and South America.

Project Contact

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Company Description

The AES Corporation (NYSE: AES) is a Fortune 200 global power company. We provide affordable, sustainable energy to 21 countries through our diverse portfolio of distribution businesses as well as thermal and renewable generation facilities. Our workforce of 25,000 people is committed to operational excellence and meeting the world's changing power needs. Our 2012 revenues were $18 billion and we own and manage $42 billion in total assets. To learn more, please visit www.aes.com.

DTE ENERGY COMPANY

IMPLEMENTATION OF DISTRIBUTED ENERGY STORAGE

Technology Partner(s) - Chrysler, DNV KEMA, Electrical Distribution Design, National Grid, NextEnergy, S&C Electric Company

Project Highlights

- First large-scale lithium ion distributed energy storage systems located on one distribution circuit
- 20 distributed 25 kW / 50 kWh storage systems and one 500 kW lithium ion storage (next to a 500 kW photo voltaic system)
- Powers 60 households during circuit interruptions
- Deploying two repurposed automotive batteries that have reached end of automotive life
- Using a distributed communication system based DNP3 host for operation and control

Project Description

Energy Storage and 500 kW PV

DTE Energy Company's Advanced Implementation of Energy Storage Technologies project is demonstrating the benefits of aggregated distributed energy storage, also called community energy storage (CES) systems, and the integration of secondary-use electric vehicle batteries in a grid application. The project is using a DNP3 protocol host in a Distributed Resources System Operation Center (DR-SOC) to individually or collectively manage the CES system. The CES units will provide backup power during circuit interruptions to about 60 customers in addition to a number of utility benefits such as voltage support and circuit peak load reduction. The 500 kW lithium ion storage unit is located next to a 500 kW PV system to perform solar production shifting and to manage solar variability. The distributed 20 CES units are rated at 25 kW / 50 kWh and are located on the secondary side of the distribution transformer. This one megawatt energy storage and 500 kW PV project is demonstrating the following.

- Peak shaving, demand response, voltage support, and emergency load relief
- Integration of renewable generation

- Islanding during outages
- Ancillary services market participation

DTE Energy Company employees evaluated the storage system and created all necessary work instructions, job units and training material. The first unit was installed at the DTE Energy Technical Development Center for evaluation and training of the installation crews. The following partners are involved in the project:

- S&C Electric constructed the CES system using lithium-ion battery technology with advanced electronics for grid integration
- Chrysler Group LLC supplying secondary-use automotive batteries
- KEMA, Inc. for performance testing and cost/benefit analysis at the end of the project
- Electrical Distribution Design (EDD) for system modeling and control algorithm
- NextEnergy Michigan Research Catalyst Center providing analysis of CES application by the U.S. Department of Defense
- National Grid providing additional utility interoperability insight

The project will also demonstrate grid application of used electric vehicle batteries that have reached their vehicle end-of-life but still have about 80 percent usable capacity. The project is deploying two 25 kW / 50 kWh secondary-use CES units to evaluate two different methods of creating CES units. The results of the project will summarize performance improvements on the grid, performance of the CES devices and control system, and the secondary-use battery. The analysis will identify gaps, improvements, and suggestions on how devices and algorithms can be standardized to be used across the U.S. with a final project expected mid-2015.

Project Contact

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Company Description

DTE Energy is one of the nation's largest diversified energy companies. Headquartered in Detroit, Michigan, DTE Energy is involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric utility serving 2.1 million customers in Southeastern Michigan and a natural gas utility serving 1.2 million customers in Michigan. The DTE Energy portfolio also includes non-utility energy businesses focused on power and industrial projects and energy trading. Information about DTE Energy is available at dteenergy.com, twitter.com/dte_energy and facebook.com/dteenergy.

DUKE ENERGY

DISTRIBUTED ENERGY RESOURCE MANAGEMENT SYSTEM

Technology Partner(s) - Alstom

Project Highlights

- Created a Distributed Energy Resource Management System (DERMS) to integrate distributed energy resources into the electrical grid more efficiently.
- Enhanced abilities to model, forecast and control the utility's portfolio of distributed energy resources, including solar generation, energy storage, demand response, and electric vehicles.
- Supports the U.S. Department of Energy's (DOE's) objectives towards significant national smart grid targets by 2030.

Project Description

Duke Energy is actively engaged in an ongoing transformation of the electric distribution system with the goal of enhancing system performance to deliver better customer service, improve efficiency, and reduce operating cost. While Duke Energy has long focused on demand management, it has recently implemented an effort targeted at providing better management on the energy supply side.

Utilizing a $10.4-million DOE grant, Duke Energy, in partnership with Alstom, launched the Distributed Energy Resource Management System (DERMS) demonstration project in 2010 in an effort to integrate distributed energy resources into the electrical grid efficiently.

Once fully integrated with Duke Energy's Distribution Management System (DMS) – a multifunctional, centralized control system that actively monitors the on-going performance of the electric distribution system while seeking opportunities to optimize grid performance – DERMS will provide Duke Energy with the capability to model, forecast and control its portfolio of distributed energy resources, including solar generation, energy storage, demand response, and electric vehicles.

The integration of DERMS with DMS will provide Duke Energy operators the ability to see the distributed resource category, its unique identifier, its rating, its capacity, and, in the case of energy storage, its real-time state of charge.

The project currently is focused on developing accurate models of the distributed energy resources to allow the system to perform power flow calculations utilizing data from several resources already installed in the field. System operators are working with Alstom to develop the appropriate user interface for the various distributed energy resources deployed.

System interfaces for DERMS have also been developed to provide key stakeholder groups, such as Duke Energy's Distribution Planning Organization, with access to the distributed resource data collected to support strategic planning efforts.

The objectives of the DERMS project are to demonstrate:

- Better management and forecasting of distributed energy resources (e.g., energy storage, distributed generation, demand response),
- Advanced distribution modeling capabilities to accurately simulate smart grid operations and represent the distribution system in real-time or near real-time topology, and
- Interoperability and seamless communication between other management systems and data bases used by the Duke Energy.

Project Contact

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Company Description

Duke Energy, the largest electric power company in the United States, supplies and delivers electricity to approximately seven million customers in the Southeast and Midwest. The company also distributes natural gas in Ohio and Kentucky. Its commercial power and international businesses operate diverse power generation assets in North America and Latin America, including a growing renewable energy portfolio. Headquartered in Charlotte, N.C., Duke Energy is a Fortune 250 company traded on the New York Stock Exchange under the symbol DUK. www.duke-energy.com.

ENERNEX

ENERGY RESILIENCY THROUGH MICROGRIDS

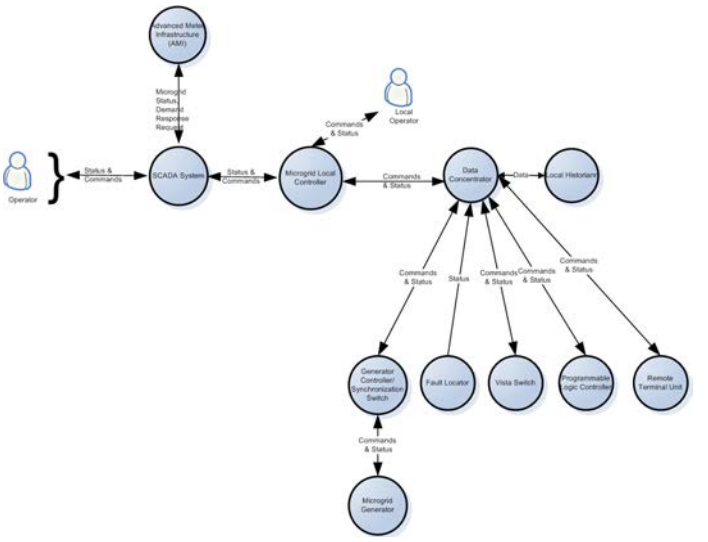
Utility Partner(s) - United Illuminating Company

Project Highlights

- Identified requirements for microgrid operation and testing.
- Analyzed critical facility loads to determine required sizing of generators.
- Developed business cases to evaluate relative cost-effectiveness of various generation options, including reciprocating engine generators, CHP units, and fuel cells.
- Analyzed energy markets and heating requirements for individual critical facilities to determine potential distributed generation value of microgrid generators.
- Benefits of the project:
  - Increased resiliency of electrical service to critical facilities.
  - Ability to transfer critical facilities to microgrid generation ahead of time, in anticipation of a severe storm.
  - Ability to remotely monitor status of critical facilities during emergency conditions.

Project Description

EnerNex assisted United Illuminating (UI) in identifying the requirements and specifications for two proposed microgrid installations in their Connecticut service territory. The microgrids are designed to serve facilities such as police stations, fire stations, town halls, public works facilities, and schools that would be critical to maintaining public health, safety, and social continuity during and in the aftermath of natural or anthropogenic disasters. The primary objective for the microgrids is to provide sustainable electricity service to these facilities during potentially prolonged outages on the main distribution network.



EnerNex determined the required sizing of generators and the various generation options in the communities. The microgrid in

Stratford, CT would be supported by a one-megawatt natural gas-fueled reciprocating engine generator (or CHP unit). The Woodbridge microgrid would require a two megawatt natural gas-fueled reciprocating engine generator (or CHP unit). The microgrids were designed to be "hardened" so that operations could be maintained during and following severe snowstorms, tropical storms, hurricanes, or other catastrophic events. The benefits of the microgrids include increased resiliency of electrical service to critical facilities; the ability to transfer critical facilities to microgrid generation ahead of time, in anticipation of a severe storm; and the ability to remotely monitor status of critical facilities during emergency conditions. The microgrid proposals have been reviewed with and are being considered by the Connecticut Department of Energy and Environmental Protection (DEEP).

In addition to requirements definition, EnerNex supported the utility through the development of business cases for the microgrids and the development of procurement specifications for the microgrid generators, back-up generators, and microgrid controls and communications systems.

Project Contact

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Company Description

EnerNex, established in 2003, provides research, engineering, and consulting services for the electric power industry. The firm focuses on providing services around the development and application of new and emerging electric power technologies to engineer a cleaner, smarter energy system of the future. www.enernex.com.

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

HAWAI'I ELECTRIC LIGHT COMPANY

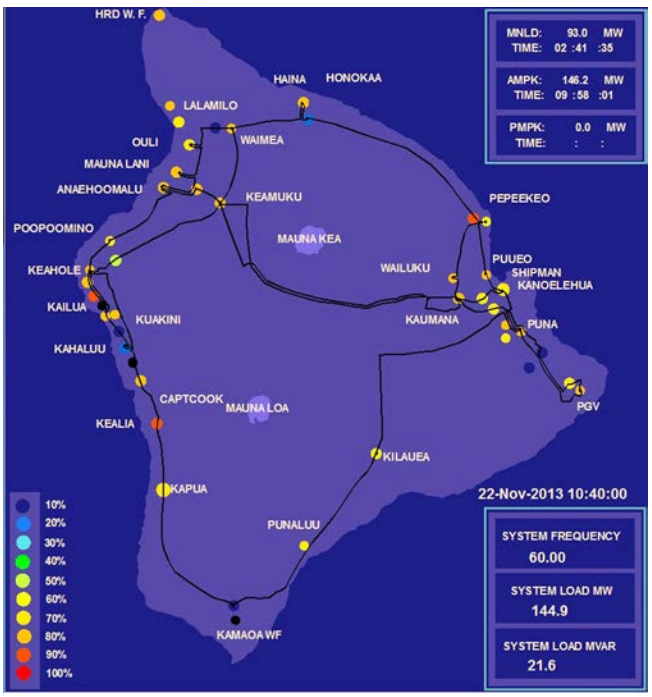
ESTIMATING DISTRIBUTED SOLAR POWER GENERATION

Project Highlights

- Address distributed solar generation that is unmetered and not monitored or controlled by Supervisory Control and Data Acquisition (SCADA)
- Installed small photovoltaic panels at 47 substations around Hawai'i Island to provide solar irradiance information through the SCADA System.
- Estimated distributed solar generation using solar irradiance data and connected solar generation.
- Produced graphical displays at System Operations to show solar irradiance at various locations, along with the estimated distributed solar generation in real time.

Project Description

Hawai'i Electric Light Company operates an autonomous power system on the island of Hawai'i. More than 40 percent of its energy is already generated from renewable energy sources, excluding solar. Solar photovoltaic (PV) is another important part of the company's portfolio of clean energy resources. Currently Hawai'i Island has more than 37 MW of distributed solar generation installed – almost double the amount installed just a year ago – and that amount is expected to continue to grow significantly. These recent increases in distributed solar generation (not monitored by SCADA) have reduced the daytime system load to below 160 MW. To understand and predict the impacts of solar generation the company required a quick and cost effective solution.



Utilizing the SCADA System for data collection, small 3-watt photovoltaic panels were installed at 47 substations. Estimated distributed solar generation is then calculated using the irradiance levels and the connected distributed solar generation capacity.

The irradiance levels are displayed at system operations to give an indication of the solar patterns around the island. The estimated solar generation and connected solar generation levels also are displayed to give the operator a sense of how much power is displaced by solar in real time.

There have been numerous events where system operations experienced a significant unexpected change in load (greater than two MW in one minute) and saw a corresponding change in solar measurements. Review of the SCADA data confirmed that system loads are impacted by solar. The magnitude and timing of the system load change corresponded to the solar change, verifying that the measurements and calculations for the estimates are valid.

The solar data is an increasingly valuable resource to the company for studying system and circuit impacts and for adjusting solar forecasting models. The data is especially valuable because Hawai'i Island experiences diverse weather patterns. With improved weather forecasting tools and system circuit modeling, Hawai'i Electric Light Company can better integrate increasing amounts of solar generation reliably and safely.

Project Contact

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Company Description

For more than 100 years, Hawaiian Electric Company has provided the energy that has fueled the islands' development from a Hawaiian kingdom to a modern state. Hawaiian Electric Company and its subsidiaries, Hawai'i Electric Light Company and Maui Electric Company, serve 450,000 customers on the islands of Oahu, Hawai'i, Maui, Lanai and Molokai, home to 95 percent of Hawai'i's 1.4 million people. Hawaiian Electric Company is a subsidiary of Hawaiian Electric Industries (NYSE: HE). For more information, visit www.hawaiianelectric.com.

NORTHWESTERN ENERGY

ENERGY BATTERY STORAGE PROJECT

Technology Partner(s) - Demand Energy Networks

Project Highlights

- Levels load curve for electricity grids by displacing four hours of peak demand using off-peak energy at off-peak prices
- Eliminates intermittency of wind and solar, making them "firm" resources
- Maximizes renewable efficiency by direct integration of PV production with storage
- Defers or avoids costly upgrades to T&D infrastructure
- Lowers T&D line loss
- Provides demand response "passively" with no disruptive effect to energy consumers

Project Description

NorthWestern Energy (NWE) has installed a battery to test storage for feeder support. The power conversion system is sized for 45 kW. The battery system uses advanced lead acid technology and is designed for 180 kWh of storage with 2,000 charge/discharge cycles at 50 percent depth of discharge/cycle. Included in the project is a 10.8 kW solar photovoltaic system coupled to the battery and vendor-provided and supported web-based hosted software that gives NWE the control and operability of the system as well the opportunity to import or export information to other software systems within the NWE operating system.

NWE's objectives for the project are to test the commercial scale viability of deploying energy storage as a utility resource; analyze the operational model and benefits of having a dispatchable load for integration of renewable energy; test direct solar PV integration with the energy storage system; and, examine and quantify the value streams of distributed energy storage, including feeder support, reduced line loss, transmission and distribution infrastructure upgrade deferral, passive demand response, energy efficiency, and other location-specific energy management solutions.

The distributed energy storage device (battery), called the Joule.System™ is supplied by Demand Energy Networks and optimizes existing generation and T&D resources by creating load during off-peak times, storing the energy at the load site, and ultimately dispatching it on command or on a managed schedule to the grid during periods of peak demand. By storing and distributing the energy at the point of use, the total electrical energy inventory of stored energy and energy storage capacity can be monitored and dispatched within seconds to coincide with the daily peak and valley usage patterns.

The Joule.System™ can potentially complement renewable generation sources, contribute to spinning reserves, reduce capital costs, and help avoid dispatching more costly incremental energy generation sources, especially during peak pricing periods.

Web based hosted software gives NWE the control and operability of the system as well the opportunity to import or export information to other software systems within the NWE operating system or smart grid project.

Project Contact

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Company Description

NorthWestern Energy provides electricity and natural gas in the Upper Midwest and Northwest, serving approximately 673,200 customers in Montana, South Dakota and Nebraska. More information on NorthWestern Energy is available on the company's website at www.northwesternenergy.com.

PEPCO HOLDINGS, INC.

DISTRIBUTION ENGINEERING WORKSTATION DEPLOYMENT

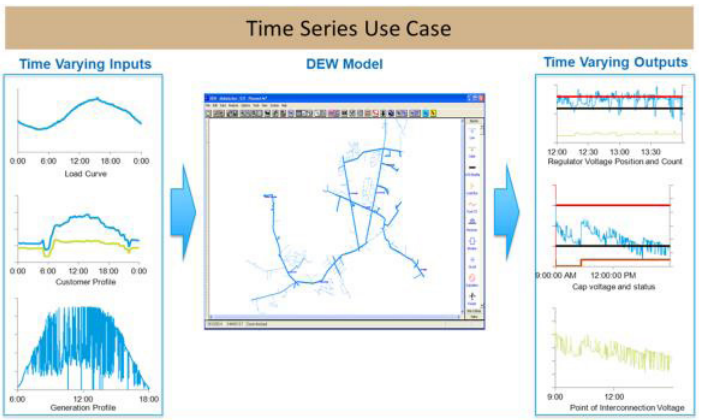
Technology Partner(s) - Electrical Distribution Design

Project Highlights

- Created a semi-automated distributed energy resource (DER) impact assessment tool that runs multiple load flows to analyze the impact on the grid.
- Provides photovoltaic (PV) system output through an interface to "Sky Data" to back cast and forecast the electrical output of solar systems.
- Provides time series aggregate impact analysis of all DERs on the electrical system.
- Models and analyzes the impact of increasing generation at the distribution level, on the whole grid.

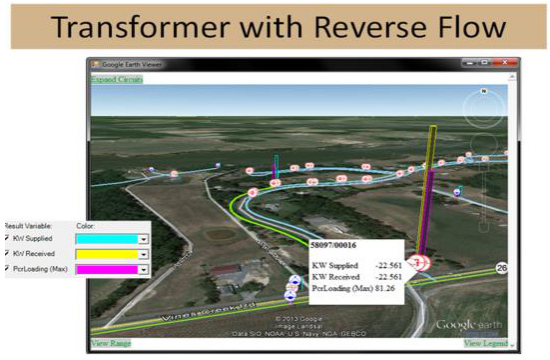
Project Description

Many utilities evaluate the impact of Distributed Energy Resources (DERs) in load flows focused on one or a few distribution feeders running in a static load flow. Pepco Holdings, Inc. (PHI) recognized that with the increasing penetration of DERs, it is important to accurately model all DERs in a time series load flow and to identify time periods of maximum impact and focus detailed study on those time periods. Working with Electrical Distribution Design, PHI has deployed the Distribution Engineering Workstation (DEW), enabling the team to do detailed impact studies in house saving customers both money and time.



Since many DERs are PV systems, it is critical to back cast and forecast the output profile and intermittency of these systems. As the distribution system increases its DER generation capacity, it will also be important to assess transmission contingency impact on the distribution system, as well as the impact of distribution contingencies on transmission.

Recent studies include a four MW PV system that had the complexity of combining a battery system to do Frequency Regulation, a study of several PV systems totaling two MW near the



end of a distribution feeder and a study to analyze internal criteria on the amount of voltage fluctuation that will be allowed on voltage regulators and capacitor banks affected by nearby intermittent resources. The program is also being used to conduct the modeling for a DOE grant studying advanced voltage regulation strategies that can operate autonomously and under central control.

Project Contact

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Company Description

Pepco Holdings, Inc. is one of the largest energy delivery companies in the Mid-Atlantic region, serving about two million customers in Delaware, the District of Columbia, Maryland and New Jersey. PHI subsidiaries Pepco, Delmarva Power and Atlantic City Electric provide regulated electricity service; Delmarva Power also provides natural gas service. PHI also provides energy efficiency and renewable energy services through Pepco Energy Services. www.pepcoholdings.com.

PNM

PROSPERITY ENERGY STORAGE PROJECT

Technology Partner(s) - Ecoult/East Penn Manufacturing, Electric Power Research Institute (EPRI), Northern New Mexico College, Sandia National Laboratories, University of New Mexico, U.S. Department of Energy (DOE)

Project Highlights

- Overcomes issues of renewable power intermittency
- Simultaneous smoothing and shifting of 500 kW of photovoltaic (PV) solar energy integrated with the grid
- Developed custom algorithms to regulate variable power and create a defined output during the system peak
- Used batteries to store PV energy and dispatch it aligned with load
- Shaved 15 percent off a feeder peak

Project Description

The Prosperity Energy Storage Project was fully commissioned to the PNM control system in February 2012. Located near Albuquerque, N.M., the project couples 500 kW of PV with multipurpose batteries to create a renewable resource that overcomes two challenges typical of wind and solar renewable resources: intermittency and lack of alignment between customer use patterns and when the renewable energy is produced. Since installation, this project has successfully and continuously demonstrated – with high availability – several simultaneous benefits that fundamentally increase the real and practical value of utility-scale PV. These benefits include smoothing and shifting of PV using statistical analysis to identify the most efficient amount of smoothing required by batteries, and successfully shaving 15 percent off a feeder peak on a continuous basis. The storage/PV system applies a custom software algorithm that automatically takes real-time data from various sources, uses that data to continuously optimize storage benefits and battery life, and seamlessly performs these duties in a cyber-secure environment. The system acquires up to 220 data points per second.

Extensive collaboration is a hallmark of the project team, including project lead PNM; Ecoult/East Penn Manufacturing, which manufactured the batteries for the project; Sandia National Laboratories, which contributed to security and rigorously tested the batteries used in the project; and the University of New Mexico and Northern New Mexico College, which helped develop algorithms in use at the facility. The Electric Power Research Institute has also been an integral partner from project outset, assisting with use case analysis, application of analysis tools and analysis of results.

This $5.8 million demonstration project is adding to the knowledge base needed to drive wider adoption of renewable energy. The leading-edge results of this project have already been widely disseminated, and public outreach channels have been established to extend this reach as the system is further optimized. The project has resulted in more than 18 juried publications through IEEE, ASES and others, and has been featured in more than 40 presentation forums throughout the globe. Results and lessons learned have directly influenced industry protocol developments and handbooks, and are used in formal classroom instruction ranging from middle school renewable-energy classes in northern New Mexico, to college-level instruction at three universities, to statistical model development at the PhD candidate level at two universities.

As this project was part of DOE's Smart Grid Energy Storage Demonstration Program funded through the American Recovery and Reinvestment Act of 2009, the economics of the project will be evaluated through the first quarter of 2014. Efforts are underway to define downstream projects that utilize Prosperity's advanced infrastructure once the current DOE project is complete. These efforts envision further analysis and development of solar forecasting and battery integration, testing advanced inverters in combination with storage, and testing advances in the battery technology itself.

Project Contact

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Company Description

With headquarters in Albuquerque, PNM is the largest electricity provider in New Mexico, serving 500,000 customers in dozens of communities across the state. PNM is a subsidiary of PNM Resources, an energy holding company also headquartered in Albuquerque. For more information, visit PNM.com.

SAN DIEGO GAS & ELECTRIC

BORREGO SPRINGS MICROGRID DEMONSTRATION

Technology Partner(s) - California Energy Commission (CEC), Horizon Energy Group, Lockheed Martin, Pacific Northwest National Laboratories (PNNL), University of San Diego (USD), U.S. Department of Energy (DOE)

Project Highlights

- First large scale utility microgrid
- Reduces the peak load of feeders to enhance system reliability
- Enables customers to become more active participants in managing their energy use
- Uses proven technologies, including local power generation, energy storage, automated switching, and active customer participation.
- Actually island real customers
- Provides a model for utilities to implement advanced technologies

Project Description

In cooperation with the U.S. Department of Energy and the California Energy Commission, SDG&E along with multiple public and private sector partners developed the Borrego Springs Microgrid Demonstration Project (Microgrid). The proven technologies used in the Microgrid included local power generation, energy storage, automated switching, and active customer participation. These elements create a more robust and resilient grid that is able to dynamically react to the changing environmental and system conditions.

The Microgrid is connected to the centralized energy grid, but can disconnect and function on its own during critical times to support its essential energy needs. The Microgrid demonstrates a variety of innovative technologies that are key elements of the "smart grid" transformation that is happening in the utility industry.

All elements of the project have been installed and demonstration tasks have been completed. SDG&E has installed 3.6 MW of local power generation, a large energy storage unit (500 kW / 1500 kWh) at the local substation, three community energy storage units (25 kW / 50 kWh) towards the end of the microgrid circuit, and 60 Home Area Networks (HAN) for local participating customers.

Microgrids have the potential to provide multiple benefits to customers including enhanced reliability, promoting renewable energy integration, and encouraging customer involvement. This project studied how to best respond to a system disturbances and maintain power to a local area, allowing customers to potentially "ride through" the disturbance. The Microgrid does this by having

Substation Energy Storage – 500 kW / 1500 kWh

enough local generation and local energy storage to meet the critical energy demands of the area.

The project also studied how to best account for the intermittent nature of renewable energy and smoothly integrate these resources onto the grid by utilizing technologies such as battery energy storage, local generation, demand response and automated switching. These technologies will help provide clean energy to the grid, maintain reliability, and preserve the environment.

This project also studied how to encourage customer participation through energy use management during Microgrid operations. SDG&E recruited approximately 60 residential and small commercial customers in Borrego Springs to be part of the Microgrid Energy Manager Program. SDG&E provided a free Home Energy Management System that displays real-time energy use and pricing information and provides convenient options to manage energy use remotely. SDG&E offered incentives to customers for participating and actively managing their energy usage to reduce peak load and promote energy efficiency.

As part of the demonstrations, planned islanding was successfully conducted on several occasions, and generation resources were used to match the local load and separate from the larger electric grid. After several hours, the load was transitioned back to the grid with no interruption to the customers. Up to 2,200 customers were transitioned at one time.

The Microgrid was also used to support customer load during an unplanned outage caused by severe weather. In April 2013, the Borrego Springs area experienced a wind storm with gusts of 87 mph. These winds damaged several of the poles on a key power line, cutting power to Borrego Springs. Once the winds subsided and the crews determined it to be safe to re-energize portions of the grid, the microgrid resources were used to restart the local grid to serve as many customers as possible while repairs were made to the line.

On another occasion, the Microgrid on-site generation was able to deliver power to a large portion of the local grid during a planned outage, reducing the scale of the outage and the corresponding impact to Borrego Springs.

Project Contact

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Company Description

San Diego Gas & Electric is a subsidiary of Sempra Energy, with customers in 26 cities and two counties in a service area that spans 4,100 square miles. SDG&E is a regulated utility that serves 1.4 million electric customers. www.sdge.com.

XCEL ENERGY

ADVANCED WIND PRODUCTION FORECASTING SYSTEM

Technology Partner(s) - Global Weather Corp. (GWC), National Center for Atmospheric Research

Project Highlights

- Use real-time, turbine-level operating data and sophisticated algorithms to forecast the amount of wind power that will be produced.
- Save customers millions of dollars in fuel costs and more efficiently utilize fossil fuels.
- Forecasting models generate information about winds at 200 to 300 feet, where turbine hubs are typically located.

Project Description

Xcel Energy is completing its fourth year of operational deployment of WindWX – one of the most advanced wind-production forecasting systems in the world – and the savings to the company continue to add up.

The WindWX system, provided by Global Weather Corp. (GWC), uses real-time, turbine-level operating data and applies sophisticated algorithms to forecast the amount of wind power that will be produced. The forecasts, now available worldwide, are designed to help utilities make better commitment and dispatch decisions, including opportunities to power down less-efficient power plants when sufficient winds are forecasted to help meet customer electric demands.

Wind-power production is difficult to forecast due to its variability, and inaccurate forecasts are costly. This precise wind-power forecasting service has significantly reduced forecast error, allowing Xcel Energy to better determine when to turn up or turn down coal- and natural gas-fired power plants.

Forecasting wind at turbine sites is challenging because landscape features such as hills and trees can reshape wind speeds and directions, and cause turbulence in ways that can greatly influence the amount of energy produced. In addition, most forecasting models are designed to generate information about winds near ground level rather than at 200 to 300 feet, which is where Xcel Energy's turbine hubs are typically located.

Through ongoing work with GWC, forecasts for a 168-hour period are provided every 15 minutes across Xcel Energy's entire service territory – from the hills of western Minnesota to the plains of eastern Colorado to the flat expanses of the Texas Panhandle. By using this technology, Xcel Energy estimates it has saved more than $30 million for customers. The company also has reduced its forecasting error rate by over 30 percent since 2009.

Building on previous project successes, Xcel Energy, the National Center for Atmospheric Research (NCAR), and GWC have initiated a third phase of project work to further enhance the sophistication of the technology. In this stage, Xcel Energy seeks to improve short-term forecasting, focusing on ramping and extreme weather events, introducing probabilities into the forecasting process, as well as exploring solar forecasting

Xcel Energy anticipates that the planned enhancements will keep the system cutting edge, and improve accuracy in wind-prediction capability. The prediction model, marketed by GWC as WindWX, should also enable other utilities to more reliably and cost-effectively integrate wind power.

In the next two years, NCAR scientists and engineers will develop custom forecasting systems to enable Xcel Energy to anticipate sudden changes in wind, shut down turbines ahead of potentially damaging icing events and even predict the amount of energy generated by private solar panels. NCAR's new agreement with Xcel Energy focuses on:

- Forecasting major changes in wind energy over a few hours due to a passing front or another atmospheric event.
- Forecasting ice and extreme temperatures to predict the impacts of freezing rain on wind turbines, which cannot operate when coated in ice.
- Generating solar forecasts using a combination of computer models and specialized cloud observing tools to help Xcel Energy better anticipate when customers are getting power from their own panels.

Some of these new systems will provide "probabilistic forecasts," estimating the chances that a particular weather event will occur. For instance, this feature will enable utility managers to make decisions based on whether there is an 80 percent chance of certain weather events at a wind farm the next day or a 20 percent chance.

In 2013, Xcel Energy, already the nation's number one wind energy provider and number five solar provider, proposed adding a total of 1,900 megawatts of wind resources, a 40 percent increase in company-wide wind capacity. Ensuring that renewables can be efficiently integrated into its operations is an important priority for Xcel Energy and the partnership with NCAR and GWC has gone a long way to helping meet this priority.

Project Contact

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Company Description

Xcel Energy (NYSE: XEL) is a major U.S. electricity and natural gas company with regulated operations in eight Western and Midwestern states. Xcel Energy provides a comprehensive portfolio of energy-related products and services to 3.4 million electricity customers and 1.9 million natural gas customers through its regulated operating companies. www.xcelenergy.com.

Customer Engagement

Educating and empowering electric utility customers to manage their energy use more strategically and efficiently are important but difficult undertakings. Over the past few years, several solutions have emerged, delivered in a multitude of mediums – print, digital, and virtual – that both engage customers and empower customers to make informed energy decisions. This chapter shows how utilities are using new approaches and technologies to better understand and influence the decision making patterns and energy management behaviors of their customers.

AEP OHIO

CUSTOMER ENGAGEMENT THROUGH HOME ENERGY REPORTS

Technology Partner(s) - Opower

Project Highlights

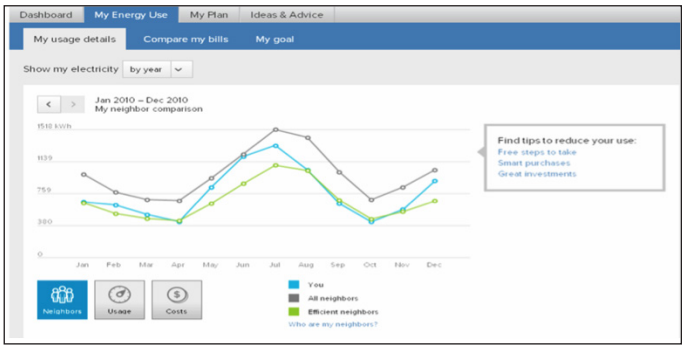
- Deliver efficiency tips, rebates, and electricity usage in 15-minute intervals as well as by day, month or year to smart metered customers through an AEP Ohio web portal.
- Provided more than 60,000 smart metered customers with personalized energy usage information through mailed Home Energy Reports.
- Saved more than 18,000 megawatt hours during the first three years (2010-2012)
- Expanded program to include more than 70,000 customers.
- Offering customers weekly email snapshot of electricity usage and unusual usage alerts for bill management.

Project Description

AEP Ohio places significant value on maximizing the customer experience associated with the new gridSMART technologies. Over time, customer expectations tend to expand along with technology. This yields an opportunity for AEP Ohio to provide these customers with new engagement tools to better empower them to manage their energy consumption. Successful rollout of these tools leads to improved customer satisfaction with the utility.

Coupled with the deployment of smart meters, AEP Ohio's Home Energy Reports represent an innovative customer engagement tool from AEP Ohio to help customers use electricity more efficiently at home. These reports, supported by Opower, provide customers with information about their electricity use, showing them how their electricity use compares to that of similar households.

The Home Energy Reports also provide customers with energy efficiency tips, rebates and information on other energy efficiency programs available in their area. Customers can access the same information through an online web portal. Through the first three years of the program, 2010-2012, the initial 60,000



households that received a mailed Home Energy Report saved more than 18,000 megawatt-hours. Given the success of the program, AEP Ohio increased the number of households receiving Home Energy Reports to more than 70,000 in 2013.

Starting in 2013, the Home Energy Reports were made available online – in addition to mail. Customers also have the option to receive weekly customer engagement email and usage alerts. Both options provide information about electricity usage to help customers manage their bills.

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Company Description

AEP Ohio provides electricity to nearly 1.5 million customers of major AEP subsidiaries Ohio Power Company in Ohio and Wheeling Power Company in the northern panhandle of West Virginia. AEP Ohio is based in Gahanna, Ohio, and is a unit of American Electric Power. American Electric Power is one of the largest electric utilities in the United States, delivering electricity to more than five million customers in 11 states. News and information about AEP Ohio can be found at AEPOhio.com.

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy under Award Number DE-OE0000193.

AmericanEfficient

AMERICAN EFFICIENT

DREAMSTREET: IMPACTING CONSUMER PURCHASE DECISIONS WITH THE "KAYAK.COM OF ENERGY EFFICIENT PRODUCTS"

Utility Partner(s) - BG&E, Delmarva Power, FirstEnergy, Pepco, SMECO

Project Highlights

- Dreamstreet is an open web-based platform that enables customers to search and discover energy efficient home products, appliances, and consumer electronics across local and online retailers.
- Dreamstreet provides product specific information about available rebates.
- Dreamstreet encourages customers to share reviews, clip items of interest, and compare products against one another in terms of pricing, energy savings, and specifications.
- As part of EmPOWER Maryland, five utilities – Baltimore Gas & Electric (BG&E), Delmarva Power, FirstEnergy, Pepco, and Southern Maryland Electric Cooperative (SMECO) – are piloting the platform and providing customers access to Dreamstreet via their websites.

Project Description

One in two offline purchases made today are first informed by online research. The same can be said for two in every three consumer electronic devices, and eight in every ten home appliances purchased. These are energy-impacting decisions.

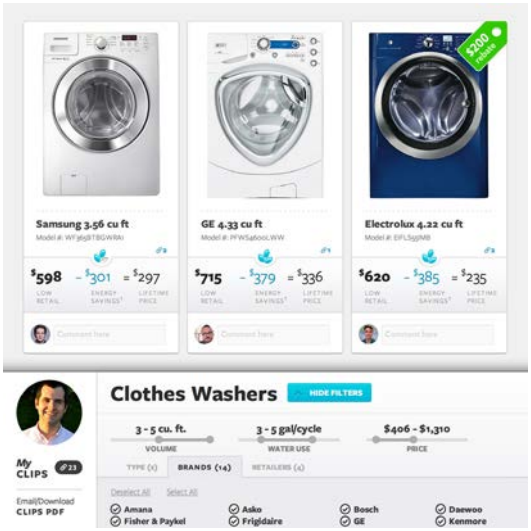
Dreamstreet provides electric utilities with a solution that actually mirrors the way customers make decisions—and one that helps push customers toward energy efficient purchases.

American Efficient's Dreamstreet is a first-of-its-kind, kayak.com-like web experience that is embedded within utility websites, customer web portals, and/or online bill pay solutions. Based on a customer's Zip Code, it enables customers to research and locate energy efficient products currently in stock at local stores, or online. Customers can learn how much they'll be saving by purchasing an energy efficient product as compared to a non-efficient product, find rebates, discover coupons, clip items, and even share products through social media. And, with smart grid data, Dreamstreet will be able to provide customized product recommendations to customers based on usage.

Dreamstreet features include:

- Search & Explore – Find energy efficient items that are in stock locally and online in real-time.
- Filters – Filter your results by level of efficiency, price, store, brand, and other features. Dreamstreet allows customers to filter along multiple parameters at the same time.

- Product Details – Check local and online availability of any product, compare prices across retailers, read reviews, find rebates, and dive into details.



As part of the EmPOWER Maryland initiative, the state's five utilities (BG&E, Delmarva Power, FirstEnergy, Pepco, and SMECO) have received approval from the Maryland Public Service Commission to launch the platform and begin providing customers access to Dreamstreet via their websites starting in November 2013.

By creating a customized energy efficiency shopping experience, Dreamstreet has the potential to expand utility energy efficiency programs in two important ways. First, using Dreamstreet's information and engagement technology platform, utilities can encourage their customers to make efficient product purchases at the information gathering stage—thus providing a new way to generate energy efficiency. Second, using the Dreamstreet platform, utilities are able to identify a clear point of influence on a specific customer product purchase before the purchase is made. This has a direct tie to calculating energy savings and improving net-to-gross ratios and the cost effectiveness of utility energy efficiency programs. In a nutshell, linking utility-provided information to actual customer purchase decisions could completely change the equation for measuring energy efficiency savings in a very positive way.

Project Contact

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Company Description

Based in Silicon Valley, American Efficient provides internet-based technologies and transactional solutions that encourage the purchase of sustainable products and services by consumers and businesses. The company is a charter member of the Institute for Electric Innovation's Partner Roundtable. Management includes repeat technology entrepreneurs whose products have served millions of customers in over 100 countries. We hail from institutions like MIT, Stanford, and the University of Pennsylvania.

Advisors include veterans of the energy and high technology sectors, including a Nobel Prize-winning academic, the former Chairman of the Colorado Public Utility Commission, the Director of the Precourt Energy Efficiency Center at Stanford University, the Executive Director of the Institute for Electric Innovation, and a founding member of Groupon. www.americanefficient.com.

DTE ENERGY COMPANY

ENERGY AWARENESS MOBILE APP

Technology Partner(s) - Vectorform

Project Highlights

- Mobile App that displays energy usage data
- Includes energy tips and projects, rewards, challenges, and community networking
- Anticipate 75,000 to 90,000 customers actively use app
- Supports behavioral change to be more energy efficient
- Anticipate 23,000 to 27,000 MWh saved annually
- Future opportunities for demand response, home automation, and home energy management

Project Description

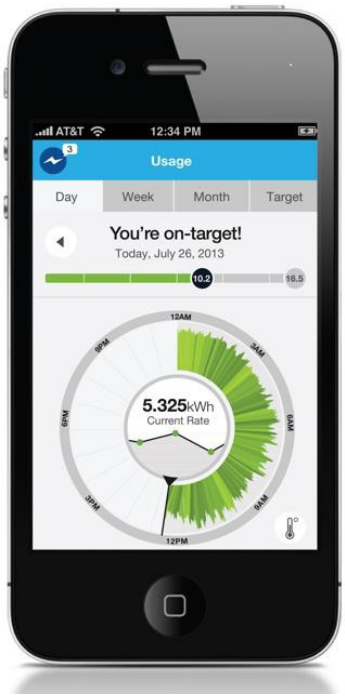
The DTE Energy Awareness mobile app is a first party digital lifestyle platform that engages users around discovering and improving their personal energy consumption, while providing DTE Energy with a next generation self-service channel that is rooted in positive customer touch points. With a unique blend of coaching, gamification, and social elements, it enables DTE customers to engage with their personal energy consumption and ultimately reduce their energy use.

Core features include:

- Dashboard that provides a coaching engine and bird's eye view of energy efficiency performance.
- Home profile survey of the customer's home and lifestyle that drive energy tips and home improvement projects.
- Electricity consumption patterns powered by Smart Meter data.
- Tools for researching ENERGY-STAR products, creating an Energy Bridge, and taking a Power Reading.
- Challenges provided weekly to incentivize energy efficient behavior through reward points.
- Natural gas consumption patterns powered by Smart Meter data (Future Phase).
- Community to connect to friends, build groups, and compare energy-saving performance and share encouragement.
- Rewards for performance, including online and retail goods and virtual avatar upgrades.

The application is still in development with early pilot testing to begin in December 2013. The goals for the project are to have 75,000 - 90,000 customers actively use the application to generate savings in the range of five to ten percent. If these goals were to be accomplished, the gross energy savings would be between 23,000 and 27,000 MWh.

Several phased rollouts are planned for 2014 to add features based on consumer feedback. In addition to verified energy savings, DTE anticipates increased customer engagement and satisfaction. The app may also serve as a platform for future in home energy management and demand response programs.



Project Contact

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Company Description

DTE Energy Co. (NYSE: DTE) is a diversified energy company involved in the development and management of energy-related businesses and services nationwide. Our largest operating subsidiaries are DTE Electric and DTE Gas. Together, these regulated utility companies provide electric and/or gas services to more than three million residential, business and industrial customers throughout Michigan. www.dteenergy.com.

ECOVA

A STRATEGIC APPROACH TO CUSTOMER ENGAGEMENT

Utility Partner(s) - Southern California Edison (SCE)

Project Highlights

- SCE program identifies need for more effective engagement between customers and utilities
- A new and simplified strategic energy management approach transforms big data into real value
- Streamlined participation leads to enhanced customer experience
- Sustainable energy savings are being delivered at an annual rate of two to thirty percent

Project Description

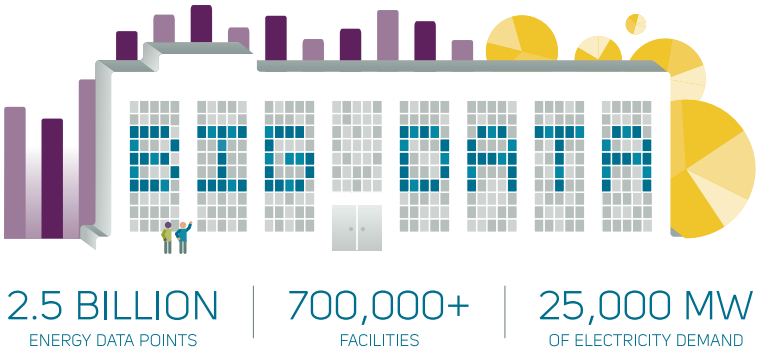
Strategic energy management (SEM) is a customer-centric approach to optimize value for hard-to-reach commercial customers. At Ecova, we have the unique advantage of providing energy services to over 700 commercial clients with 700,000 facilities and more than 40 utilities as part of their energy efficiency programs. We are engaged on both sides of the meter and have assembled the largest collection of big data in the industry. Today, Ecova can easily identify facility outliers for our commercial clients. We can quantify the operating cost savings from getting the outliers to average or best-in-class energy performance and present a compelling business case.

Why don't customers take action?

In 2010, we began work with Southern California Edison (SCE) on continuous energy improvement (CEI) to address behavior in this space. The program produced good behavioral energy savings through education and training and several engagements. One key finding was that the traditional utility approach to engaging commercial customers in utility programs does not work well – it is too complex. A utility customer sees a series of one-off transactions to participate in energy efficiency, demand response, renewables, and smart grid. Specifically, the energy efficiency options alone require a customer to navigate over 50 trade allies delivering more than 200 energy saving options. This is anything but simple for customers to sort through!

SEM offered a new approach to improve customer engagement. SEM is a holistic move toward energy use where the building and people within the organization are treated as a single system. We then apply a proven management system methodology based on continuous improvement and engagement of top management. SEM facilitates a collaborative engagement between the customer and utility to leverage the entire utility portfolio of services in a three-year plan, including

ECOVA BIG DATA WAREHOUSE



a systematic way to turn big data into real value. This comprehensive approach allows utilities to work with existing customers beyond a simple one-off retrofit. Similar to our successful approach with SCE, we use SEM to better align utility energy efficiency goals with their customer goals centered on the bottom line. By keeping customers informed about the favorable revenue impacts related to operational, capital, and asset management planning, the customer requirements are consolidated and participation is streamlined to enhance the customer experience and deliver sustainable energy savings of two to thirty percent annually.

Project Contact

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Company Description

Ecova is *the* total energy and sustainability management company whose sole purpose is to see more, save more, and sustain more for its clients. Using insights based on consumption, cost and carbon footprint data spanning thousands of utilities, hundreds of thousands of business sites and millions of households, Ecova provides fully managed, technology-optimized solutions for saving resources, which in turn increase returns, lower risks, and enhance reputations. Learn more today at www.Ecova.com.

INTELLIGENT ENERGY SOLUTIONS, LLC

COMPREHENSIVE ENERGY SAVINGS FOR RESIDENTIAL COMMUNITIES

Project Highlights

- IES is piloting a comprehensive end-to-end energy cost reduction program for a commercial property manager responsible for 45,000 residential and commercial facilities across 20 U.S. military bases
- Projected seven to ten percent reduction in annual energy consumption
- Stage One (completed Oct. 30, 2013) results indicate deployed programs achieved savings levels 50 percent above expected
- Intelligent Grid-edge platform optimizes energy resources and operational performance of building assets
- Cloud-based service is highly scalable and can be rapidly extended to properties throughout the portfolio

Project Description

Intelligent Energy Solutions (IES) is working with a commercial property manager who owns and manages an estimated 45,000 residential and commercial facilities spread across twenty U.S. military bases. The property manager is responsible for all costs associated with the operation and maintenance of these facilities, including energy consumption, demand, and the reliability of HVAC systems, water heaters, and refrigerators. The property manager faces the simultaneous challenges of reduced fees received from the U.S. Department of Defense (due to sequestration and cutbacks) and rising electric rates.

To address these challenges, the property manager is partnering with the U.S. Department of Energy in its Better Buildings Challenge to reduce the energy intensity 20 percent of its properties by 2020. To meet this goal, the property manager has engaged IES to manage a comprehensive energy cost reduction program including proactive management of energy capacity and peak demand levels, customer engagement, and assessment and identification of savings opportunities in asset life cycle costs through continued retrofits to existing structures, home energy audits, and installation of distributed renewable energy technologies. IES provides an end-to-end managed service assuming full responsibility for delivering to its customer's bottom-line energy savings results to meet agreed performance goals while improving resident comfort and satisfaction.

IES is currently proving the value and cost-effectiveness of their end-to-end service by implementing solutions at the lowest-energy-cost base in the property manager's portfolio. Based on the Stage One review of this engagement (completed October 30th, 2013) on the project is on track to deliver annualized consumption reductions of seven percent or greater. Actual savings delivered to date are 50 percent greater than expected based on previously deployed campaigns.

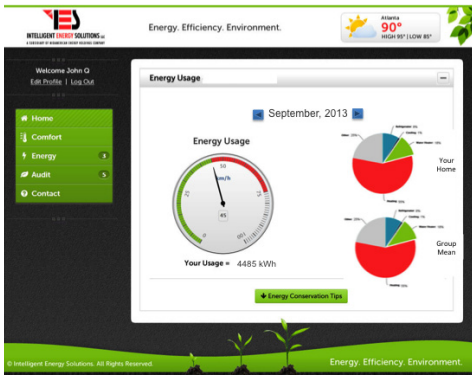
The strength of IES's solutions can be found in its integration of analytics and decision models operating within the unique architecture of its cloud-based real time service delivery platform.

IES uses real-time data analytics and models to audit and score each residence in several key areas, including the energy intensity of the facility, the thermal envelope of the building, and the operational energy performance of HVAC, water heater, and refrigeration systems. Results are used to identify opportunities for managing reductions in peak demand, set baselines, and prioritize repair/replacement and investments activities.

IES has launched education and awareness programs and provided tools to residents for managing set points and schedules for thermostats and water heaters. The plug-level data analytics used by IES to abstract run times, cycle times, thermal efficiencies, and operational performance of assets within these properties provides a knowledge-rich environment for decision and action. For example, the Residential Energy Dashboard offers a breakdown illustrating major sources of energy use and offering residents a comparison of their energy performance to that of an average neighbor. Unlike other energy management services, IES does not rely upon residents' actions to deliver savings; however, socializing these findings has been proven to accelerate the savings delivered by IES's automated, continuous commissioning, and optimization campaigns.

To coordinate the program's components, IES has also created IROMTM, a cloud-based transactive energy platform exercising learning algorithms to remotely manage and optimize the combined performance of in-building equipment, distributed generation, and storage. The adaptive intelligence of IROM operates continuously within properties, behind the scenes, to automatically synchronizing energy use decisions with grid and market conditions. IES's platform interconnects to sensors and controllers installed in residential and commercial buildings to produce and operate solutions for: capacity management, predictive peak management, critical peak demand response, distributed energy resources management, and energy efficiency optimization. The result is aggregated negawatts and clean capacity.

Residential Energy Dashboard



Project Contact

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Company Description

Formed in April 2013, IES delivers a turnkey, end-to-end managed service to its customers managing a portfolio of energy assets and distributed energy resource technologies to maximize the portfolio's overall performance by more efficiently operating individual energy assets inside the customer portfolio. www.intelligent-es.com.

OPOWER AND HONEYWELL

ENERGY EFFICIENCY THROUGH A SMARTER THERMOSTAT SOLUTION

Utility Partner(s) - Pacific Gas & Electric Company (PG&E)

Project Highlights

- PG&E has partnered with Opower and Honeywell to deliver a smart thermostat solution.
- 505 customers from East Bay and Central Valley are participating.
- Savings measured with most rigorous method – randomized control trial and billing analysis.
- Launched in June 2013. Results for pilot will be available mid-2014.
- Solution includes a Honeywell Wi-Fi-thermostat along with Opower's mobile and web applications.
- Customers receive mobile control of the thermostat and proactive energy saving advice.

Project Description

Opower, Honeywell, and PG&E have launched a Smart Thermostat Pilot program to provide customers mobile access to their heating and cooling systems via a Honeywell Wi-Fi Thermostat platform and Opower thermostat management software. The solution coaches customers to create optimal thermostat schedules that fit their lifestyles. The goal of the pilot is to gauge customer acceptance of and experience with the technology, as well as estimate the realistic energy savings for customers in PG&E's diverse service territory.

As connected thermostats become more prevalent, the utility industry is eager to identify both their energy efficiency and demand response potential. The Opower/Honeywell pilot is helping to provide answers on the energy efficiency potential by combining Honeywell's proven climate control technology with Opower's behavioral expertise in a consumer facing software solution. The Opower-designed mobile and web applications control Honeywell's thermostat, and provide real-time energy efficient feedback to customers for reducing heating and cooling costs by improving their thermostat settings. Also, the thermostat is programmed for energy savings (via the Opower solution) using efficient default set points before installation, which helps guide customers on the right path to efficiency from the onset.

For the pilot, 505 participants were recruited and given a professionally installed Honeywell VisionPRO thermostat at no charge, and asked to download the free Opower App that accesses the customer's energy usage data and controls their new thermostat. These customers were randomly assigned to receive the solution, while another group of customers were randomly denied the solution to create an unbiased control group. The methodology of utilizing randomized control

trials to measure the difference in energy usage between the customers who receive the solution and those who were denied the the thermostat has been successful for decades. Trial participants are PG&E customers in the East Bay and Central Valley, representing a broad range of climates and energy needs.

The results of this trial will not be made available until mid-2014, but initial findings on customer attitudes and engagement with the smart thermostat solution have been garnered. So far, customers are generally enthusiastic and pleased with the new solution. Nearly eight out of ten who responded said they thought they had reduced energy use as a result of the thermostat and messaging.

Project Contact

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Company Description

Opower, the global leader in customer engagement solutions, is transforming the way the world approaches household energy conservation. Opower combines a cloud-based platform, big data, and behavioral science to help utilities around the world reduce energy consumption and improve their relationship with their customers. This helps consumers lower their energy use and costs, and significantly reduces carbon emissions. Through its partnerships with 90 utilities across eight countries, Opower empowers 22 million customers to take control of their energy consumption. Founded in 2007 and privately held, Opower is headquartered in Arlington, Virginia, with offices in San Francisco, London, Singapore and Tokyo. For more information, please visit www.opower.com and follow us on Twitter at @Opower.

Honeywell is a Fortune 100 diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services; control technologies for buildings, homes and industry; turbochargers; and performance materials. Based in Morris Township, N.J., Honeywell's shares are traded on the New York, London, and Chicago Stock Exchanges.

With technology in more than 150 million homes, ten million buildings, and thousands of industrial sites around the world, Honeywell is a global leader in energy efficiency.

For more information, visit honeywellsmartgrid.com or follow @HoneywellGrid on Twitter.

PULSE ENERGY

ENERGY INTELLIGENCE FOR COMMERCIAL CUSTOMERS

Utility Partner(s) - BC Hydro

Project Highlights

- Over one third of all large commercial buildings in BC adopted the Continuous Optimization approach in the first three years.
- Early adopters of BC Hydro's PowerSmart program are showing ten to 25 percent savings in large commercial buildings. Program forecasts are calling for an eight to 12 percent average for these customers and we estimate savings of over 30 million kWh to date.
- As part of PowerSmart, Pulse Energy is engaged with every health care authority in the province, the three largest universities, and a significant portion of school districts.
- Hundreds of BC Hydro's small commercial customers are engaged in a pilot project with personalized, multi-channel communications, applying principles of behavior change theory and data-driven micromarketing. These vertical specific Energy Check reports are created through analyzing historical consumption data, and matched with actionable tips to save energy. Typical Pulse Check programs engage tens of thousands of small and medium enterprises (SMEs) using online and direct mail channels.

Project Description

Pulse Energy helps utilities to improve energy efficiency and customer satisfaction by enabling commercial and industrial (C&I) clients to better understand and manage their energy consumption. As part of BC Hydro's PowerSmart program, the firm has been working with BC Hydro to engage their C&I customer base since 2009, using its Energy Intelligence Software (EIS) to deliver actionable and targeted energy insight to enterprises of all sizes.

BC Hydro's PowerSmart program assists large commercial and portfolio building owners to retro-commission their buildings and help them maintain and continually improve energy efficiency – an approach called "Continuous Optimization". One key is the incorporation of utility sponsored EIS services to identify measures, provide continuous feedback on success, and ensure persistence of savings over time. Pulse Energy's unique Pulse™ Adaptive Model drives an innovative measurement and verification approach that determines efficiency savings at a whole building level.

As several cohorts of buildings have moved through the program phases, the results have been strong, with the program forecast calling for eight to 12 percent average usage reductions and early adopters of the program delivering ten to 25 percent savings.

Small and medium enterprise customers require a lighter-touch approach that provides quick, easy, and cost-effective engagement for a segment that has less time and budget for efficiency improvements. To serve this market, Pulse Energy and BC Hydro PowerSmart are using Pulse Check, a customer engagement application designed specifically for SMEs. Pulse Check collects, analyzes, and presents energy insight to users to drive energy savings through benchmarking and customized energy tips. Additional benefits are expected to include improved customer satisfaction, better relationships with SME customers, and an opportunity to promote relevant rebates and programs to specific customers. Applying principles of behavior change theory and data-driven micromarketing, Pulse Energy expect an average of 1.5 to three percent energy savings across program participants in the first year.

Key elements for this segment include:

- Using benchmarking to drive awareness by illustrating how SMEs compare to other businesses of the same type in the area.
- Empowering participants with actionable insight from personalized energy saving tips based on their own energy data and industry norms.
- Engaging users with an integrated multi-channel communications approach including email, web, and paper mailers, giving users different ways to learn about their energy use in a consistent, branded experience.

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Company Description

Founded in 2006, Pulse Energy helps utilities to improve energy efficiency and customer satisfaction by enabling commercial businesses to better understand and manage their energy use. A robust Energy Intelligence Software (EIS) solution, the Pulse Platform also provides utilities with insight on their customers, using advanced analytics built on the analysis of over one million commercial meters and a family of applications which engage these customers directly.

With Pulse, utilities are able to promote energy intelligence, support efficiency objectives, meet regulatory requirements and improve customer satisfaction. www.pulsenergy.com.

SIMPLE ENERGY

REAL-TIME COMMUNITY AND CUSTOMER ENGAGEMENT SAVES ENERGY

Utility Partner(s) - Delmarva Power, a Pepco Holdings Inc. Company

Project Highlights

- *Customer Engagement*: of the 6,700 residential customers in Simple Energy's select customer group, 30 percent activated online account.
- *Targeted Online Communication*: online only marketing approach allows for scalability and the ability to personalize customer messaging. Simple Energy delivered over 196,000 targeted emails to a select group of customers over the nine-month program period. Emails contained information about each customer's weekly energy use and progress in the Energy Challenge.
- *Email Open Rate*: 31 percent average
- *Community Focus:* $25,000 in prizes were awarded to participating Wilmington Schools

Project Description

Delmarva Power (Delmarva) is a subsidiary of Pepco Holdings, Inc. that provides electricity to 501,000 customers in Delaware and the Delmarva Peninsula. In 2012, Delmarva partnered with Simple Energy to launch the Delmarva Energy Challenge, a residential customer engagement and demand side management program. The program leverages Delmarva Power's smart grid investments to motivate customers and also provides a platform to promote utility messaging, utilizing emails and a web platform to present customers with information on their energy consumption and strategically targeted messaging to influence their behavior.

The program included two challenge components for saving energy: Individual and Community. The community challenge allowed users to "donate" their support and points to a participating Wilmington school; all were competing for the Grand Prize worth $10,000. In the individual challenge, users earned points, badges, and entries to win prizes (e.g. gift cards offered daily and iPads offered monthly) when they saved energy against their historic baseline or compared favorably to their neighbors.

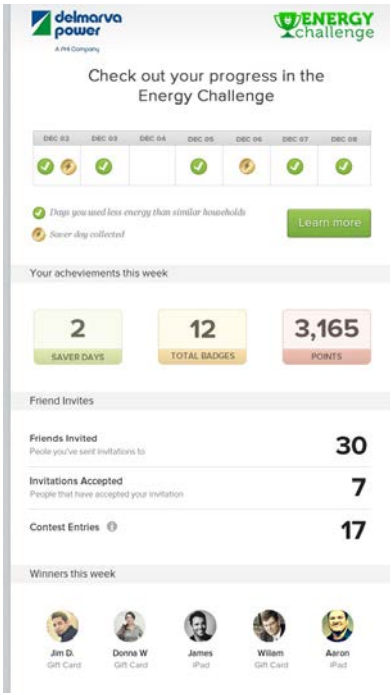
The program launched to eligible Delmarva customers on September 1, 2012. Eligible customers included those who live in Wilmington, DE; had smart meters; and were not participating in other Delmarva pilot programs. This yielded a pool of ~50,000 eligible customers.

To test Simple Energy's customer engagement, a group of 6,700 customers with known email addresses was identified from within the pool of eligible customers. On launch day, Simple Energy sent "Welcome and Tour" emails to a select customer group. Throughout the duration

of the project, this customer set continued to receive regular personalized, email communications with information about their energy usage and progress in the challenge.

As opposed to the traditional method of marketing behavioral energy efficiency programs with direct mail, the Delmarva Energy Challenge communicated exclusively online. Marketing utilized personalized email campaigns, community outreach, and social media activity such as Facebook and Twitter. Over the nine-month span of the program, Simple Energy delivered more than 196,000 targeted email messages to the selected group of 6,700 customers.

By the end of the challenge, $25,000 in prizes had been awarded to local schools. Of the 6,700 customers who had been receiving regular email communications, approximately 30 percent activated an account through Delmarva's website.



Weekly Energy Summary Email

Project Contact

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Company Description

Simple Energy uses social networks and game mechanics to motivate people to save energy, making saving energy easy, social, and fun. Working with utilities to leverage the Simple Energy Customer Engagement Platform, we engage customers to deliver measurable results with verifiable energy efficiency, manage demand, and leverage smart grid investment. By providing customers compelling motivation – leveraging leading behavioral science and game mechanics delivered on the technology platforms people use most – Simple Energy enables utilities to connect with customers where they already are: social networks, web, email, and mobile. utilities.simpleenergy.com.

Demand Response and Energy Management

Over the past few years, as a result of technology, pricing signals, and market rules, customer demand response has grown exponentially in wholesale markets and is starting to take-off in retail markets. Demand response is also being used to deliver flexibility for managing renewable energy resources. This chapter provides examples of demand response and energy management approaches that provide responsive, flexible resources to the power grid.

ARPA-E (AUTOGRID)

DEMAND RESPONSE OPTIMIZATION AND MANAGEMENT SYSTEM: UTILIZING EXISTING GRID ASSETS FOR MAXIMUM RETURNS

Utility Partner(s) - Oklahoma Gas & Electric (OG&E), City of Palo Alto Utilities (CPAU), Austin Energy

Project Highlights

- OG&E SmartHours Program
  - Providing real-time load forecasting, analytics, measurement & verification based on AMI data
  - 80,000 enrollees - largest market-to-market two-way residential DR program in the U.S.
- CPAU C&I Program
  - Muni was able to get their first C&I DR program up and running in under 30 days at 90 percent lower cost than traditional DR programs using software platform.
  - 1.2 MW shed and 3.5 MWh saved per peak event.
- Austin Energy Power Partners Program
  - Signaling to various types of thermostats and EV chargers through a unified dashboard
  - Bring Your Own Technology (BYOT) model increases customer satisfaction and participation
  - Up to 33 percent reduction in participant's HVAC load during peak events

Project Description

Through AutoGrid's Demand Response Optimization and Management System (DROMS™), utilities can leverage existing Advanced Meter Infrastructure (AMI) networks and Building Energy Management Systems (BEMS) to upgrade legacy programs, quickly and affordably implement new demand response (DR) programs, and manage entire portfolios through a unified dashboard that covers all devices, all customer segments, and all program types. DROMS™ is highly scalable, secure software that provides end-to-end DR, covering enrollment, forecasting, optimization, notifications, Direct Load Control (DLC), and real-time measurement and verification (M&V). The development of this technology was funded in part by DOE's Advanced Research Projects Agency – Energy (ARPA-e).

Oklahoma Gas and Electric (OG&E) SmartHours Program

Running the largest two-way communicating residential Demand Response program in the U.S., OG&E has over 80,000 customers enrolled in TOU and CPP programs with a target goal of 120,000 by 2014. Utilizing Silver Spring Networks' AMI, AutoGrid's DROMS™ forecasts peak loads and

reductions at the speed of one million forecasts every ten minutes, with hourly updates reflecting new AMI and weather data, improving OG&E's DR and peak dispatch. Customer segments are scored and feedback is immediately incorporated into program design to improve ROI. Same day M&V enables DR to become an integrated resource in generation planning.

City of Palo Alto Utilities C&I Program

A small muni with big customers, City of Palo Alto Utilities (CPAU) got their first DR program up and running in under 30 days due to the scalability and affordability offered by AutoGrid's cloud-based DROMS™ software. CPAU began their program with seven C&I customers including SAP, Xerox Parc, and the Veterans Hospital, representing 26 MW of a 180 MW total peak load. Leveraging interval meters and existing hardware in facilities, deployment costs were 90 percent less than a traditional DR program startup. Each facility agreed to reduce at least 50 kW up to 15 times a year in return for an incentive. CPAU is using DROMS™ to shed an average of 1.2 MW per event, or reduce 3.5 MWh of total energy per event. "AutoGrid played a critical role in our being able to implement a Demand Response program in Palo Alto," said Karla Dailey, CPAU Senior Resource Planner.

Austin Energy Power Partners Program

With the first DLC program to combine multiple thermostat brands with Electric Vehicle Supply Equipment (EVSE), including Electric Vehicle (EV) driver notifications and opt-in/opt-out capabilities, Austin Energy is offering residential customers the choice to BYOT – Bring Your Own Technology – without sacrificing reliability. Customers are able to choose between vendors, purchase through retail, and enroll self-installed thermostats in the program, increasing participation and satisfaction. Through the DROMS™ unified view dashboard, Austin Energy is able to signal across multiple technology brands to targeted customer segments and reliably forecast load shed on a per-device basis resulting in up to 33 percent reduction in a participant's HVAC load during a peak event.

Project Contact

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Company Description

AutoGrid has developed a highly scalable, cloud-based platform that brings the power of Big Data, predictive analytics and automated demand response to the grid. Serving utilities, grid operators, electricity retailers, ESCOs, and end-users, AutoGrid's tools analyze data generated by smart meters, voltage regulators, building management systems and other equipment along with historical and prospective usage patterns so suppliers and consumers can precisely monitor or change power consumption in real time safely, quickly and securely. www.auto-grid.com.

BALTIMORE GAS & ELECTRIC COMPANY

An Exelon Company

SMART ENERGY REWARDS℠

Technology Partner(s) - Honeywell, Opower

Project Highlights

- Peak Time Rebate program
- Customers automatically eligible upon installation of smart meter
- Launched July 2013
- 315,000 customers eligible in summer 2013
- Four events in 2013
- On average, 82 percent of eligible customers earned a credit in 2013
- Average credit earned was about $10 per event

Project Description

The BGE Smart Energy Rewards℠ program, which mirrors a four year pilot program, helps customers to evaluate their energy usage while helping them to control their electricity costs and increase their understanding of energy impacts on the electric grid and the environment. BGE developed the program to address customer and state concerns regarding rising energy consumption and costs. The program was offered to encourage customers to use less energy during summer peak hours, helping to reduce the need for additional power plants, and to keep down the overall cost of electricity, from where it otherwise would be, and ease the burden on Maryland's electricity delivery system. The straightforward program design includes robust price signals, comprehensive customer education components, and timely information to help customers become their own energy managers and reduce their energy consumption in the process.

BGE Smart Energy Rewards is a voluntary program that helps residential customers earn credits on summer electricity bills. In summer 2013, the program was available to BGE residential customers with smart meters installed before June 1. Customers automatically earn bill credits for voluntarily reducing their electricity usage from 1 pm to 7 pm on designated Energy Savings Days. For every kilowatt-hour saved compared to their typical usage on days with similar weather, customers earned a bill credit of $1.25.

On four separate occasions throughout the summer, BGE notified participating customers by email, text and/or phone call of an Energy Savings Day – a very hot summer day when demand for electricity was expected to be especially high. These notifications were sent out by Opower. Similarly, after an event, the following day, Opower sent notifications to customers showing the bill credit they had earned from their actions on the prior day. During the summer, 464,000 pre-event emails were sent and had an incredibly high 61 percent open rate. Over one million pre-event calls also were made.

Based on the four year pilot program, the expected average customer savings was $10 per event. As anticipated, the $10 savings per event was also experienced this summer and 82 percent of eligible customers earned a credit.

One of the reasons BGE Smart Energy Rewards was so successful was the extensive educational campaign both preceding the summer 2013 season and throughout its duration. Information was provided, both physically and electronically, to all customers well in advance of the summer, and customers were able to access information in a wide variety of mediums and locations.

In addition, there was no barrier by requiring customers to opt into the program. Customers did not need to indicate their intention to participate in advance and only had to make small changes in their energy usage in order to earn credits toward their bills. BGE residential customers did not have to go out of their way to participate in the program—they could simply make a conscious effort to make energy-saving changes in their home on Energy Savings Days, earning credits toward their bills. Those who did not want to participate could simply unsubscribe from receiving Energy Savings Day notifications. Starting in the summer of 2014, the majority of BGE residential customers, which total 1.2 million, will have smart meters and be able to participate in this program.

Project Contact

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Company Description

BGE, headquartered in Baltimore, is Maryland's largest gas and electric utility, delivering power to more than 1.2 million electric customers and more than 655,000 natural gas customers in central Maryland. The company's approximately 3,400 employees are committed to the safe and reliable delivery of gas and electricity, as well as enhanced energy management, conservation, environmental stewardship and community assistance. BGE is a subsidiary of Exelon Corporation (NYSE: EXC), the nation's leading competitive energy provider, with 2012 revenues of approximately $23.5 billion. www.bge.com.

BUILDINGIQ

COMMERCIAL BUILDING SMART ENERGY MANAGEMENT

Utility Partner(s) - NV Energy

Project Highlights

- BuildingIQ's automated demand response software lowered energy consumption and reduced peak-demand at NV Energy's Pearson Headquarters.
- BuildingIQ's software interfaced with the existing building management system at NV Energy's Pearson Headquarters building.
- NV Energy is now making the automated DR software solution available to its large commercial customers as part of the mPowered program.

Project Description

NV Energy's Pearson headquarters is a 270,000 square foot commercial facility located in a desert climate that can reach upwards of 120 degrees.

This building was the site for an energy efficiency pilot utilizing BuildingIQ's predictive energy management software, which offers an automated demand response (DR) solution for lowering energy consumption and reducing peak-demand. The project stakeholders agreed on a plan to optimize energy use while incorporating a number of DR parameters into the system settings. NV Energy chose to interface BuildingIQ into the existing building management system (BMS) at its headquarters, leveraging previous investments in the BMS and mechanical plant. This allowed BuildingIQ to use existing building data, weather forecasts, energy tariffs, and DR signals to make changes to building controls and optimize energy usage in real-time, without sacrificing occupant comfort. This solution did not require any new sensors or building data in order to be implemented.

NV Energy was so impressed with the BuildingIQ solution and the energy savings it produced within its own facility that it is now rolling out the program to its large commercial customers through the mPowered program.

By lowering the amount of energy customers consume during peak demand hours, utilities can reduce the burden on the power grid and eliminate the need for expensive new infrastructure. For this reason, utility companies, such as NV Energy provide financial incentives for reducing energy usage during peak demand hours. NV Energy's mPowered program is available to large NV Energy customers throughout its service territory.

Project Contact

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Company Description

BuildingIQ is a leading provider of advanced energy management software that actively predicts and manages HVAC loads in commercial buildings. As the only supplier of patent-pending Predictive Energy Optimization™ technology, BuildingIQ's cloud-based solution is powering energy and operational savings in buildings across the globe with reductions in HVAC energy costs by as much as 25 percent. By using variables such as weather forecasts, utility tariffs, building characteristics, occupant comfort and demand response events, its solution is able to make adjustments to building controls in real-time.

BuildingIQ's management team and advisors bring decades of valuable experience with technology and technology startups, energy management and commercial buildings. Their combined skill sets, track record and global networks put BuildingIQ in a unique position to achieve its mission. www.buildingiq.com.

COMVERGE

MASS MARKET DEMAND RESPONSE

Utility Partner(s) - Pepco Holdings, Inc. (PHI)

Project Highlights

- Comverge is responsible for implementing PHI's Energy Wise Rewards program, including marketing tactics, collateral materials to increase participation levels, administration and management of the enrollment process along with the integration of participant information with PHI's customer and billing systems, control device fulfillment, maintenance, repairs, and call center operations.
- Working together, Comverge and PHI have successfully deployed more than 260,000 intelligent energy management devices, including Comverge IntelliTEMP web programmable thermostats and IntelliPEAK digital control units.
- Program received the 2012 Platts Global Energy Award of Excellence.

Project Description

Pepco Holdings, Inc. (PHI) is one of the largest energy delivery companies in the Mid-Atlantic region, serving approximately two million customers in Delaware, the District of Columbia, Maryland, and New Jersey. Operating across multiple jurisdictions poses unique challenges. The EmPOWER Maryland Energy Efficiency Act of 2008, for example, requires Maryland's electric utilities to develop programs that achieve specified peak demand goals and a 15 percent reduction in electric energy demand by 2015. Similarly, New Jersey has a reduction goal of 20 percent by 2020, and the District of Columbia has a reduction goal of 15 percent by 2015.

To meet these state initiatives, PHI outlined an aggressive initiative of energy efficiency and demand response programs and weighed whether to undertake execution in-house by increasing staff levels or to collaborate with a vendor experienced with such programs. PHI's list of key considerations pointed to the need for a broad range of technical, commercial, and IT solutions as well as variable staffing levels to implement the programs. In 2009 PHI selected Comverge as its implementation partner for Energy Wise Rewards, a peak energy management program based on voluntary participation.

Energy Wise Rewards offers residential customers and businesses the opportunity to sign up to receive a web-programmable thermostat or outdoor switch that automatically cycles participating central air conditioners and heat pumps on selected days from June through September. These conservation periods, or Peak Savings Days, help balance the region's demand for electricity, and customers receive bill credits for participating. Program devices were installed in nearly 50 percent of eligible homes in the Pepco Maryland service territory, and PHI's direct load control

participation is currently fourth among U.S. utilities.

Partnering with Comverge, PHI has achieved significant successes, including reducing load by nearly 300 megawatts, receiving PJM revenue for capacity, opening five different markets, installing 260,000 control devices and counting, launching a commercial program and master meter program in Maryland, and receiving the 2012 Platts Global Energy Award of Excellence.

Project Contact

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Company Description

Comverge delivers a comprehensive suite of intelligent energy management solutions that enable utilities, grid operators, and commercial and industrial organizations to optimize their energy usage in order to reduce costs, meet regulatory requirements, and support sustainability initiatives. With 30 years of experience helping customers implement innovative Demand-Side Management programs, Comverge has deployed more than five and a half million energy management devices, recruited over one million residential customers into mass market demand response programs, and served thousands of commercial & industrial customers. www.comverge.com.

CONSOLIDATED EDISON COMPANY OF NEW YORK

SECURE INTEROPERABLE OPEN SMART GRID DEMONSTRATION PROJECT

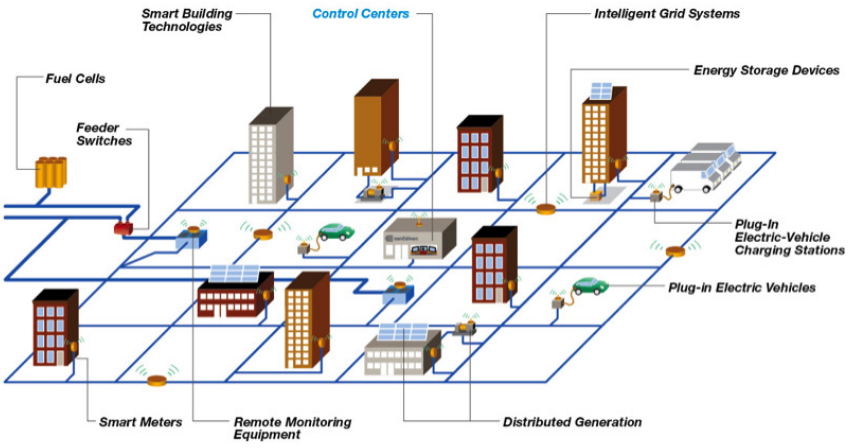
Technology Partner(s) - Green Charge Networks, Innoventive Power, New York City Economic Development Corporation, Siemens, TIBCO, Viridity Energy

Project Highlights

- Interoperable and cybersecure management of customer sited resources
- Mapped 24 of 64 underground networks in the visualization platform.
- Enables dispatch of roughly 700 distributed load relief assets for grid reliability
- Real time monitoring and validation of distributed resources
- Automated and seamless customer interface
- Demonstrates open standards and interoperability
- Demonstrates real time integration of 26 MW of customer sited resources

Project Description

The project demonstrates a scalable, cost-effective smart grid system prototype that promotes cyber security, reduces electricity demand and peak energy use, and increases reliability and energy efficiency. The total system will include renewable energy generation, grid monitoring, electric vehicle charging stations, and consumer systems that will help expand the use of renewable energy and lead to greater consumer participation in the electricity system. This project demonstrates integration of building management systems, distributed storage, photovoltaics, advanced metering infrastructures and electric vehicle charging.



On the utility side, the project demonstrates risk management methods to improve the efficiency of operation, new dashboard technology for control center operators, an intelligent maintenance system, and more. One of the major objectives of this project is to utilize a demand response command center to aggregate multiple DR resources at retail electric customer sites to supply critical services, under tariff-based and market-based programs, to the electric distribution company and to the New York Independent System Operator (NYISO).

This project is being conducted in New York City. A very high density service territory, this area includes critical customers such as the Federal Reserve, Wall Street, major communications hubs, and major medical facilities. With 86 percent of the Con Ed distribution system underground and a load density (MW/sq mi) that is 20 times the national average, this project will serve as a blueprint for high density, urban, underground networks. The total budget for this project is more than $92 million, including a federal share of more than $45 million. The project is a Smart Grid Demonstration Program as part of the 2009 American Recovery and Reinvestment Act (ARRA). A key partner is Orange and Rockland Utilities, Inc.

Project Contact

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Company Description

Consolidated Edison, Inc. is one of the nation's largest investor-owned energy companies, with approximately $12 billion in annual revenues and $42 billion in assets. The company provides a wide range of energy-related products and services to its customers through its two regulated utility subsidiaries and its three competitive energy businesses. For additional financial, operations and customer service information, visit Consolidated Edison, Inc.'s website at www.conedison.com.

ENBALA

POWERSHIFT ATLANTIC: RELIABLE WIND INTEGRATION THROUGH A NETWORK OF DEMAND-SIDE LOADS

Utility Partner(s) - New Brunswick Power

Project Highlights

- ENBALA and New Brunswick Power have partnered to reliably integrate intermittent wind generation
- ENBALA intelligently aggregates MWs captured from real-time, power usage shifts within a network of process loads operated by commercial and industrial facilities
- New Brunswick Power utilizes this consolidated "operational flexibility" as a single, dispatchable resource to help integrate wind
- Through a real-time connection to a virtual power plant (VPP), ENBALA's network of demand-side loads is providing real-time balance of electricity supply and demand to New Brunswick without impacting daily operations of participating customers

Project Description

Wind blows in abundance in the Maritime region of eastern Canada, producing a valuable source of energy that is both clean and renewable. The Maritime region has the potential to have the highest penetration of installed wind capacity in the country over the next 15 years. However, the integration of wind power into a power system can be complex. Utilities and grid operators are faced with the challenge of balancing the generation mix in real-time and continually meeting customer demand. Because wind is sporadic and unpredictable by nature, new solutions are required to reliably integrate wind energy into the power system.

Launched in 2010 as a Clean Energy Fund project through National Resources Canada, Powershift Atlantic is a collaborative research initiative led by New Brunswick Power, a provincial utility with 294 MW of wind power in its generation mix. New Brunswick Power selected ENBALA Power Networks to be a part of a reliable and efficient solution to wind integration.

In line with the utility's aim to engage their customers in their wind integration project, ENBALA looks to the demand side to deliver the flexibility required to manage intermittent wind.

ENBALA's GOFlex™ platform delivers grid operational flexibility to New Brunswick Power by continuously connecting to both a network of commercial and industrial loads and a virtual power plant (VPP) that consistently monitors energy generation and consumption and sends out signals to ENBALA and other aggregators based on wind activity and demand on the power system. ENBALA's wind integration solution taps into the "operational flexibility" inherent in demand-side loads, which is the amount large customers can shift and vary their power usage within defined operating parameters. ENBALA forecasts which loads can balance changes in wind and how much power shifting is currently available. The flexibility of connected customers' power use is then aggregated and utilized to balance the fluctuations in wind generation. Viewed as a single, dispatchable resource by New Brunswick Power, this network of demand-side loads is able to continuously follow changes in wind, providing real-time balancing services without impacting the day-to-day operations of participating customers.

ENBALA is the first company in Canada to connect and intelligently manage loads to balance the intermittency of wind power. New Brunswick Power and ENBALA are playing an important role in accelerating the successful adoption of renewable energy while providing innovative green initiatives for commercial and industrial customers.

Project Contact

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Company Description

ENBALA Power Networks is a smart grid technology company that provides innovative solutions to utilities and system operators that address many operational challenges emerging in today's increasingly complex power systems. ENBALA's versatile GOFlex™ platform (which stands for grid operational flexibility) continuously connects a network of commercial and industrial electricity users to deliver on-going, real-time value to grid operators and to electricity customers. The platform offers a widespread set of solutions that improve generator efficiency, reliably integrate renewable generation resources and defer infrastructure upgrades to reduce operating costs and to enhance overall system efficiency. For more information, visit www.enbala.com.

ENERGATE

FIRSTENERGY SMART-GRID MODERNIZATION INITIATIVE

Utility Partner(s) - FirstEnergy

Project Highlights

- FirstEnergy is one of the nation's largest investor-owned electric systems, serving six million customers in the Midwest and Mid-Atlantic regions.
- Smart-grid initiative leverages smart meters with Energate utility software and in-home technology through a peak-time rebate program.
- Energate thermostats delivered an average of 50 percent peak-load reduction and good customer reviews.

Project Description

In 2011, FirstEnergy began a two-phase, smart-grid and residential demand response initiative for selected consumers in The Illuminating Company northeast Ohio service area. Among other things, this initiative tests the value and performance of load-control devices, in-home displays and energy education in a peak-time rebate program.

A key objective is to offer peak-time rebates to customers who reduce their energy consumption. This reduction is measured against an established baseline determined during Phase One of the program. Parameters of the study include the demand reduction capabilities of different combinations of in-home technology and peak-time rebates.

In the first phase of FirstEnergy's pilot program, smart meters were deployed to approximately 5,000 homes within The Illuminating Company service area. About 290 customers opted not to participate in the program and received no smart meter. The enrolled customers participated through designated groups.

FirstEnergy conducted 15 planned peak-time events in the first program year, during which customers were encouraged to reduce their electric consumption. Customers were informed of these events through technologies such as smart thermostats and in-home displays as well as through other messaging systems such as text or email. All pilot participants were offered a peak-time rebate of $0.40 per kWh saved during each event. Customers also could opt out of the event. As this first phase concluded, FirstEnergy engaged Shelton Group to conduct an attitudinal study of the pilot program participants.

During Phase One, Energate's Pioneer Smart Thermostat and PowerTab In-Home Display (IHD) was used to engage and educate consumers and deliver significant and verifiable peak-load reduction. Phase Two, which commences on June 1, 2014 through August 31, 2014, includes

load control switches and additional technologies for up to 39,000 homes. The devices communicate over the Itron OpenWay AMI system and Itron OpenWay ZigBee meters using Energate Load Management Software and CORE Middleware.

Energate's Consumer Connected Demand Response™ (CCDR) is a comprehensive suite of hardware and software solutions that bridge the gap between utilities and consumers. It does so by providing utilities with an advanced load management system that offers insight into energy consumption patterns of its customers and the ability to control peak demand. CCDR also provides consumers with ZigBee-enabled smart thermostats, load-control switches, in-home displays, web portals and mobile apps to help them make informed energy consumption choices through smart-energy programs designed by utilities.

Specifically, CCDR enables utilities to intelligently reduce electric loads during peak usage periods, utilizing two-way demand response communications over AMI and broadband connections. Energate's proven AMI interoperability and portfolio of in-home devices enable utilities to deliver immediate demand response benefits while offering a future-proof solution set as the Smart Grid continues to be built out globally.

Through the Itron OpenWay AMI system, Energate CCDR software delivers two-way, verifiable results. Phase One demonstrated a clear demand reduction benefit to providing in-home technology in addition to education. This benefit is backed up by data from a survey completed by a third party. Beyond the savings from smart thermostats, survey results show that the majority of those surveyed have increased their understanding of peak power usage. Consumers with a Pioneer or PowerTab were twice as likely to follow the tips and suggestions found in the educational materials.

FirstEnergy is one of the more than 43 utilities that have Energate's devices in homes across North America.

Project Contact

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Company Description

Energate is the leader in Consumer Demand Response Solutions for utilities and their residential customers. The company provides home energy management solutions including software, portals, mobile applications, and wireless devices such as gateways, smart thermostats, load control switches, and consumer energy displays. Energate's standards-based open Consumer Connected Demand Response (CCDR) platform allows utilities to immediately address residential demand and empowers consumers to more effectively manage energy use. Energate solutions leverage the Smart Grid to mitigate supply and demand challenges, increase the use of renewables, and utilize dynamic rate structures. www.energateinc.com.

ENERNOC

AGRICULTURAL DEMAND RESPONSE WITH PACIFICORP

Utility Partner(s) - PacifiCorp / Rocky Mountain Power

Project Highlights

- PacifiCorp selected EnerNOC to deliver up to 185 MW of DR for ten years.
- Program transitioned from tariff-based to third-party managed DR program with customers receiving incentive payments for their actual capacity availability.
- Upgraded technology platform provides real-time visibility into energy consumption, contributions to load reduction, and control of irrigation sites.
- PacifiCorp improved program performance by aligning customer incentives with the utility's need, dramatically increasing realization rates.

Project Description

Demand response (DR) resources deliver valuable capacity to the grid while simultaneously enabling utilities to deliver substantial value to their commercial, industrial, and institutional customers. PacifiCorp and its operating companies have long been leaders in utility demand response, with decades of experience managing large-scale DR programs. One prominent example is Rocky Mountain Power's Irrigation Load Control (ILC) program, which has operated since the early 1980s. While participation has been high, with close to 300 MW of peak demand enrolled in the program in Idaho and Utah, estimates of realization rates at times of system peak were variable, and often less than 50 percent. Interested in improving program performance and cost-effectiveness while reliably meeting customer energy requirements, PacifiCorp decided to take a new path forward – partnering with a third party to implement and manage the next generation of its ILC program.

In 2012, PacifiCorp selected EnerNOC through a competitive bid process for a ten-year contract to provide an irrigation control technology platform and deliver approximately 185 MW of electric reduction capability in Idaho and Utah. The PacifiCorp contract with EnerNOC represents one of the largest outsourced demand response programs in North America, and serves as an informative case study of the opportunities and challenges associated with transitioning a tariff-based program to a third-party managed program.

Under the updated ILC program, new monitoring devices have been installed at participating irrigation sites to ensure reliable communications and real-time visibility into energy consumption, with five-minute interval data available to participants and to the utility. Through this technology platform, irrigators can use a web-based portal to monitor the operations of their pumps from any computer or smartphone. Importantly, the utility also has granular, real-time

data to determine participant contributions to overall load reduction during a DR event. Program design changes better aligned incentives, allowing PacifiCorp to pay for capacity based on actual availability, an improvement over the structure in prior years where the tariff compensated participants for enrollment, regardless of event performance or availability. All of these enhancements have helped PacifiCorp achieve the goals of reducing cost and improving program performance by narrowing the gap between paid capacity and actual event performance. Working in partnership with PacifiCorp, EnerNOC enabled more than 1,500 irrigation pumps with this updated technology platform between March and July of 2013, representing more than 150 MW of peak capacity.

Project Contact

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Company Description

EnerNOC (NASDAQ: ENOC) is changing the way the world uses energy. EnerNOC's goal is to make energy management as integral as accounting to the operation of every organization. EnerNOC helps commercial, institutional, and industrial organizations use energy more intelligently, pay less for it, and generate cash flow that benefits the bottom line through a complete suite of technology-enabled energy management solutions.

EnerNOC's Utility Solutions team has partnered with hundreds of utilities and grid operators worldwide to meet their demand-side management objectives. EnerNOC partners with leading utilities to deliver custom-tailored demand response and energy efficiency programs designed to maximize both cost-effectiveness and customer satisfaction within the commercial, industrial, and agricultural market segments. EnerNOC also supports a broad range of utility demand-side management activities, including potential assessments, program design and administration, load research, technology demonstrations, measurement and evaluation, and regulatory support. www.enernoc.com.

IDAHO POWER

AMI DEPLOYMENT AND CUSTOMER ENGAGEMENT

Technology Partner(s) - Aclara, GE, Itron, Landis+Gyr

Project Highlights

- Deployed more than 500,000 smart meters
- Support customer energy management with fully functional web interface
- Read system-wide voltage several times daily
- Installed more than 34,000 direct load control devices on air conditioners and irrigation pumps
- Customers can compare energy rate options using their historic time of use data
- Integrated smart meters with outage-management systems

Project Description

In 2011, Idaho Power completed a three-year deployment of the Aclara two-way automated communication system (TWACS) in conjunction with an investment in 470,000 Landis+Gyr residential smart meters and 38,000 GE commercial smart meters. The system is integrated with the Itron Enterprise Edition meter data management system (MDMS) and Aclara's customer user advisory tool web software.

Customer Portal for viewing and analyzing energy use data on the Idaho Power website.

Idaho Power uses this suite of systems to manage incoming data from smart meters and provide customers with the ability to view and analyze their detailed energy use, and evaluate rate options based on historic time-of-use. Customers can also choose to participate in a number of direct load control demand-side management options. To date, over 34,000 direct load control devices have been installed at customer sites, providing 45 MW of available demand

response resources. The company can call for up to 60 hours of AC cycling events per summer season with a typical peak load reduction of 37 to 39 MW.

In addition to providing customers with energy usage insights, Idaho Power leverages historic hourly energy use for all endpoints and voltage data to support load analysis and a number of distribution enhancements such as improved distribution transformer sizing, improved voltage regulation, and improved troubleshooting of power quality issues. By integrating meter data with outage management data Idaho Power can determine the exact scope of outages, provide enhanced response to system issues, confirm power restoration, and improve reliability.

One of the next steps for Idaho Power is deploying meters with internal disconnect switches to a select group of customers with repeat connects and disconnects in an effort to enhance service and reduce operating costs.

Project Contact

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Company Description

Idaho Power, headquartered in Boise, Idaho, and locally operated since 1916, is an electric utility that employs more than 2,000 people who serve more than 500,000 customers throughout a 24,000-square-mile area in southern Idaho and eastern Oregon. With 17 low-cost hydroelectric projects as the core of its diverse generation portfolio, Idaho Power's residential, business and agricultural customers pay among the nation's lowest rates for electricity. IDACORP, Inc. (NYSE: IDA), Idaho Power's independent publicly traded parent company, is also headquartered in Boise, Idaho. To learn more, visit www.idahopower.com or www.idacorpinc.com.

OKLAHOMA GAS & ELECTRIC

SMARTHOURS®

Technology Partner(s) - Corix, Energate, Silver Spring Networks, The Structure Group

Project Highlights

- Completed smart meter deployment to more than 823,000 customers
- Signed up over 80,000 SmartHours customers thru October 2013
- Acquired 123 megawatt load reduction capability thru October 2013
- Delivered average bill savings of about $190 per participating residential customer in Oklahoma in 2012
- Helped 99 percent of participating customers in Oklahoma save money in 2012

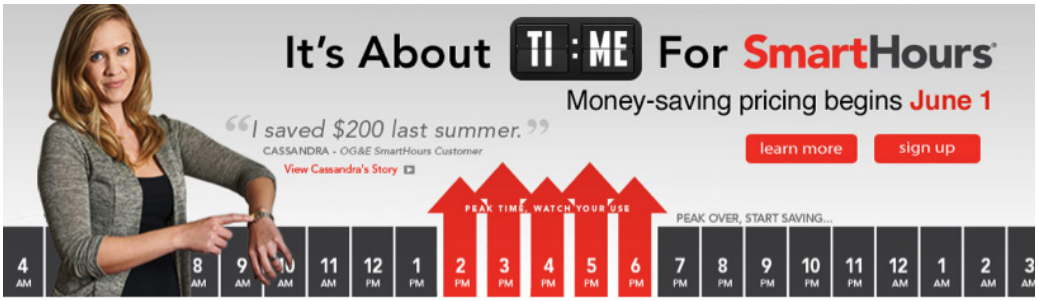
Project Description

In 2012, OG&E completed a three-year installation of more than 823,000 smart meters throughout its service area and launched myOGEpower, a free online tool that allows customers to see their energy use and costs in great detail.

OG&E also partnered with Energate, Silver Spring Networks, Corix, and other collaborators and began offering SmartHours, a voluntary time-based pricing program that helps enrolled customers save money during the summer months by shifting their peak energy use, typically from 2 pm to 7 pm on weekdays, to off-peak hours. Customers receive advance notice the day before a high-priced day so they can proactively manage their energy use on a time-of-day basis through a variety of means, including Energate's programmable communicating thermostat (PCT) that provides customers the flexibility to set their preferences for cost and comfort. The shift in energy to off-peak hours is helping OG&E achieve its target of over 200 megawatts of annual peak load reduction by the end of 2014.

As of October 2013 more than 80,000 customers in Oklahoma and Arkansas have participated in the SmartHours program, resulting in over 120 MW of demand reduction capability for OG&E. Customer savings information is not available yet for 2013, but in 2012, more than 99 percent of Oklahoma customers saved money, with residential customers saving an average of about $190 per participating household.

Used together, myOGEpower and SmartHours help customers save more on their electric bills and help OG&E reduce peak demand.



Project Contact

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Company Description

OG&E is a subsidiary of OGE Energy Corp. (NYSE: OGE), and serves more than 800,000 customers in a service territory spanning 30,000 square miles in Oklahoma and western Arkansas. www.oge.com.

PEPCO HOLDINGS, INC.

PEAK ENERGY SAVINGS CREDIT

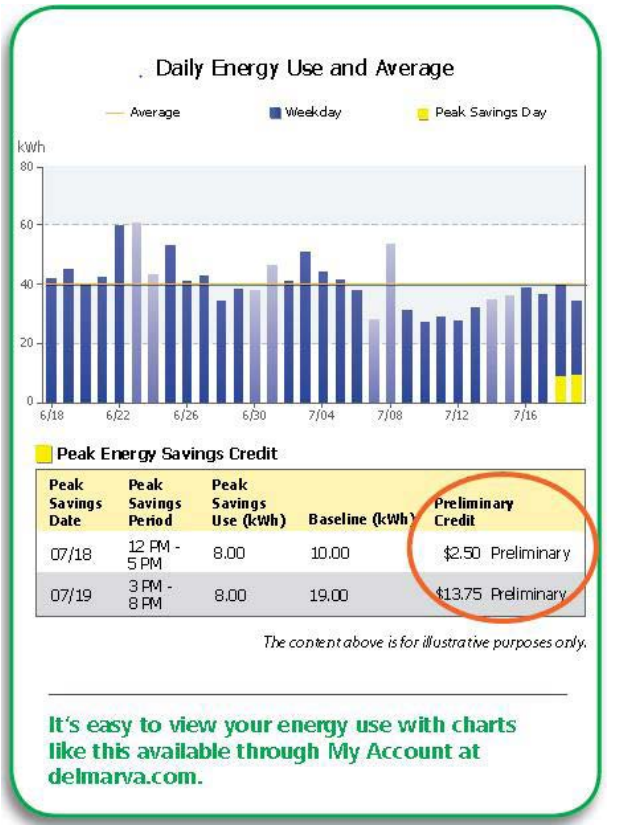
Technology Partner(s) - Aclara, IBM, Itron, Silver Spring Networks

Project Highlights

- Launched Peak Energy Savings program, a critical peak rebate pricing program in the Maryland and Delaware service areas in 2013.
- Over 600,000 customers (about 80 percent of those eligible) participated in four events this summer.
- Participating customers saved over 3.5 million kWh of electricity.
- Customers earned approximately $4.5 million in bill credits.

Project Description

Wanting to take advantage of the untapped opportunity for conservation by residential customers, PHI took on an innovative approach to demand response programs. Enabled by smart meters, PHI's Peak Energy Savings Credit program provides customers in the Pepco Maryland and Delmarva Power Delaware service areas opportunities to reduce their energy use for a few hours during peak usage days in order to earn credits on their bill. Customers choose two of three methods (voicemail, email or SMS text) to be notified of a peak event. Notifications occur the night before the event and participation in the program is voluntary. The only requirement is that the customer has a smart meter.



Participating customers take various measures such as turning off lights, delaying running the dishwasher, delaying laundry, and adjusting their thermostats to reduce usage. Those that

reduce usage enough earn credits at a rate of $1.25 per kWh saved. Customers can view their average usage online prior to the event (based on the same hours as the event), as well as check their consumption and preliminary credit after the event.

In the summer of 2013, four events were called and 600,000 customers participated, saving over 3.5 million kWh of electricity and earning $4.5 million in bill credits.

As the program matures and customers learn how to make conservation activities work for their unique situations, Pepco and Delmarva Power Delaware expect to see an increase in both the volume of customers participating as well as credits earned.

Project Contact

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Company Description

Pepco Holdings, Inc. is one of the largest energy delivery companies in the Mid-Atlantic region, serving about two million customers in Delaware, the District of Columbia, Maryland and New Jersey. PHI subsidiaries Pepco, Delmarva Power and Atlantic City Electric provide regulated electricity service; Delmarva Power also provides natural gas service. PHI also provides energy efficiency and renewable energy services through Pepco Energy Services. www.pepcoholdings.com.

THINKECO

CUSTOMER-DRIVEN DEMAND RESPONSE

Utility Partner(s) - Consolidated Edison Company of New York (Con Edison)

Project Highlights

- coolNYC is a Public Service Commission approved demand response pilot to peak-shave more than six million room ACs (RACs) in Con Edison's service territory.
- RACs are aggregated into a central DR platform using the modlet smartAC kit, which was jointly developed by Con Edison & ThinkEco.
- As of YE2012, the average demand reduction for coolNYC DR events was 24.25 percent, with an average RAC load of 1,116 W, demonstrating significant peak demand shaving.
- Very high year-over-year program retention rates have been observed due to high customer satisfaction.
- Positive total resource cost (TRC) test results were demonstrated for all years coolNYC has been implemented.
- coolNYC was the recipient of the 2013 Association of Energy Service Professionals awards for "Residential Program Design" and "Pricing and Demand Response," and the 2012 Peak Load Management Alliance award in Innovative Marketing.
- Expanding application of the ThinkEco modlet smartAC technology to assist with grid operations

Project Description

ThinkEco has partnered with Con Edison since 2010, working with its R&D and energy efficiency groups. At Con Edison's request, ThinkEco developed a custom demand-response product (called the modlet smartAC) for use with room air conditioning units (RACs), so that the utility could access some of NYC's 6+ million RACs and remotely cycle them during times of peak demand. For end consumers, the ThinkEco modlet smartAC solution is a do-it-yourself product that lets them control their RACs from their smartphone and check on their room temperature from anywhere. In this way, the modlet smartAC solution provides value to both the utility and the end consumer.

After the modlet smartAC was developed, ThinkEco served as Con Edison's implementation contractor to launch the product into the market as a residential demand response (DR) pilot. ThinkEco provided a full suite of services: marketing and recruitment, fulfillment and logistics, customer service, demand response implementation, project management, and measurement and verification (M&V). The program was named coolNYC.

In 2011, the pilot program spanned 500 RACs. In 2012, the program was expanded to 10,000 RACs after the New York State Public Service Commission (PSC) approved an expanded budget based on 2011 M&V data and a positive TRC. In 2013, the program was again approved by the PSC to double in size, based on 2012 TRCs.

As desired, coolNYC successfully distributed 10,000 units in NYC in 2012, with a heavy emphasis on Brooklyn and Manhattan. Five DR events were conducted in 2011; four in 2012. The average demand reduction across all nine events was 24.25 percent, with an average RAC load of 1,116W, demonstrating significant peak demand shaving. In addition, 95 percent of surveyed customers cited that they wanted to participate in coolNYC the following year, indicating very high customer satisfaction.

In 2013, CoolNYC was recognized by the Association of Energy Service Professionals (Residential Program Design, and Pricing and Demand Response), following on the heels of its 2012 Peak Load Management Alliance award in Innovative Marketing.

ThinkEco and Con Edison are expanding application of the ThinkEco modlet smartAC technology to assist with grid operations. By monitoring the load on pole-top transformers and doing more targeted DR using the modlet smartAC in corresponding customer homes, the hope is to demonstrate over the coming summer that (a) grid operations can be improved in certain neighborhoods, and (b) faster power status verification can be enabled in the event of an outage.

Because modlets are essentially affordable plug-level meters with load control capabilities, and the Con Edison territory has few smart meters installed, ThinkEco and Con Edison believe that there is potential to use modlets to make the grid smarter and enhance grid reliability within Con Edison neighborhoods. For this reason, Con Edison refers to this project as the Smart Block Study.

Project Contact

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Company Description

ThinkEco (New York, NY) offers a patented, cloud-based energy efficiency and demand response platform to utilities. In addition to offering turn-key program management services, ThinkEco conducts custom R&D projects that bring big data and internet-of-things capabilities to its utility partners, in order to provide unique, cost effective services for their respective markets. www.thinkecoinc.com.

WISCONSIN PUBLIC SERVICE

ADVANCED METERING INFRASTRUCTURE AND ENERGY OPTIMIZATION

Technology Partner(s) - Aclara, Cooper Power Systems

Project Highlights

- Installed advanced metering infrastructure (AMI) meters to 450,000 electric customers in 2005
- Greatly expanded use of AMI investment beyond meter reading since implementation.
- Enrolled 18 to 20 percent of customer load in demand response programs
- Demand response (DR) rate offerings include: time-of-use, critical peak pricing, and direct load control
- Provide eight to nine percent of MISO-area interruptible demand

Project Description

Wisconsin Public Service (WPS) was an early adopter of using new technology in reading electric meters. WPS completed an advanced metering infrastructure (AMI) network deployment in 2005, providing AMI capable meters to 450,000 electric customers. At this time in the utility industry, this was considered an automated meter reading (AMR) project, as the industry had not yet defined AMI. Today this system is operating as an AMI system and is an example of how an innovative project can transform how customers manage and use electricity.

Examples of the expanse of this technology beyond the meter reading function includes: daily reads, hourly data, detection of metering inaccuracies, energy diversion, efficient management of meter assets, net metering analytics, back office system use of AMI data, outage management system (OMS) response, meter diagnostics, and customer usage analytics.

By utilizing the current AMI system, rate structures, and demand response programs, WPS has achieved reductions in peak demand and overall end-use consumption. Although WPS constitutes two to 2.5 percent of the Midwest ISO (MISO) load, WPS currently is responsible for approximately eight to nine percent of MISO's interruptible demand due to innovative rates and positive relationships with its industrial customers.

WPS demand response programs have approximately 18 to 20 percent of customer load participating in demand response programs including critical peak pricing (CPP), interruptible and direct load control (DLC) programs. WPS has had CPP rates in place for residential and C&I customers for some time and currently has over 200 customers participating in CPP rates and expects this to continue to grow. WPS also has over 24,000 customers participating in a

DLC program. The CPP rates that have been implemented to-date are tariffs with fixed CPP price levels with CPP hours ranging from 50 hours for residential to 300 hours for C&I customers.

Today, WPS has over 20,000 customers participating in various time-of-use rates. The use of the hourly AMI data and customer web portals provide WPS customers with more information to help them decide whether to participate in dynamic pricing options.

With the combination of technology and rate offerings WPS is transforming how customers manage and use electricity.

Project Contact

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Company Description

Wisconsin Public Service is a regulated electric and natural gas utility that has been serving customers with safe and reliable energy since 1883. Currently, we serve 443,000 electric customers and 321,000 natural gas customers in Northeast and Central Wisconsin and an adjacent portion of Upper Michigan. www.wisconsinpublicservice.com.

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The Edison Foundation

INSTITUTE for
ELECTRIC INNOVATION

The Edison Foundation Institute for Electric Innovation focuses on advancing the adoption and application of new technologies that will strengthen and transform the power grid. The Institute's members are the investor-owned electric utilities that represent about 70 percent of the U.S. electric power industry. The membership is committed to an affordable, reliable, secure, and clean energy future.

The Edison Foundation Institute for Electric Innovation promotes the sharing of information, ideas, and experiences among regulators, policymakers, technology companies, thought leaders, and the electric power industry. It also identifies policies that support the business case for the adoption of cost-effective technologies.

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