SMUD's SmartSacramento:

A Clean Technology Pioneer

Institute for Energy and the Environment
Vermont Law School

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Smart Grid Case Study Series – Case 3

June 2012

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SMART GRID PROJECT OVERVIEW

The United States electric transmission and distribution system is on the verge of a transformation to a smart electric grid. At the center of this evolution is the introduction of new technology at the customer meter as well as the distribution and transmission system level. Unsurprisingly, the introduction of this new technology has presented new legal, policy, and regulatory challenges for state and federal regulators. The federal government has added additional momentum to this technological evolution by making a smart electric grid a central component of the US clean energy agenda and awarding $3.4 billion in smart grid investment grants to utilities and other entities as part of the American Recovery and Reinvestment Act.

THE SMART GRID CASE STUDIES SERIES

Vermont Law School's Institute for Energy and the Environment Smart Grid Project was initiated in 2010 through joint funding of the United States Department of Energy, with the support of Vermont Congressman Peter Welch, and Vermont Law School. Utilizing case study analysis of smart grid program implementation, the research project is examining the question: what legal, regulatory, and other policy changes can best ensure that Smart Grid implementation in the U.S. improves reliability, enhances consumer value, and meets our clean energy goals?

PROJECT FOCUS 2012 AND BEYOND

FERC Chairman John Wellinghoff has noted that climate change and a smart electric grid are both key issues for the energy industry and the federal government, but rarely are these two issues linked in policy debates. The focus of the Institute for Energy and Environment's Smart Grid Project is to help better define this important link, and to promote smart policies that benefit both the climate and the electric grid. Research such as that conducted by Pacific Northwest National Laboratory (PNNL) and the Electric Power Research Institute have identified that a smarter grid is likely to be a significantly greener grid, which could lead to significant reductions in both energy usage and carbon emissions. PNNL's research suggests that a Smart Grid can lead to a 12% reduction in carbon emissions alone by 2030. Building on our case study research during the second phase of our project, we are producing up to five Smart Grid policy reports. These reports will examine best practices, lessons learned, and policy issues related to:

Our Smart Grid Case Study Series Includes:

- ✓ Central Vermont Public Service (Vermont)
- ✓ Commonwealth Edison (Illinois)
- ✓ Pecan Street Project (Texas)
- ✓ Sacramento Municipal Utility District (California)
- ✓ Salt River Project (Arizona)
- ✓ San Diego Gas and Electric (California)

- Legal and regulatory challenges to Smart Grid implementation, including customer data privacy;
- Integration of electric vehicles into the grid;
- Supercharging efficiency and expanding demand response;
- Integration of clean distributed generation and storage; and
- Distribution optimization and conservation voltage reduction.

More about the Institute's Smart Grid Project is available at: www.vermontlaw.edu/smartgrid

INTRODUCTION

The federal government allocated $4.5 billion in federal economic stimulus funds for Smart Grid development though the American Recovery and Reinvestment Act (ARRA). The Smart Grid is an electrical grid in which information about behavior and use of electricity on the consumer and supplier level is organized to promote more reliable and efficient services. The Energy Independence and Security Act defines the Smart Grid as the "modernization of the nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth."[1] In addition, the Smart Grid has been adopted as a way to protect the environment by increasing energy efficiency and limiting climate change. The Smart Grid's technological improvements are expected to reduce energy consumption, avert the need to build more power plants, and create a more reliable and secure electricity infrastructure to meet future energy growth.

The Sacramento Municipal Utility District (SMUD) is one of a number of utilities developing a Smart Grid program. In 2009, SMUD received $127.5 million from the Department of Energy to support its Smart Grid efforts. SMUD has been applying this grant to its $308 million Smart Grid investment, "SmartSacramento®,"[2] which includes a joint venture with community partners who are the California State University at Sacramento, the State Department of General Services, the County of Sacramento, the Sacramento City Unified School District, Elk Grove Unified School

[1] Title XIII of the Energy Independence and Security Act of 2007 (EISA)

[2] ® A service mark of Sacramento Municipal Utility District.

District, and the Los Rios Community College District. This paper presents a case study of SMUD's Smart Grid programs, namely "SmartSacramento." The SmartSacramento project encourages customers to be part of the energy solution. It involves enhanced technology infrastructure, Advanced Metering Infrastructure (AMI), distribution automation, demand response, customer applications such as web access to energy usage and analysis, a consumer behavior (pricing) study, cyber security, and partner projects. These various projects started in 2009 and are projected to be completed by 2014. However, the SmartSacramento project is just one of SMUD's initiatives that leverages Smart Grid, energy efficiency, and clean technology efforts.[3]

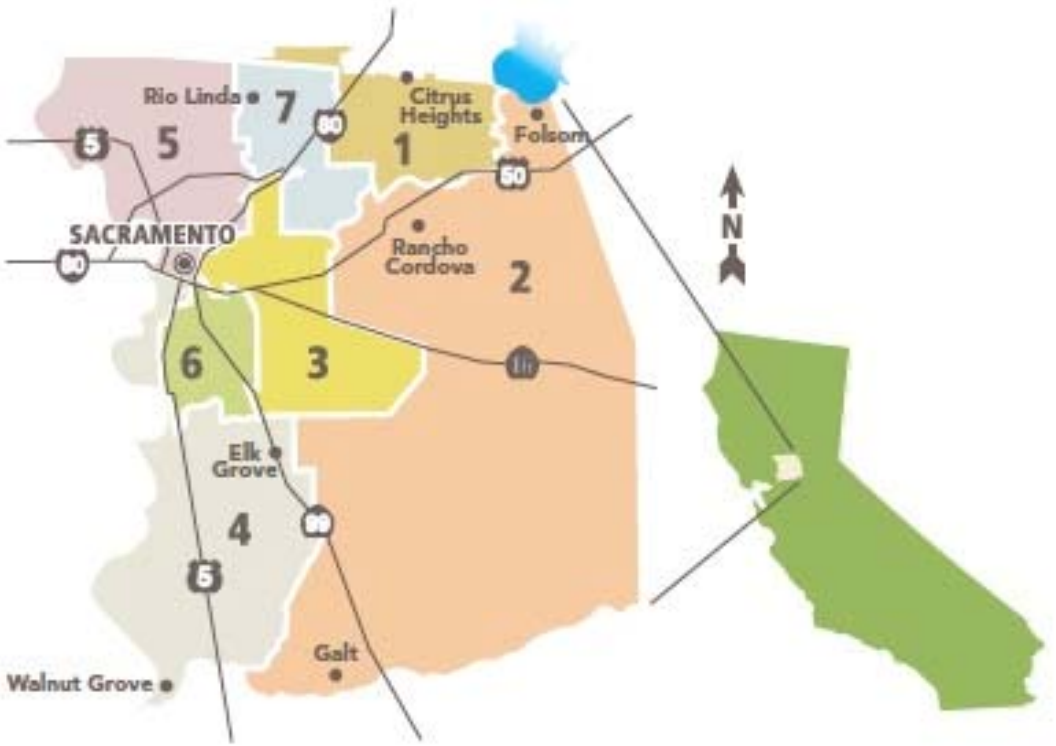
BACKGROUND ON THE SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD)

SMUD is a community-owned, not-for-profit electric utility that has provided public power throughout Sacramento since 1946.[4] It has an elected Board of Directors (Board) that does not report to a city council and is owned by its customers. The Board has exclusive legal authority to establish the rates and rules for electricity customers within its service territory.[5]

[3] While the title of this case study references SMUD's SmartSacramento a number of SMUD's related Smart Grid and clean energy initiatives are discussed throughout the report.

[4] Sacramento County residents originally voted to establish SMUD in 1923 as a customer-owned utility, but due to legal controversy with Pacific Gas & Electric Company of San Francisco, it did not start providing power for two decades. Additionally, it needed to build an organization of engineers, electricians, managers and office workers to take over Sacramento's old electric system before supplying electricity to Sacramento customers. www.smud.org/en/about/Pages/history-1940s.aspx, last visited June 15, 2011.

[5] http://www.smud.org/en/about/documents/reports-pdfs/draft-time-based-electricity-and-smart-grid.pdf



SMUD's Service Territory Source: SMUD

SMUD is the sixth largest community-owned electric utility in the United States (U.S.) and second largest in California. It employs 2,036 people.[6] SMUD currently serves 529,695 residential customers and 68,510 business customers in a service area with a total population of about 1.4 million. SMUD encompasses a 900-square mile service territory in Sacramento, Placer and Yolo Counties.

SMUD generates electricity using a diverse array of sources. SMUD owns a 500 megawatt (MW) natural gas combined cycle power plant and three natural gas fired co-generation facilities that make up approximately 50% (2010) of its total production. SMUD runs its hydroelectric plants for providing peak demand, which make up about 14% (2010) of its generation. In addition, SMUD has actively supported renewable energy and distributed generation development

[6] SMUD's company profile, SMUD website, https://www.smud.org/en/about-smud/company-information/company-profile.htm, last visited January 20, 2012

to serve its customers as part of its goal to reduce its greenhouse gas emissions to 10% of its 1990 level by 2050.[7]

SMUD promotes renewable energy and energy efficiency.[8] It has pioneered green technology and its energy efficiency and renewable energy programs are recognized nationally for their leadership and innovation. In 2008, SMUD adopted a goal to procure 33% renewable power by 2020 before it was mandatory for all California electric utilities.[9] SMUD was also the only large utility that met the previous 20% renewable goal by 2010 using eligible resources under the current California Energy Commission Renewable Portfolio Standards Eligibility Guidebook. It has 102 MW of wind-powered facilities and 35 MW of photovoltaic generating facilities. These renewable energy sources generate almost 3% (2010) of SMUD's energy output with the remaining renewable energy supplied by Power Purchase Agreements. Thus, SMUD's total energy from renewable energy sources in 2010 was approximately 24%.[10]

SMUD's policies focus on serving the community. For example, its vision is to "empower its customers with solutions and options that increase energy efficiency, protect the environment,

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[7] Timothy N. Tutt, SMUD's Government Affairs Representative, presenting SMUD's comments regarding implementing the proposed goal of 12,000 MW of clean local distributed generation (DG) using Smart Grid solutions to the California Energy Commission, July 20, 2011; http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/comments/SMUD_comments_TN-61471.pdf, last visited August 10, 2011

[8] SMUD's energy efficiency programs have already resulted in customer savings of more than $550 million over the last 35 years.

[9] SMUD comments on "Renewable Power in California: Status and Issues," October 5, 2011, http://www.energy.ca.gov/2011_energypolicy/documents/2011-09-14_workshop/comments/SMUD_Comments_on_Draft_Renewable_Power_in_California_TN-62550.pdf, last visited January 18th, 2012

[10] *Id.*

reduce global warming and lower the cost to serve its region."[11] SMUD provides its customers with information and other useful tools to keep down their electricity bills. It also sets competitive rates, which are typically below neighboring utility rates.

OVERVIEW OF SMUD'S SMART GRID PROGRAMS

SMUD is transitioning to a Smart Grid in order to give customers more flexibility and choice in their electricity use while also meeting the organization's environmental goals. SMUD received a $127.5 million Smart Grid Investment Grant (SGIG) from the Department of Energy through ARRA to advance Smart Grid implementation. The award is one of the 10 largest in the nation. The contract was signed on April 23, 2010, and has a total budget of $307,697,792. Hence, SMUD is charged with implementing almost $308 million worth of projects. This amount was 63% of the SGIG money allotted to all California electric utilities. SMUD's initial phase of the Smart Grid program, focused on installing a functional AMI (e.g. Smart Meters), is expected to be fully deployed by the end of the first quarter of 2012. The rest of the projects are projected to be completed by 2014.

CONSUMER-OWNED PERSPECTIVE

SMUD is considered one of the most progressive of the mid-sized utilities in the U.S.[12] because of its focus on promoting renewable energy and energy efficiency, and on developing the Smart Grid. "Energy efficiency is the most cost-effective way for SMUD and Sacramento to move

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[11] http://www.smud.org/en/about/Pages/index.aspx; http://www.smartgridnews.com/artman/publish/Video-Education-and-Information/Smart-grid-implementation-at-SMUD-3304.html November 23, 2010 presentation

[12] Many "clean technology" websites have highlighted SMUD's focus on clean technology, such as Pike Research, CleanTech Market Intelligence, http://www.pikeresearch.com/blog/articles/will-utilities-such-as-smud-develop-microgrid-models-for-the-developing-world, last accessed, June 30, 2011

beyond carbon."[13] SMUD expects to be the first utility to meet the state's clean power mandate, while also exceeding California's energy efficiency mandate. SMUD expects that its Smart Grid program will improve the grid and help meet the clean power and energy efficiency goals.

SMUD plans to use multiple strategies simultaneously to achieve these goals. It is installing smart meters; focusing on consumer behavior through pricing programs, surveys, focus groups and communication with customers; and automating portions of its distribution system. In addition, it is improving technological infrastructure by installing a state-of-the-art demand response management system, implementing innovative demand response programs which leverage the new Smart Grid infrastructure, conducting research and development through several pilot programs, and addressing cyber security issues. SMUD is focused on supporting its smart-grid initiatives through implementing a comprehensive customer relationship management system that integrates directly with its billing system.

SMUD developed its Smart Grid programs based on a vision of a regional solution that will integrate smart meters and home area networks with upstream, automated distribution operations. To improve system reliability and efficiency SMUD plans to optimize distribution system operations. Further, it will enable its customers to fully participate in the electricity marketplace through dynamic pricing and demand response programs.[14]

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[13] SMUD's 2008 Annual Report

[14] Jim Parks' Presentation to the CPUC Smart Grid Workshop; March 18, 2010; "Smart Grid Implementation at the Sacramento Municipal Utility District;"http://www.cpuc.ca.gov/NR/rdonlyres/D25C3103-D534-4F19-B267-823FD40C9C20/0/CPUCWorkshop31810SMUDParks2.pdf

ORGANIZATION OF PROGRAMS

Through its Smart Grid program, SMUD plans to reduce greenhouse gas emissions to 10% of 1990 levels by 2050.[15] It will achieve this objective by assuring a reliable, diverse power supply through its Smart Grid programs. SMUD's funded Smart Grid projects include:

1) AMI and smart meters
2) Consumer behavior study and dynamic pricing
3) Demand response management system and programs
4) Distribution system improvements and automation
5) Technology Infrastructure
6) Customer Applications (partner projects)
7) Cyber Security

SMUD received other grants promoting the Smart Grid through ARRA, including "Smart Grid Demonstrations — Storage for Grid Support." This initiative awards a sub-grant to Premium Power for two battery systems to demonstrate the integration of photovoltaics (PV) and energy storage into Smart Grid applications.[16] In addition, SMUD plans to develop infrastructure standards for plug in hybrid electric vehicles (PHEVs) that charge off-peak and feed electricity back to the grid during peak periods. SMUD will also test the effectiveness of battery storage and power management products. Another project, the "PV and Energy Storage for Smart Grids," develops tools modeling a distribution system into Smart Grid applications. SMUD is developing its Smart Grid through various approaches and has received funding and other support to plan and implement related initiatives.

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[15] *Id.*

[16] SMUD and the American Recovery and Reinvestment Act of 2009, http://www.smud.org/en/about/grants/Pages/default.aspx, last visited June 20, 2011

The Smart Grid research and development (R&D) budget is $42.9 million, bringing the total Smart Grid budget to over $350 million. Additional R&D projects include a micro-grid demonstration, residential information and controls pilot, smart controls in multifamily projects, and dairy digesters. The R&D demonstrations will test the capabilities, costs, and benefits of emerging technologies and will lay the foundation for future Smart Grid deployments.

PROGRAM MANAGEMENT AND DEVELOPMENT

In 2008, SMUD's Board of Directors resolved to adopt a Smart Grid policy. The staff needed the approval of the Board prior to investing in new technology. SMUD recognized the importance of working with its customers and partnering with local organizations.[17]

SMUD has partnered with six public agencies in its service territory to implement a portion of the Smart Grid grant as sub-recipients. These partners include Los Rios Community College District (LRCCD), the California Department of General Services (DGS), Sacramento City Unified School District, the County of Sacramento, Elk Grove Unified School District, and California State University at Sacramento (CSUS). Energy management systems will be installed or updated with advanced controls, the capability to monitor electricity use, the ability to identify buildings that use excessive energy, and the ability to reduce peak loads. These partners will enable energy management systems to respond to automated demand response (Auto DR) events to reduce peak loads. In addition to its formal sub-recipients, SMUD met with equipment and software vendors to assess the available technology, and to test equipment in order to determine which equipment to deploy.

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[17] Jim Parks I 4 Energy Presentation, November 2010; http://www.youtube.com/watch?v=RyKVm078cJ4&feature=player_embedded, last visited July 20, 2011

SMUD's Smart Grid program and its partnerships are managed by a Smart Grid manager who implements SMUD's plan with the focus on ARRA projects through 2014. The manager will develop a strategic plan to guide the program beyond 2014. A major focus of the plan is customer communications and customer experience before, during, and after the implementation of Smart Grid. SMUD will use brochures, media, an online presence, and presentations; it will assign staff specifically to address customer concerns about smart meters.

Moreover, SMUD has also collaborated with the Electric Power Research Institute (EPRI) on its "SmartSacramento" demonstration project. The two have worked together on demonstrations and a host-site project integrating distributed generation and Smart Grid development.[18] Finally, California and SMUD's pioneering leadership in clean technology positioned SMUD particularly well to be a successful leader in Smart Grid technology.

ESTIMATED COSTS

SMUD estimates that it will cost $307.7 million to implement all of the projects involved in its SmartSacramento program.[19] This figure includes not only investment in technology, but also accompanying behavioral and consumer studies.[20] In addition to the ARRA funding allotted to SMUD by the Department of Energy to develop various Smart Grid solutions in Sacramento, SMUD

[18] In August 2011, SMUD has become the 12th host site project in EPRI's smart grid demonstration initiative.

[19] Jim Parks' Presentation to the CPUC Smart Grid Workshop; March 18, 2010; "Smart Grid Implementation at the Sacramento Municipal Utility District;"http://www.cpuc.ca.gov/NR/rdonlyres/D25C3103-D534-4F19-B267-823FD40C9C20/0/CPUCWorkshop31810SMUDParks2.pdf

[20] Communication with SMUD's Smart Grid Core Team; April 1, 2011

received an $19.2 million in ARRA and California Energy Commission grants to partially fund $42.9 million in Smart Grid-related research and develop demonstration projects.[21]

SMUD'S SMART GRID ROADMAP: SEVEN KEY PROJECTS

SMART METERS AND ADVANCED METERING INFRASTRUCTURE (AMI)

Initially, SMUD focused on installing Advanced Metering Infrastructure (AMI), primarily smart meters. SMUD identified smart meters as the first step toward a Smart Grid, connecting SMUD to its customers by integrating the delivery and consumption of electricity using two-way wireless communications.[22] Smart meters collect and store a customer's electricity usage data at regular intervals. The customer's data is then securely transmitted to a local collection point. The collection point securely transmits the data to SMUD. SMUD then uses the information to bill the customer and provide energy usage data online. The two-way communication between a customer's home and the utility enables SMUD to explore pricing that varies by season and time of day.[23]

Installing AMI will significantly improve SMUD's knowledge of circuit-specific conditions. The smart meters will reduce SMUD's operating costs and improve reliability. Because customers

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[21] Communication with SMUD's Smart Grid Core Team, February 14, 2012, updating the data from published presentation by Timothy N. Tutt, SMUD's Government Affairs Representative, commenting on SMUD's implementation of the proposed goal of 12,000 MW of clean local distributed generation (DG) using Smart Grid solutions to the California Energy Commission, July 20, 2011; http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/comments/SMUD_comments_TN-61471.pdf, last visited August 10, 2011

[22] Public Utility Regulatory Policies Act of 1978 as Amended by the Energy Independence and Security Act of 2007: Staff Report and Proposed Board Determination on the Information on Time-Based Electricity Prices and Sources of Power Standard Smart Grid Information;

[23] SMUD's General Manager's Report and Recommendation on Rates and Services: SmartSacramento® Pricing Pilot, April 7, 2011, Volume 2; https://www.smud.org/en/about-smud/company-information/document-library/documents/GMRateReport-Vol2-04-07-11.pdf

will be able to see their usage by hour online, customers will be easily informed and capable of making decisions based on the costs of their energy consumption. SMUD focuses on the potential of customer data and information to empower customers to make choices about consumption. This Smart Grid project coincides well with SMUD's community-based structure and mission.

SMUD makes a compelling business case for AMI because more than $9,000,000 annually prior to AMI was spent on meter reading. By installing meters that can communicate wirelessly, SMUD anticipates significant financial savings. In addition, SMUD predicts other benefits from AMI. AMI enables time-differentiated rates and critical peak pricing opportunities and makes demand response possible through automatic or remote control of appliances and equipment. AMI facilitates loading information and automation along the entire supply chain.

SMUD's implementation of AMI calls for the installation of approximately 615,000 new smart meters for all customers by the first quarter of 2012.[24] To date, SMUD has installed 610,000.[25] SMUD completed a 78,000 meter pilot project in 2010, installing selected Silver Spring Networks, Inc. and Landis + Gyr meters.

As of January 2012, approximately 98% of the customer meters had been replaced with smart meters. The remaining 2% are expected to be replaced by March 2012. SMUD's communication network is 100% complete. SMUD's rollout of its wireless smart meter technology

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[24] Jaspal Deol, P.E, Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, SmartSacramento® presentation, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

[25] As of January 31, 2012; Jaspal Deol, P.E. Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, SmartSacramento® presentation, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

received little criticism, generating very few customer complaints, all of which SMUD responded to quickly. Importantly, more than 95% of customers were satisfied with the installation as of December of 2011.[26]

As SMUD develops its system, customers will be able to go online and see detailed information about their energy use, manage demand response events, and make adjustments as desired using their cell phone or computer. SMUD sends each customer a letter and brochure before the smart meter is installed so that the customer understands the change. To avoid adding burdensome responsibility to the customer, SMUD does not require customers to do anything, except remove barriers to access, so customers need not be home for the meter installation. The meter programming and back-office features can be used remotely through wireless communication technologies.

SMUD is training its employees and board members to be available to customers for smart meter presentations. Since October 2009, SMUD has given 116 customer presentations and 71 internal employee presentations.[27] SMUD presents to city councils and county boards of supervisors, individual elected officials and their staff, community planning councils, social civic clubs, chambers of commerce, and neighborhood associations. SMUD is making a big effort to ensure that customer service, transparency, and understanding are priorities in its Smart Grid program.

SMUD's Board adopted a policy to allow smart meter opt-outs for those few customers (less than 0.4%) who have expressed concern about the possible privacy and health issues

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26 *Id.*

27 *Id.*

associated with installing wireless AMI devices on their homes. SMUD charges a fee to customers who opt out so it can recover the incremental costs related to opting out like meter reading. SMUD does not want its customers to subsidize the alternative metering solution for the opt-out customers. Customers who opt-out may not realize the many benefits of smart meters like time of use rate options and customer programs that are available only to customers who have wireless smart meters.[28]

CONSUMER BEHAVIOR STUDY AND DYNAMIC PRICING

SMUD is a customer-owned public utility. Its policies focus on serving the community, setting competitive rates below published rates, and educating its customers about how to keep down their electricity bills. "Maintaining competitive rates is a core value of SMUD."[29] In responding to customer needs, SMUD is providing customer education and new tools to manage energy usage information while making usage more transparent and giving customers more control. Along these lines, SMUD is partnering with customers to make them part of the energy solution by helping them reduce peak load, and improve energy efficiency.

SMUD has budgeted about $13 million for a Consumer Behavior Study; the final cost will depend on the ultimate scope of the study. This study will evaluate the impacts of time-based rates, enabling technologies, and recruitment treatments on energy consumption and peak

[28] *Id.*

[29] Draft Staff Report and Proposed Board Determination on the Rate Design Modifications to Promote Energy Efficiency Investments Standard; https://www.smud.org/en/about-smud/company-information/document-library/documents/draft-rate-design-mod-EE-invest-standard.pdf, last visited January 20, 2012

demand.[30] The study will take place from June 2012 through September 2013, with interim evaluation reporting in April 2013 and final evaluation reporting in January 2014. It uses the same methodology as the 2009 Residential Summer Solutions Study, which tested the use of dynamic pricing and communicating thermostats in the small commercial sector. The 2009 study showed 20% energy savings and bill savings of 25%.[31] This customer behavior study will be used to "develop strategies for rate design, provide information on real-time use display, measure satisfaction by demographics, and measure value for the consumer and SMUD."[32] Seven randomly chosen groups of residential customers were offered one of seven equipment and rate configuration treatments. SMUD will use the results of this study, consisting of a sample frame of approximately 57,000 residential customers,[33] to statistically measure the capability of the equipment and rate configurations to reduce electricity use, reduce peak demand, and determine the likelihood of participation by demographic.

SMUD currently uses a two-tier residential rate structure designed to encourage conservation based on its "inclining block rates,"[34] which increase as usage increases. The more Kilowatt-hours used, the higher the rate. The rates vary by seasons as well. Layered on top of

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[30] Consumer Behavior Study, Sacramento Municipal Utility District, SmartSacramento®, U.S. Department of Energy, April 2011; http://www.smartgrid.gov/sites/default/files/pdfs/cbs/smud-cbs-description-final_0.pdf

[31] Karen Herter, SMUD's Residential Summer Solutions Study; 8/26/2011, http://eetd-seminars.lbl.gov/seminar/smud%E2%80%99s-residential-summer-solutions-study , last visited January 20th, 2012

[32] Jaspal Deol, P.E, Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

[33] Consumer Behavior Study, Sacramento Municipal Utility District, SmartSacramento®, U.S. Department of Energy, April 2011; http://www.smartgrid.gov/sites/default/files/pdfs/cbs/smud-cbs-description-final_0.pdf

[34] Draft Staff Report and Proposed Board Determination on the Rate Design Modifications to Promote Energy Efficiency Investments Standard; https://www.smud.org/en/about-smud/company-information/document-library/documents/draft-rate-design-mod-EE-invest-standard.pdf, last visited January 20, 2012

these rates, SMUD adds a Rate Stabilization Fund surcharge of about 1/4-cent per kilowatt-hour that is applied during low hydro years. SMUD's rates are designed to achieve goals ranging from linking the marginal cost of when energy is used to rates, reducing use during peak times, and encouraging energy efficiency and conservation. SMUD's rates are designed to "offer flexibility and options to customers, be simple and easy to understand, meet needs of customers with fixed low incomes and severe medical conditions, and equitably allocate costs across customer classes."[35]

DEMAND RESPONSE/ENERGY EFFICIENCY

SMUD is developing demand response resources to meet its integrated resource planning goals and to fulfill resource procurement and operational requirements. SMUD has allotted $15 million to demand response over a three-year period and approximately $35 million per year to energy efficiency. It will install a Demand Response Management System to serve as the common platform for all demand response activities. The new system will support both price-based and incentive-based demand response programs. It will integrate with many of SMUD's other business systems such as AMI, Customer Information System, Meter Data Management System, Geographic Information System (GIS), and energy operations center. As part of the DOE grant, SMUD will install up to 1,800 Home Area Network (HAN) devices and encourage homes and businesses to participate in direct load management programs. The Customer Applications component of SmartSacramento will equip approximately 900 homes with HAN.[36]

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[35] *Id.*

[36] Communication with SMUD's Smart Grid Core Team, April 5, 2012.

SMUD will expand its current demand response portfolio, which consists of programs that have provided as much as 8% peak load reduction capability.[37] It will also integrate new renewable resources and help manage larger percentages of distributed generation. SMUD believes that offering customers a variety of demand response programs and automating demand response will provide customers with tools to manage their bills, reduce system peak, and respond to dynamic pricing.

SMUD will design and deliver programs for medium and large commercial customers to automatically respond using Open ADR communication protocols tied to their energy management systems. These programs would include both price-based and incentive-based offerings. SMUD would provide medium and large commercial customers with technical assistance to modify their technology so it can automatically respond to signals from SMUD to reduce load. SMUD is also integrating demand response and energy efficiency by connecting automated demand response technology and Open ADR to energy efficiency programs for commercial customer energy management systems and advanced lighting technologies.

DISTRIBUTION SYSTEM IMPROVEMENTS AND AUTOMATION

SMUD will install automated controls throughout the distribution system to improve system efficiency, reduce operations and maintenance costs, and improve reliability by reducing

[37] Timothy N. Tutt, SMUD's Government Affairs Representative, presenting SMUD's comments regarding implementing the proposed goal of 12,000 MW of clean local distributed generation (DG) using Smart Grid solutions to the California Energy Commission, July 20, 2011; http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/comments/SMUD_comments_TN-61471.pdf, last visited August 10, 2011

the duration of outages by 20-25%.[38] In SMUD's comments to the California Energy Commission, Timothy Tutt, SMUD's Government Affairs Representative, stated: "The primary mission for our distribution system is keeping the lights on for our customers in a manner that leads the industry in safety, reliability and customer service."[39]

SMUD plans to spend $58.2 million on distribution automation. It will upgrade aging infrastructure by replacing electro-mechanical relays with digital relays at many medium voltage substations. SMUD plans to use Smart Grid technology in its distribution system to enable advanced operations management for volt optimization, conservation voltage reduction, and automated sectionalization and restoration. SMUD will be able to restore power much more quickly in the event of an outage because automated switching will allow it to optimize its distribution network and enhance operating capability.[40] Automating distribution will also expand SMUD's supervisory control and data acquisition (SCADA) system.[41]

SMUD plans to install SCADA at 40 substations and install automated line devices with two-way communication on 18%, or 109, distribution circuits. SMUD will automate 44%, or 24, of

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[38] Jaspal Deol, P.E, Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

[39] Timothy N. Tutt, SMUD's Government Affairs Representative, presenting SMUD's comments regarding implementing the proposed goal of 12,000 MW of clean local distributed generation (DG) using Smart Grid solutions to the California Energy Commission, July 20, 2011; http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/comments/SMUD_comments_TN-61471.pdf, last visited August 10, 2011

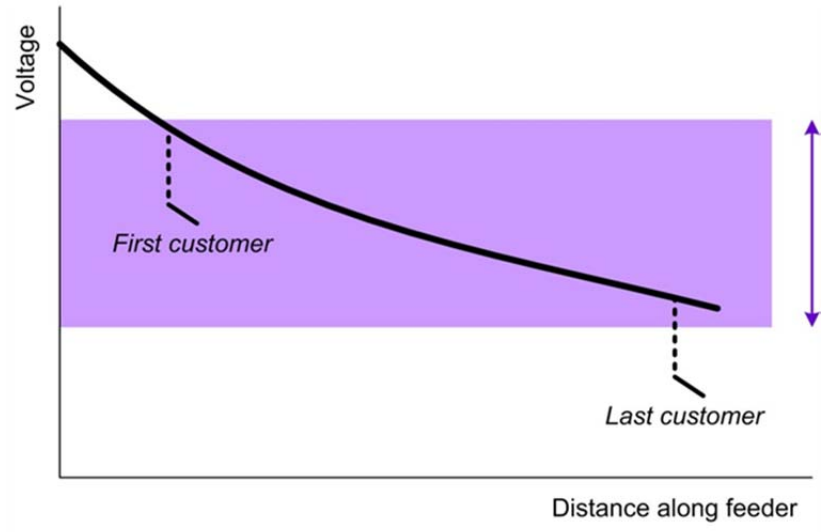
[40] SMUD and the Smart grid video; http://www.smud.org/en/video/Pages/cc_tabbed.html?bclid=769701255&bctid=930929496001, last visited August 10, 20111

[41] Timothy N. Tutt, SMUD's Government Affairs Representative, presenting SMUD's comments regarding implementing the proposed goal of 12,000 MW of clean local distributed generation (DG) using Smart Grid solutions to the California Energy Commission, July 20, 2011; http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/comments/SMUD_comments_TN-61471.pdf, last visited August 10, 2011

SMUD's sub-transmission circuits.[42] SMUD will install intelligent switching and monitoring equipment and a wireless communication system.

In the near term, SMUD expects to implement an advanced operating system in 18% of its service territory that will sectionalize and restore power to customers after an outage, optimize distribution circuit voltage to enable energy savings and reduce losses. The desired results include increased system efficiency, improved power factor, reduction of system losses, reduction of energy consumption, and decreased frequency and duration of outages.[43]

SMUD's conservation voltage reduction (CVR) and volt/var optimization (VVO) strategies will be deployed in order to make the grid more energy efficient. SMUD completed testing of their CVR and VVO strategies in the summer of 2011. Although energy savings will differ by circuit based on various types of loads, the testing results were very promising. SMUD's initial testing included two substations in different geographical areas and the three circuits connected to each of the two substations. Testing of CVR and VVO on the feeders associated with the first



Smart Grid technology allows more efficient management of distribution system voltage both maintaining reliability and saving energy.

[42] *Id.*

[43] *Id.*

substation yielded an average of 2.5% demand reduction, an average demand reduction of 315 kW at peak (between 4:30 to 6:30 pm) and minimized line losses by maintaining power factor at approximately .95 leading. The second substation and associated feeders yielded an average of 1% demand reduction, an average demand reduction of 150 kW at peak (between 4:30 to 6:30 pm) and minimized line losses by maintaining power factor at approximately .95 leading. SMUD is currently undergoing vigorous lab testing of their automated sectionalization and restoration control logic prior to "turning on" the automated control logic on their distribution system.

SMUD has invested in its software infrastructure as well. It installed the Enterprise Service Bus software platform to reduce the cost of communications between systems by reducing the number, size, and complexity of interfaces between systems. The new platform will ultimately improve the speed of service to the customer. SMUD is currently upgrading its existing Outage Management System to include Web Methods functionality, ease the integration with other systems, and enable SCADA integration through an ICCP gateway. SMUD will tie together the upgraded outage management system with their AMI system for outage reporting from smart meters. Once smart meters are used to report system outages to distribution system operators, SMUD will introduce automated, proactive outage communication with their customers. SMUD will notify customers of outages that are affecting their service, provide estimated restoration times and confirm restoration of service.

SMUD also installed Customer Relationship Management System software to provide customer representatives a real-time view of energy usage. This software integrates a customer service call center with SMUD's back-office billing system.

PHEV/BEV INFRASTRUCTURE AND INTEGRATION

SMUD is committed to examining customer applications for an electric vehicle infrastructure. It is dedicating a portion of its Smart Grid resources to plug in hybrid electric vehicles (PHEV) and battery electric vehicles (BEV), together known as Plug-In Electric Vehicles (PEVs). The purpose of SMUD's Smart Grid Smart Charging Pilot Program is to offer time-based rates to PEV drivers in order to learn how best to encourage off-peak charging. During the first year of the pilot project, two or more time-of-use experimental rates will be offered to 180 residential PEV drivers. Up to 60 of the drivers will be offered two-way communicating Electric Vehicle Supply Equipment (EVSE) that will be used to give them a "managed charging" option. As part of the partner programs, up to 25 two-way communicating smart charging stations will be installed on the CSUS and Cosumnes River College campuses. SMUD will incentivize customers to charge their batteries during off-peak periods by using price signals. SMUD is conducting applied research that in the future may allow for Vehicle to Grid (V2G) electricity sales and home energy storage demonstration projects. It is also working on a project with the California Energy Commission to test the impacts of electric vehicles on the grid. In the future, SMUD may be able to pay customers to feed power from their EVs into the grid to support reliability, while ensuring that the battery charge will not fall below a pre-specified level.

Because electric vehicle owners tend to cluster in certain areas, SMUD plans to test the impacts of multiple electric vehicles on a single distribution transformer. It will model this

scenario using multiple EV battery systems on a transformer in a test bed setting. SMUD is also using a load simulator to simulate reactive and resistive variable loads. It will apply to the most common transformers (25 kVA, 50 kVA and 75 kVA) in the system. SMUD will mount transformers at the Hedge Substation where its training facility is located.[44]

SMUD has also tested and used alternative fuel vehicles. It has explored the practical uses of electric vehicles (EVs) and is purchasing and testing EVs in daily operations to advance the technology, such as the Chevrolet Volt.[45] To further encourage off-peak charging that will improve overall system efficiency, SMUD offers an EV time-of-use rate that provides power at a much lower rate during the night.[46]

Finally, SMUD has developed tools to help customers with plug-in EVs. SMUD has an EV web page with a cost calculator to assist potential EV buyers in their decision process, a section with Frequently Asked Questions about EVs and charging the vehicle, and has in-house staff ready to answer customer questions.

CUSTOMER APPLICATIONS

SMUD is partnering with six public agencies to implement part of its Smart Grid grant from DOE. Of the estimated $308 million for SMUD's "SmartSacramento," SMUD's sub-recipients are

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[44] Jaspal Deol, P.E. Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, SmartSacramento® presentation, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

[45] SMUD has received funding from the federal government and other sources to advance transportation through vehicle electrification and to advance SMUD's strategy to accelerate the transition to electric vehicles. "Our Stimulus Grants," https://www.smud.org/en/about-smud/company-information/grants.htm, last visited January 18th, 2012

[46] SMUD leading local Plug-In Electric Vehicle Wave: SMUD tests Chevy Volts and helps customers get plugged in too, November 15, 2011, https://www.smud.org/en/about-smud/news-media/news-releases/2011-11-15.htm, last visited January 22, 2012

contributing approximately $18.3 million for $36.6 million worth of projects. The ARRA grant covers 50% of the cost for sub-recipient projects.

Each sub-recipient will install or update energy management systems on its campus to monitor electricity use, identify buildings that use excessive energy, save energy, and reduce peak loads. For example, advanced controls and sub-metering will be installed on all 57 buildings on the CSUS campus. Smart electric vehicle charging stations will be installed on some sub-recipient campuses. Linda Hafar, director of Utilities and Facility Services at CSUS announced that 16 electric car charging stations would be constructed; and, the grant would also support a new energy management system to better control building heating and cooling systems.[47]

SMUD's partnership with CSUS has included developing a shared vision and investing resources for CSUS's new California Smart Grid Interpretive Center, a living laboratory to showcase the use of Smart Grid technologies. SMUD and CSUS will develop course work educate students about energy efficiency. They will also upgrade the CSUS distribution system to increase campus grid reliability.

SMUD has developed other "customer applications," including services for residential and commercial customers that educate, inform, and enable them to access and use the information available through the Smart Grid to better manage their energy use.[48] Initiatives include pilot projects to enable customers to manage their bills, reduce peak demand, and increase energy efficiency. Pilot offerings combine technology and dynamic pricing at varying levels of customer

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[47] Sacramento State, Sacramento Municipal Utility District Formalize Energy Partnership, US Fed News, June 9, 2011

[48] Jaspal Deol, P.E.Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, SmartSacramento presentation, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

commitment, equipment cost, and SMUD involvement in energy management. Technologies include smart thermostats, in-home displays, smart appliances, online interval usage graphs, and energy management systems.[49] Commercial applications include rebates for installing advanced, controllable lighting systems; updating the commercial energy information and tools software package; and installing energy management systems for buildings.

SMUD is partnering with a local developer on a 42-home subdivision to create a Smart Grid-enabled, net-zero energy development in the heart of downtown Sacramento which includes photovoltaic systems, energy storage, controllable appliances, home energy management systems, and energy efficiency.

CYBER SECURITY

In addition to the goal of improving reliability, incorporating information technology into the electric industry through the Smart Grid may make the electric grid more vulnerable to attacks and loss of service. SMUD has allotted $3.3 million[50] in total project costs to cyber security. Although the Smart Grid has many purported benefits, the Federal Government and general public have high-level security concerns about an increasingly complex and vulnerable grid.

An often noted additional risk is the potential to compromise data confidentiality, such as breach of customer privacy. SMUD has assured its customers that their energy use information will remain confidential and safe. SMUD is using DOE's approved Cyber Security plan.[51] It will

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[49] Communication with SMUD's Smart Grid Core Team, April 5, 2012.

[50] Some SMUD presentations suggest $5.3 million.

[51] Jaspal Deol, P.E.Manager, Transmission and Distribution Substation Design, Construction, and Maintenance, SmartSacramento presentation, March 23, 2011; http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

perform ongoing cyber security assessments. SMUD will also install tools that will detect intrusions, and it will install vulnerability management tools to maintain a secure computer system. The smart meters will transmit customer energy use information to SMUD's secure servers, run by the same wireless network and same types of security as the Department of Defense and the online banking industry.[52]

The goal of SMUD's cyber security initiative is to enact security programs and procedures that conform to and exceed government-mandated standards. It will continue its current best practices with and increase the level of funding for those programs to support Smart Grid initiatives. SMUD has implemented a "holistic and robust cyber security program"[53] to protect confidentiality, integrity and information related to customer data. Also, SMUD plans on implementing the cyber-security protocols needed for system security. SMUD will focus on the technical and communications infrastructure necessary to optimize its system and cyber security protocols over the next few years.

IMPLEMENTATION CHALLENGES

Despite SMUD's success in receiving funding for its Smart Grid programs[54] and even with its strong reputation supporting energy efficiency, renewable energy programs, and local generation, transforming the old electric grid to a smart one is an intensive, complex process. SMUD has invested significant time and resources into developing short, medium, and long-term plans for

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[52] SMUD's Smart Meters Frequently Asked Questions; http://www.smud.org/en/smartmeter/pages/smartmeter-faq.aspx; last accessed June 30, 2011

[53] Staff Report and Proposed Board Determination on the Information on Time-Based Electricity Prices and Sources of Power Standard Smart Grid Information; http://www.smud.org/en/about/Documents/reports-pdfs/draft-time-based-electricity-and-smart-grid.pdf, last accessed July 15, 2011

[54] SMUD received one of the top ten largest grants in the country.

building the Smart Grid, however actually implementing the necessary changes will be challenging. In an "I 4 Energy" seminar, Jim Parks, the SMUD Program Manager for Energy Efficiency and Customer R&D, talked about SMUD's current success in putting together the prescriptive pieces of a Smart Grid, but he noted that parts of the system do not currently communicate with each other and may not for a few years. He suggested that the ultimate goal is to manage and link the entire system. He also offered that the funding SMUD has received is not enough to fully implement Smart Grid throughout its entire service territory, so it is focusing on a few areas for now.[55]

SMUD is still in the nascent stages of its Smart Grid build out. As of March 2012, the SmartSacramento project was still in the process of being implemented, with approximately 55% of the project completed. Although SMUD does not have to prove that proposed benefits are real to regulators, as a customer-owned electric utility, SMUD's Board of Directors and customers should understand the value of the system. Additionally, SMUD is affected by California state policy decisions generally.[56] Moreover, although SMUD has always been closely allied with its consumers, some SMUD customers may find the adjustment to a new system difficult or may feel wary about privacy and security concerns. Only a few customers have expressed concern about keeping their personal information confidential.

In its communication plan for AMI, SMUD anticipated customer concerns over high bills. Therefore, when questions arose, SMUD simply followed the processes set forth in the plan.[57]

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[55] Jim Parks I 4 Energy Presentation, November 2010; http://www.youtube.com/watch?v=RyKVm078cJ4&feature=player_embedded, last visited July 20, 2011

[56] Communication with SMUD's Smart Grid Core Team, April 5, 2012

[57] Communication with SMUD's Smart Grid Core Team, April 5, 2012

Even from the beginning, SMUD has received very few customer comments on this concern.[58] In fact, since the early stages, SMUD's customers have generally provided positive feedback about the Smart Grid; however some have expressed concerns about different rate structures, especially time of use rates.

SMUD recognizes that it faces challenges to their Smart Grid program that present implementation issues. SMUD suggests that the most pressing challenges will be based on the amount, size, location, and voltage levels of the interconnected resources; the capabilities of those resources for dispatch and communication (and similar Smart Grid capabilities); and the ability of the grid to accept generation at multiple distributed sites and flow power as needed in the opposite direction as initially designed.[59] Although they have not fully implemented their program, SMUD has concluded in its first few years that more research and development is needed and that it will take 10-20 years to build out its Smart Grid.[60]

Intermittent resources play a significant challenge in SMUD's management of the grid. For example, SMUD anticipates that its current 35 MW of solar capacity and 102 MW of wind will increase to 160 MW of solar and 250 MW of wind in the next three years.[61] For example, one of SMUD's largest capital investments is the Solano Wind project, which consists of 55 260-foot-high

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[58] Communication with SMUD's Smart Grid Core Team, April 5, 2012

[59] Timothy N. Tutt, SMUD's Government Affairs Representative, presenting SMUD's comments regarding implementing the proposed goal of 12,000 MW of clean local distributed generation (DG) using Smart Grid solutions to the California Energy Commission, July 20, 2011; http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/comments/SMUD_comments_TN-61471.pdf, last visited August 10, 2011

[60] http://www.usea.org/Programs/EUPP/SouthCentralAsiaTDWorkshop/DAY3PRESENTATIONS-DISTRIBUTION/5_-_SMUD_SmartSacramento_March_2011.pdf

[61] Jim Parks I 4 Energy Presentation, November 2010; http://www.youtube.com/watch?v=RyKVm078cJ4&feature=player_embedded, last visited July 20, 2011

turbines that will generate approximately 128 MW to power enough electricity to light 38,000 homes.[62]

Some PV resources cannot be fully integrated into the Smart Grid until there is sufficient two-way communication and control capability between the utility and PV inverters.[63] Erik Krause, Product Development Manager for SMUD, suggests that utilities can gather information by installing separate meters to measure production at the PV systems.[64] Integration between the inverters and smart meters could eliminate the need for a second meter, but are not required to gather data. As the percentage of total generation that is renewable rises, SMUD's ability to provide infrastructure, capacity (V2G, storage plants) and effective "smart" demand-response management will be critical. SMUD is identifying key research and development questions related to issues like the integration of intermittent resources, and noting how the Smart Grid can play a role. Intermittent resources require extensive planning to coordinate effectively. However, SMUD

[62] Rick Daysog, SMUD selling wind energy project to gain stimulus funds, Sacramento Bee, Section B, pg. 6, September 13, 2011

[63] Mark Rawson, SMUD PV and Smart Grid Pilot at Anatolia, http://www1.eere.energy.gov/solar/pdfs/highpenforum1-14_rawson_smud.pdf, last visited July 20, 2011

[64] Communication with Erik Krause, SMUD's Project Development Manager, January 31, 2012

does not currently have the means to manage this increasing resource.

SMUD is also examining storage to support its plan to increase renewable energy supplies by 2050. It is performing demonstration projects, such as the Anatolia SolarSmart Community with Lennar Homes, to quantify the cost and benefits of storage deployment and distributed solar generation. In that project, SMUD equipped more than 270 homes with battery storage tied to the solar grid to see if firm renewables would reduce peak load and improve reliability. This demonstration monitored inverters using AMI communication from smart meter to inverter. In addition, SMUD has received federal stimulus funding for PV and energy storage. It has already installed 14 of the planned 17 PV systems; and it is developing tools to model a distribution system while demonstrating PV integration and energy storage into Smart Grid applications.[65]

SMUD also notes that many of the software and technology packages are very new so it is difficult to determine overall product reliability, accuracy and whether the products will be supported long-term. The delayed release of the ZigBee SEP 2.0 interoperability standard is another technology issue facing all utilities with demand response implementations using ZigBee HAN devices. This delay is also impacting SMUD's ability to support EVSE and PV inverter communication and control over AMI networks.[66] Further demonstration projects and pilots are needed to assess the viability of new products. SMUD is currently taking advantage of Itron technology for meter data management. SMUD may eventually implement distribution management software, but anticipates that implementation is three to five years out because the software is premature, lacks standardization, and cyber-security concerns persist.

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[65] "Our Stimulus Grants," https://www.smud.org/en/about-smud/company-information/grants.htm, last visited January 20th 2012

[66] Communication with SMUD's Smart Grid Core Team, April 5, 2012

SMUD is aware of the technical challenges that come with the addition of significant percentages of distributed generation. For example, meeting the requisite standards for solar power on a partially cloudy day may be challenging. However, SMUD suggests that Balancing Authority performance requirements should be further evaluated to avoid this problem. It will take time and experience with the new grid infrastructure before operators understand how best to integrate distributed generation on a circuit-by circuit basis and address the potential for two-way power flow.

Importantly, SMUD plans to implement the Smart Grid only after necessary research has been done on the cumulative impacts to the grid. For example, it has no plans to acquire widespread adoption of communication technology for monitoring and control of all systems before receiving the results of its research projects. Although SMUD is installing technology, it is in the exploratory phase of Smart Grid. Based on the results obtained from the SmartSacramento project pilots and other research and development projects and pilots, SMUD will evaluate the results and make decisions about how to best proceed for highest benefits for its customers.[67] Moreover, SMUD's smart meter deployment plan called for initially installing 78,000 smart meters, and then paused temporarily to perform a series of performance tests on the meters and communication system to ensure full system functionality and to help minimize public concerns.[68] Only when SMUD was satisfied with the results did the deployment continue, with up to 65,000 installations per month, until being completed in the first quarter of 2012. As programs are implemented and lessons are learned, plans must be reevaluated.

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[67] Communication with SMUD's Smart Grid Core Team, March 23, 2012

[68] SMUD has not had any public opinion issues other than with a very small percentage of customers ~0.45% who have asked not to receive a meter. According to communication with SMUD's Smart Grid Core Team; January 31, 2012.

SMUD has the basic resources and infrastructure to implement a successful Smart Grid program for its customers. It has invested a lot of time, money, and expertise to plan for a thriving and functional Smart Grid that will completely modernize and transform the electric grid as it is currently known.

FOCUSING ON STRATEGIC PLANNING AND STRONG COMMUNICATION WITH CUSTOMERS

Early on in the process, SMUD has focused intensively on its plan and its communication with customers. After all, SMUD is a customer-owned and customer-based utility. As Michael Gianunzio, SMUD's Chief Legislative & Regulatory Affairs Officer, expressed: "We have been very careful and deliberative in our communications with customers. We have some time to go before studies will be underway that evaluate the behavioral aspects of this kind of thing; lots of groundwork and contracts and strategies need to be developed well in advance. It will be years, I am sure, before we have a complete picture of how successful this can be."[69] SMUD's Smart Grid program is in the full implementation stage right now. SMUD will start to evaluate the projects in late 2012 and will develop a Smart Grid road map that identifies the next steps. Demonstration projects that show strong potential will be considered for broader scale deployment in the future. Additional demonstration projects will also be identified.

Despite a few concerns, customers responded positively to SMUD's Smart Grid program, understanding the perceived benefits, such as SMUD's ability to provide future outage information and create new programs for energy efficiency. Given its customers' acceptance of the changes so

[69] Email communication with Michael Gianunzio, November 15, 2010

far, when SMUD moves deeper into the implementation phases of its program, it is likely to be successful.

In its early stages of implementation, SMUD has made the transition to a Smart Grid relatively easy for its customers. SMUD does not require customers to be home for the smart meter to be installed. They also provide customers with adequate information about the technology, the justification for the shift, and the expected benefits. SMUD invites and encourages volunteers to participate as early adopters. SMUD demonstrates how a Smart Grid provides the customer with greater understanding and control of their electric services.

While it is too early to analyze lessons learned or to suggest that SMUD has been successful in making an impact on its clean energy goals and improving system reliability, it appears that it has enhanced customer value. At the very least, its customers were informed as they received their smart meters and invited to take advantage of the increased accessibility of their electric information.

EXPERTISE AND LEADERSHIP IN CLEAN ENERGY TECHNOLOGY LEADS TO SUCCESS IN SMART GRID IMPLEMENTATION

SMUD's pioneering leadership in clean technologies, including energy efficiency, renewable energy, and storage, position it well to be a successful leader in Smart Grid technology. Moreover, SMUD's plan is at least designed to enable more renewable energy, higher levels of energy efficiency and better integration of distributed resources. Hence, SMUD's strategic and advanced planning offers a great opportunity for SMUD to be a leader in the Smart Grid movement, as it is in renewable energy and customer services. SMUD's pioneering leadership and expertise in clean technology, including energy efficiency, renewables, and storage, has positioned it well to be a successful leader in implementing the Smart Grid.

CALIFORNIA'S CLEAN ENERGY LEADERSHIP AND CLEAR POLICIES HAVE BEEN SUPPORTIVE

The State of California has been recognized for its innovative and forward-thinking energy policies supporting clean technology. California's investment in renewable energy, energy efficiency, and enhanced storage capacity helps not only to support its public utilities and independent service operators, but also the consumer-owned utilities, such as SMUD. Consequently, California and SMUD's pioneering leadership in clean technology has positioned SMUD particularly well to be a successful leader in Smart Grid technology.

Although the California Public Utilities Commission does not regulate SMUD — SMUD reports to a Board of Directors — it benefits from operating within a state that supports investing in clean technology and recognizes the need for infrastructure investment. California's legislation directly and indirectly drives some of SMUD's priorities, as SMUD strives to be an industry leader and a good neighbor to the customers that own it and the environment that surround it by empowering its customers with solutions and options that increase energy efficiency, protect the environment, reduce global warming, and lower the cost of to serve within its region.

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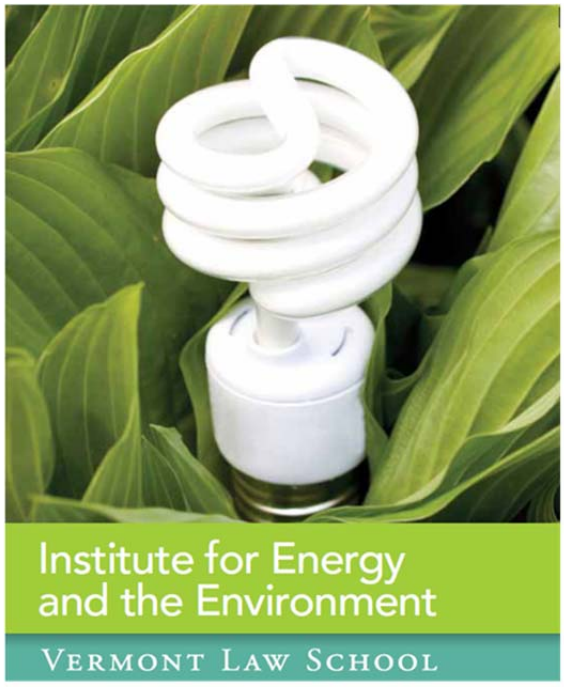

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