

# San Diego Gas & Electric: The Smart Grid's Leading Edge



Institute for Energy and the Environment  
Vermont Law School



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Smart Grid Case Study Series – Case 6

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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?

#### 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)

### 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. More about the Institute's Smart Grid Project is available at: [www.vermontlaw.edu/smartgrid](http://www.vermontlaw.edu/smartgrid)

### HISTORY & BACKGROUND

San Diego Gas & Electric (SDG&E) has been providing electricity services since 1881 when five San Diegans met in the parlor of the Consolidated Bank to incorporate the first San Diego Gas



Company. At the beginning it served 89 gas customers. Today, SDG&E is a regulated public utility that serves 3.5 million customers. Its service area covers 4,100 square miles in San Diego and southern Orange counties in the State of California. It is a subsidiary of Sempra Energy; a San-Diego based Fortune 500 Company.<sup>1</sup> Sempra was founded to take advantage of opportunities in the open competitive energy markets. Sempra's 17,500 employees provide services for 31 million customers not just in San Diego, but all over the world.<sup>2</sup>

As of December 31, 2010, 1,160 megawatts (MW) of Combined Cycle Plants, 960 MW of Steam Plants, 688 MW of Simple Cycle Peaking Plants, 157 MW of Cogeneration Plants, and 75 MW of Renewable Generation were interconnected to the SDG&E transmission system.<sup>3</sup> SDG&E transmission network includes 500 kilovolt (kV), 230kV, 138kV, and 69kV lines that are overhead and underground. In terms of SDG&E's own procurement resources, in 2011 they were 40% carbon free and 20% renewable. SDG&E's transmission infrastructure is commonly described as an "electrical cul-de-

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<sup>1</sup> "San Diego Gas & Electric - About Us." *San Diego Gas & Electric*. Web. 03 Aug. 2011. <<http://www.sdge.com/aboutus/>>.

<sup>2</sup> "The Sempra Energy Story." *Sempra Energy*. Web. 17 Sept. 2011. <<http://www.sempra.com/about/>>.

<sup>3</sup> San Diego Gas & Electric. *Smart Grid Deployment Plan 2011-2020*. Rep. 2011. Print. Pg. 57. Available at <http://www.sdge.com/documents/smartgrid/deploymentplan.pdf>. (Hereinafter "SDG&E SGDP").

sac” because it is located in the southwestern corner of California near the ocean and the Mexican border.<sup>4</sup> SDG&E’s distribution grid is a radial, open loop system. SDG&E already uses Supervisory Control and Data Acquisition (SCADA) for its distribution circuits, which allows some self-healing and resilience in the grid.<sup>5</sup> In fact, SDG&E was ranked by an independent utility consulting firm as having the “best” reliability in the western US for five years in a row and earned the honor of “Best Reliability in the Nation” for 2009.<sup>6</sup>

SDG&E’s SunRise Powerlink, was recently completed, adding 115 miles of 500kV and 230kV transmission lines.<sup>7,8</sup> The 1,000 MW line will bring solar and wind power from the Imperial Valley to San Diego and power roughly 650,000 homes. The new transmission line has the potential to reduce greenhouse gas emissions by one million tons a year by carrying cleaner electricity to San Diegans.<sup>9</sup> In order to obtain approvals to construct this line, they addressed siting and endangered species habitat concerns among other issues.<sup>10</sup> Construction of the Sunrise Powerlink could prove extremely beneficial to the San Diego region given the outage of the San Onofre Nuclear Power facility, currently out of service indefinitely. In September 2011, Six million people lost power in California, Arizona, and a

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<sup>4</sup> Pullins, Steve, and John Westerman, Sr., et al. *San Diego Smart Grid Study Final Report*. Rep. San Diego: Energy Policy Initiatives Center University of San Diego School of Law, 2006. Print. Pg. 84. Available at [http://www.sandiego.edu/epic/research\\_reports/documents/061017\\_SDSmartGridStudyFINAL.pdf](http://www.sandiego.edu/epic/research_reports/documents/061017_SDSmartGridStudyFINAL.pdf)

<sup>5</sup> SDG&E SGDP Pg. 60.

<sup>6</sup> SDG&E SGDP Pg. 64. (citing “PA Consulting Group recognizes North American Utilities for excellence in reliability and customer service at the 2010 ReliabilityOne™ and ServiceOne Awards,” Nov. 18, 2010).

<sup>7</sup> "New Safety Concerns Raised After Powerlink Tower Mishaps." *10News.com*. 15 June 2011. Web. 4 Aug. 2011. Available at <http://www.10news.com/news/28253731/detail.html>.

<sup>8</sup> SDG&E SGDP Pg. 60.

<sup>9</sup> Soto, Onell R. "Governor Calls Sunrise Powerlink Example to Nation." Web log post. *SignOn San Diego*. The San Diego Union-Tribune, 9 Dec. 2010. Web. 4 Aug. 2011. <<http://www.signonsandiego.com/news/2010/dec/09/governor-to-attend-sunrise-groundbreaking-today/>>.

<sup>10</sup> *The Protect Our Communities Foundation*. 10 June 2011. Web. 10 Aug. 2011. <<http://protectourcommunities.org/poc-blog/>>.

part of Mexico as the result of human error of an employee of Arizona Public Service, an Arizona company that owns a transmission line feeding San Diego.

## **STATE AND FEDERAL POLICY GOALS**

In 2007 the United States Congress passed the Energy Independence and Security Act (EISA), which authorized the Smart Grid Investment Program and the Smart Grid Demonstration Program. In 2009 Congress passed the American Resource and Recovery Act (ARRA), which appropriated \$4.5 billion to fund the federal smart grid programs. San Diego Gas and Electric was awarded \$5 million in funding under the Smart Grid Investment Grant Program through the American Recovery and Reinvestment Act.<sup>11</sup> Also, in 2009, the California state legislature demonstrated policy leadership and required its investor owned utilities (IOUs) – Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric – to submit plans to the California Public Utilities Commission (CPUC) to implement smart grid technologies throughout their service territories.<sup>12</sup> Through California Senate Bill 17 (SB 17), the California legislature directed its IOUs “to modernize the state’s electrical transmission and distribution system to maintain safe, reliable, efficient, and secure electrical service” making the deployment of smart grid technology the policy of the state.<sup>13</sup> Former Governor Arnold Schwarzenegger signed SB 17 into law on October 11, 2009.

Following up on the legislature’s policy leadership the CPUC instituted a rulemaking proceeding that then “determine[d] the requirements for a Smart Grid Deployment Plan (SGDP) consistent with the

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<sup>11</sup> <http://recovery-and-reinvestment-act.theblaze.com/q/526170/7357/How-much-did-the-San-Diego-Gas-And-Electric-Company-Smart-Grid-Investment-Grant-Program-EISA-1306-in-San-Diego-CA-recvie-from-the-ARRA>

<sup>12</sup> ‘By July 1, 2011, each electrical corporation shall develop and submit a Smart Grid Deployment Plan to the commission for approval.’ Cal. Pub. Util. Code § 8364 (West 2009).

<sup>13</sup> Senate Bill 17 (SB 17), Cal. Pub. Util. Code § 8360 (West 2009).

policies set forth in [SB 17] and federal law.”<sup>14</sup> The CPUC set guidelines for the major IOUs in California to file Smart Grid Deployment Plans by July 1, 2011. Their directive outlined the content required in the Smart Grid Deployment Plans each of which was to include:

1. Smart grid vision statement;
2. Deployment baseline;
3. Smart grid strategy;
4. Grid Security and Cyber Security Strategy; and
5. Cost and benefit estimates and metrics.

The CPUC decision further reiterated the policy goals outlined in SB 17 that were to be the focus for the major utilities in California.<sup>15</sup> Those policy goals include that the smart grid:

1. Create a self-healing and resilient grid;
2. Empower consumers to actively participate in operations of the grid;
3. Resist attack;
4. Provide higher quality of power and avoid outages, saving money;
5. Accommodate all generation and storage options;
6. Enable electricity markets to flourish;
7. Run the grid more efficiently;
8. Enable penetration of intermittent power generation sources;
9. Create a platform for deployment of a wide range of energy technologies and management services;
10. Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources; and,
11. Significantly reduce the total environmental footprint of the current electric generation and delivery system in California.<sup>16</sup>

SDG&E’s vision as outlined in their Deployment Plan is: “San Diego Gas & Electric, in collaboration with key stakeholders, will create the foundation for an innovative, connected and sustainable energy future.”<sup>17</sup> SDG&E worked with a number of its key stakeholders, including other organizations and its customers, to develop a plan that would best meet SDG&E’s obligations to the

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<sup>14</sup> Cal. Pub. Util. Code § 8360-69 (West 2009).

<sup>15</sup> CPUC D.10-06-047

<sup>16</sup> SDG&E SGDP Pg. 34

<sup>17</sup> SDG&E SGDP Pg. 17



CPUC and the California legislature, its customers, other interest groups, grid reliability, and the environment. SDG&E set a vision and goals for attainment for 2015 and 2020 completion in its Smart Grid Deployment Plan filing with the CPUC. SDG&E President and COO, Michael R. Niggli, pointed out in a letter accompanying the SDG&E Deployment Plan, that unlike in other areas of the country; San Diego’s customers are “driving” the Deployment Plan. Mr. Niggli noted that even prior to the filing of the Deployment Plan, over 13,000 customers had installed over 100 megawatts of photovoltaics, and customers were adopting plug-in electric vehicles (EVs) at one of the highest rates in the country. Customers were already taking advantage of real-time information about their energy use to make more informed decisions, and there was broad support for the California’s environment friendly policies.<sup>18</sup>

## OVERVIEW OF SAN DIEGO GAS & ELECTRIC’S SMART GRID PROGRAM

### COLLABORATION AMONG STAKEHOLDERS

In an effort to gain the approval for its Smart Grid Deployment Plan from its customer base and other local constituencies, SDG&E partnered with:

- Academia;
- Business organizations;
- Municipal utilities and governmental organizations;
- A ratepayer advocacy organization (UCAN);
- Energy NGOs;
- Environmental NGOs;
- A corporate customer;
- Labor interests.

These groups helped SDG&E form some parts of its Smart Grid Deployment Plan (SGDP) regarding workforce vocational education, security and privacy, environmental impact, and community input. The Environmental Defense Fund (EDF) has stayed involved and recently evaluated the three Smart Grid Deployment Plans from IOUs in California (more on that in the “Environmental Defense Fund

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<sup>18</sup> Letter from Michael R. Niggli to Michael R. Peevey, President, California Public Utility Commission, June 6 2011, SDG&E Smart Grid Deployment Plan: 2011-2020

Evaluation” section of this report). Additionally, SDG&E has said it would like to continue to work with unions and vocational schools to enable its workforce transition.

## **ADVANCED METERING INFRASTRUCTURE AND HOME AREA NETWORK**

SDG&E has already integrated significant smart grid technology into its operations over the past ten years. By the end of 2012 SDG&E had replaced about 1.4 million electric meters and retrofit 900,000 gas modules.<sup>19</sup> As of June 30, 2012 SDG&E’s deployment was 98.7% complete.<sup>20</sup> Additionally, 36,000 programmable communicating thermostats (PCT) and remote turn-on, turn-off devices for all residential meters are a part of SDG&E’s efforts to upgrade its residential and commercial meter infrastructure.<sup>21</sup>

Since SDG&E has already installed most smart meters, the next goal is to facilitate two-way communication between the customer and the Utility. Once SDG&E and its customers can communicate with each other about real time electricity use, the Utility will deploy tools to incentivize different habits on both ends of the distribution line to increase efficiency, decrease costs, and decrease emissions. Tools deployed based on the new data will range from smart transformers, to EV charging stations, to new dynamic rates.

SDG&E is currently using Itron Open Way® smart meters to collect usage data. The wireless HAN signal has not yet been activated. Currently, SDG&E is installing Zigbee Smart Energy Profile (SEP) 1.0 in its pilot applications, which the Utility says, “has limitations and does not allow for upgrades to SEP 2.0 (the desired specification for mass rollout of HAN devices), for our pilots this

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<sup>19</sup> SDG&E SGDP Pg. 69

<sup>20</sup> SDG&E Smart Grid Deployment Plan 2012 Update, Pg. 1  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf).

<sup>21</sup> SDG&E SGDP Pg. 69.

year.”<sup>22</sup> The upgrade to SEP 2.0 requires a standard be ratified, golden units be built and successfully tested, and finally for SDG&E testing and Firmware (FW) updates to be successful. SDG&E hopes to have their Itron smart meters to support SEP 2.0 in their AMI products by the beginning of 2014.<sup>23</sup>

Because the HAN technology comes after the implementation of smart meters, the Utility has not begun to talk to its customers about these capabilities specifically, “but rather the benefits of the HAN technology” generally.<sup>24</sup>

One benefit of smart meters is that they allow for meters to be read remotely. Additionally, electric service may be connected, disconnected, and reconnected without a person needing to physically go out and fix the problem. In 2012 SDG&E was able to avoid “approximately 3.2 million miles of vehicle travel.” Not only does this save money, but it is better for the environment. Reductions in vehicle miles traveled resulted into a “savings of approximately 275,000 gallons of gasoline which equates into more than 2,400 tons of reduced CO<sub>2</sub>e emissions.”<sup>25</sup>

## **DEMAND RESPONSE/ EFFICIENCY**

SDG&E has included automation technology that would allow demand response and energy efficiency as an element of smart grid deployment. With SDG&E’s existing Time-of-Use (TOU) rates the Utility is well positioned to integrate technology that would empower its customers with information to make better electricity consumption decisions. Plug-In Electric Vehicles (EV) can be a part of a grid storage solution – called vehicle-to-grid (V2G) – by taking in electricity at night and storing it during the day when it has the potential to help balance the needs of the smart grid load at different times of the

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<sup>22</sup> Brill, Tom, SDG&E. "Re: Interview Follow-up Questions." Message to the author. 9 Sept. 2011. E-mail.

<sup>23</sup> Brill, Tom, SDG&E. "RE: Interview Follow-up Questions." Message to the author. 20 Sept. 2011. E-mail.

<sup>24</sup> Brill, Tom, SDG&E. "Re: Interview Follow-up Questions." Message to the author. 9 Sept. 2011. E-mail.

<sup>25</sup> SDG&E Smart Grid Deployment Plan, Pg. 20-21  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf)

day. The idea is to automate the technology connected to the grid to enable real time pricing, and thus create true market forces which could trigger positive reactions in customer behavior.<sup>26</sup> By 2020 SDG&E hopes to achieve price-driven demand response, energy efficiency, distributed generation, and storage.<sup>27</sup>

SDG&E customers may already choose from various dynamic rate structures that offer lower costs at off-peak times to incentivize more environmentally friendly electric usage. EV owners can receive rebates and incentives from the state and federal governments,<sup>28</sup> and may, in addition, elect to integrate their home and vehicle electric usage on the same TOU rate structure. Existing AMI created a two-way communications infrastructure between utilities and customers. It measures energy use data in fifteen-minute increments for commercial applications and hourly increments for residential applications. This has enabled electric demand response and load control that helps customers reduce peak energy use.<sup>29</sup>

SDG&E's existing dynamic rate structure allows customers with EVs to choose to charge their cars separately from their normal residential rate. Those customers also have the choice to put their residential consumption on TOU pricing as well. The first of two EV rates is the "EV-TOU" rate, which requires a separate smart meter for the vehicle. Customers who opt for this are required to have a second

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<sup>26</sup> SDG&E SGDP Pg. 50

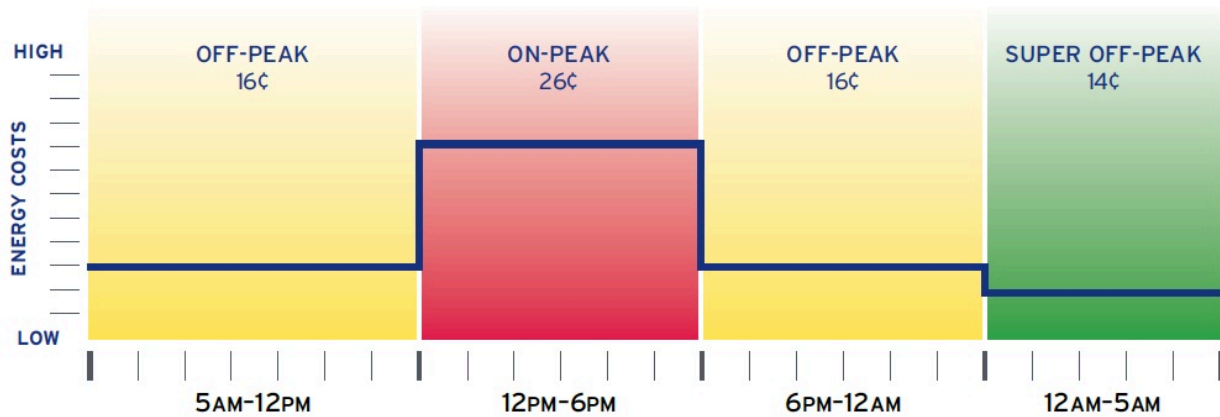
<sup>27</sup> *Id.* at Pg. 51

<sup>28</sup> "Federal Tax Credit for Electric Vehicles Purchased in or after 2010." *Fuel Economy*. U.S. Department of Energy, 16 Sept. 2011. Web. 18 Sept. 2011. <http://www.fueleconomy.gov/feg/taxevb.shtml>, State & Federal Incentives | Plug In America." *Plug In America | We Drive Change*. Web. 18 Sept. 2011. <http://www.pluginamerica.org/why-plug-vehicles/state-federal-incentives>.

<sup>29</sup> SDG&E SGDP Pg. 70

meter socket installed in their home. “EV-TOU-2” provides one smart meter to communicate the data of home and the vehicle electricity use together.<sup>30</sup>

## It matters when you charge your electric car.



Rate prices listed represent the summer EV-TOU-2 (whole house) rate as of October 20, 2012 and are per kilowatt hour. Find current rates at [sdge.com/evrates](http://sdge.com/evrates).

SDG&E separates its time of use rates into “Super Off Peak,” “Off Peak,” and “Peak” (see table above). The significant rate differential provides meaningful economic incentive to charge electric vehicles in the late evening and night. A Nissan Leaf’s full charge takes about 24 kWh while a Chevy volt requires 13 kWh based on manufacturers data.

In addition to separating out pricing regimes based on the time of the day, SDG&E also separates its customers into different “Baseline” groups based on their average electricity consumption. For the general “Domestic Rate” used by a majority of its customers without rooftop solar or EV, the “Baseline” level costs 13.8 cents per kWh. Those who consume 101% - 130% of the “Baseline” pay 16 cents per kWh. At 131%-200 of “Baseline” customers will pay 29 cents per kWh and 31 cents a kWh for anything above 200% of “Baseline”.

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<sup>30</sup> "The Cost of Charging Your Electric Vehicle." *San Diego Gas & Electric*. Web. 15 Sept. 2011. <<http://www.sdge.com/environment/cleantransportation/evRates.shtml>>.

There are a few other rate options for SDG&E customers. Customers with solar photovoltaic (PV) electric systems are eligible for a net metered rate based off the domestic rate as a foundation (DR-SES). Net Metering (NEM) allows customers who produce 1000 kW or less of wind or solar power at their homes to get a rebate. Those customers with NEM do not have to pay some of the fixed costs as a part of their rate that non-NEM customers do. Customers who use more than 1,500 kWh per month are encouraged to use the Domestic Time-of-Use Rate (DR-TOU). The Utility suggests customers to choose this rate if no one in the home from noon to 6pm on weekdays. Additionally, SDG&E encourages DR-TOU customers to put timers on large appliances to help decrease peak electricity consumption. Additionally, a few TOU rates are available for Industrial or “Non-Residential” customers.<sup>31</sup> SDG&E also continues to offer a Low-Income Home Energy Assistance Program (LIHEAP).<sup>32</sup> In order to qualify for low-income assistance, customers must either “spend a high percentage of income on energy, or have elderly or disabled members, or children under three years of age.”<sup>33</sup>

The most recent demand response program is SDG&E’s Reduce Your Use program, a demand response service, launched in July 2012. While participation in the program is optional, SDG&E automatically enrolled all residential and small business customers with smart meters in the program.<sup>34</sup> Under the program, SDG&E notifies customers of event days when they can earn a credit for each kWh below their previous average usage during the hours of 11 a.m. – 6 p.m. Customers can earn a credit of \$.75 per kWh saved or \$1.25 / kWh if the customer has qualifying enabling technology installed. Enabling technologies include devices that are set up to receive signals or alerts directly from SDG&E.

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<sup>31</sup> <http://sdge.com/electric-tariff-book-commercialindustrial-rates>.

<sup>32</sup> <http://sdge.com/low-income-home-energy-assistance-program-liheap>.

<sup>33</sup> *Id.*

<sup>34</sup> San Diego Gas & Electric. *Smart Grid Development Plan 2012 Annual Report*. October 1, 2012. P. 7. Available at [http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf).

## PLUG-IN ELECTRIC VEHICLES

Plug-In Electric Vehicles (EVs) are growing in popularity in the U.S. as the Nissan Leaf Chevrolet Volt, BMW ActiveE, Ford Focus Electric, and Mitsubishi I are supplementing the Toyota Prius as the newest greenest vehicles on the market. San Diego has the highest penetration of EV in the country with about 1,600 vehicles on the road as of June 2012.<sup>35</sup> SDG&E has collaborated with the Smart City San Diego effort to launch of “car2go,” which is “the world’s first deployment of an all-electric car sharing pilot. In the first 100 days of operation more than 6,000 people registered as members and more than 25,000 trips were taken in the smart electric car2go vehicles.”<sup>36</sup> This may be why manufacturers like Ford, Mitsubishi, and BMW have targeted the San Diego region for their upcoming EV releases in the next year or two. The State of California and the federal government both provide monetary rebates and incentives for customers to purchase EVs.<sup>37</sup> Carpool lane access is available for EVs in California, and Plug-In Hybrid EV access is pending. The federal government offers a tax credit for EVs of \$2,500 to \$7,500 depending on the size of the battery in the car (4 kWh to 16 kWh), for electric-drive vehicles (both EVs and Hybrid EVs) sold after December 31, 2008. PlugInAmerica.org calls it “the best and biggest new incentive brought on by the American Recovery and Reinvestment Act of 2009.” This tax credit will “[apply] to at least 200,000 units per auto manufacturer before it phases out.”

EVs have proven their environmental benefit. The California Air Resources Board produced a study estimating that battery electric vehicles could emit at least 67% lower greenhouse gases than cars

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<sup>35</sup> SDG&E Smart Grid Deployment Plan 2012 Update, Pg. 21  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf)

<sup>36</sup> SDG&E Smart Grid Deployment Plan 2012 Update, Pg. 2  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf)

<sup>37</sup> Neighborhood Electric vehicles are like golf carts. They can usually only go low speeds like 30 mph.

run solely on gasoline.<sup>38</sup> Additionally, as car batteries get lighter and more efficient; and the grid is run with more renewable sources, the environmental benefits are going to increase.

Infrastructure upgrades may be necessary to meet the increased electric load required to charge the vehicles. SDG&E's plan for EV growth in its service territory takes into account that existing residential transformers may not be able to handle the increased load of charging electric vehicle, especially if customers want to charge during peak hours. In order to make sure that appropriate infrastructure upgrades are made, SDG&E is monitoring installations of EV charging stations. The Utility is working with automakers and others to track where the EV are being sold to predict where charging stations will go, and thus, where infrastructure updates are needed.

SDG&E is preparing for these increased challenges by supporting customer and utility charging stations. One of the biggest challenges to Plug-In Electric Vehicle (EV) integration is the regulation of the charging infrastructure. Some states have struggled with whether the sale of electricity at the charging station is retail or wholesale. This distinction is important because the Federal Power Act gives the Federal Energy Regulatory Commission (FERC) the obligation to regulate wholesale power, which is sale for resale.<sup>39</sup> States have jurisdiction over retail sale, which is sale for end use.<sup>40</sup> No matter the regulatory jurisdiction, rates should be just and reasonable.<sup>41</sup> CPUC had previously addressed the status of electricity sale at EV charging stations. CPUC held it had sole jurisdiction over the sale of electricity from charging stations in California, clarifying its view regarding state versus federal jurisdiction.<sup>42</sup> In

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<sup>38</sup> "STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING, PUBLIC HEARING TO CONSIDER ADOPTION OF REGULATIONS TO CONTROL GREENHOUSE GAS EMISSIONS FROM MOTOR VEHICLES." CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY AIR RESOURCES BOARD, 6 Aug. 2004. Web. 10 Sept. 2011. <<http://www.arb.ca.gov/regact/grnhsgas/isor.pdf>>.

<sup>39</sup> Federal Power Act, 16 U.S.C. § 796(24) (1935).

<sup>40</sup> *Id.* at § 796(15).

<sup>41</sup> *Id.* at § 824(d), *E.g.*, Electrical corporations; procurement plans, CAL. PUB. UTIL. CODE § 454.5 (West 2008).

<sup>42</sup> *Re: Alternative-Fueled Vehicle Tariffs*, 283 P.U.R.4th 361 (Cal.P.U.C. 2010).



exerting its jurisdiction, it chose *not* to regulate the “ownership or operation of a facility that sells electric vehicle charging services.”<sup>43</sup> The legislature directed the CPUC to incentivize growth in the EV market.<sup>44</sup> The CPUC opted to minimize regulation because, “neither the letter of the law nor the spirit of the law require commission regulation of electric vehicle charging stations.”<sup>45</sup> The CPUC retained control over only setting the rate for the electricity sold by an IOU to an electric vehicle charging service as long as it is a bundled customer of the utility.<sup>46</sup> In September, 2011 the California legislature further clarified the state regulatory role when it passed an assembly bill stating, “the ownership, control, operation, or management of a facility that supplies electricity to the public only for use to charge light duty plug-in electric vehicles, as defined, does not make the corporation or person a public utility for purposes of the act.”<sup>47</sup> This policy supports charging stations becoming a competitive service with third parties competing to install infrastructure. This clear policy leadership has allowed third party vendors to start the initial infrastructure investment for public EV charging with reduced uncertainty. The state’s clear leadership also clarified that it would be the third parties not the utilities that would provide for this investment, which further reduced uncertainty for competitive provision of this service.

SDG&E, as a distribution service provider, will need to consider potential infrastructure upgrades as charging station locations are determined. SDG&E intends to install 129 utility-owned Level 2 charging stations and 13 Level 3 “Fast Charge” stations next year. Storage will also be an

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<sup>43</sup> *Id.* at 361.

<sup>44</sup> Public Utilities – Electric Vehicles, Cal. Pub. Util. Code § 216 (West 2009).

<sup>45</sup> 283 P.U.R.4th at361, 362.

<sup>46</sup> *Id.* at283 P.U.R.4th 361, 361.

<sup>47</sup> 2011 California Assembly Bill No. 631, California 2011-2012 Regular Session

element of the infrastructure upgrades. The Utility is working on a pilot to integrate stationary batteries with fast charging stations, which will also collect data on consumption habits for future design plans.<sup>48</sup>

In regard to storage technology, the California State Assembly passed a bill in June 2011 that requires the CPUC to establish cost effective energy storage systems procurement targets for each utility by March, 1, 2012. By October 1, 2013 SDG&E will have three years to adopt the storage target. To be cost effective, there must be significant advances in this technology. A provision for a second target of December 31, 2021 exists to provide some time for better technology, if needed.<sup>49</sup>

One of the primary benefits to EVs is the decreased greenhouse gas emissions. But, if significant numbers of EVs are being charged during the height of daily electric use, that benefit may be partly lost because the California Independent System Operator which operates the California grid may be forced to make up for the increased demand by dispatching additional peaking power plants. The Utility plans to continue developing its TOU rates. Currently, SDG&E is studying the habits of EV owners to formulate the best rate design to incentivize off-peak charging. Their findings should be useful to other utilities to integrate EV. SDG&E hopes to support the growth of the whole EV market by supporting the services that support EV charging. The Utility also supports education and outreach for residential and commercial charging through third party contractors, municipalities, dealerships, and the media, to name a few.

## **DISTRIBUTION AUTOMATION AND RELIABILITY**

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<sup>48</sup> SDG&E SGDP Pg. 237

<sup>49</sup> "California State Assembly Passes Energy Storage Bill AB 2514 -- SACRAMENTO, Calif., June 4 /PRNewswire-USNewswire/." *PR Newswire: Press Release Distribution, Targeting, Monitoring and Marketing*. CESA (California Energy Storage Alliance), 4 June 2011. Web. 22 Sept. 2011. <<http://www.prnewswire.com/news-releases/california-state-assembly-passes-energy-storage-bill-ab-2514-95656959.html>>.

One of the things SDG&E values highly is reliable electric service. The Utility complies with CPUC guidelines<sup>50</sup> for collecting data based on certain reliability indices during momentary and sustained outages using SAIDI (System Average Interruption Duration Index), SAIFI (System Average Interruption Frequency Index), and MAIFI (Momentary Average Interruption Frequency Index). The Utility then submits an annual report containing this data.<sup>51</sup> The CPUC also enforces standards for operation, reliability, and safety during emergencies.<sup>52</sup>

Reliability remains one of SDG&E's most important goals while implementing smart grid technologies. Reliability is important because electricity is so necessary for the functioning of the economy, vital health services, public transportation, and safety, just to name a few. Loss of service due to technology failure during smart grid deployment could cause noticeable power outages, and would increase the cost of smart grid implementation. According to a study by the National University System Institute for Policy Research, the most recent blackout in August, 2011 in SDG&E's territory cost the greater San Diego region \$97-118 million. This included costs in spoiled food, government overtime, and lost productivity. These figures are just for the San Diego region. They do not include the other parts of Arizona and Mexico that were without power. Americans lose about \$150 billion a year due to small blackouts and brownouts.<sup>53</sup>

Fortunately, the technology updates being made to implement the smart grid should help improve reliability. The data utilities receive about voltages on their distributions system will allow

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<sup>50</sup> CPUC D.96-09-045

<sup>51</sup> SDG&E SGDP 216-17

<sup>52</sup> D.98-07-097, adopting General Order 166, D.00-05-022 adding Standards 12 and 13 to GO 166, pertaining to the Restoration Performance Benchmark for a Measured Event.

<sup>53</sup> DiSavino, Scott. "Insight: Power Reliability Will Cost Americans More." Reuters, 13 Sept. 2011. Web. 15 Sept. 2011. <<http://www.reuters.com/article/2011/09/13/us-utilities-sandiego-blackout-idUSTRE78C4UG20110913>>.

SDG&E to plan for appropriate adjustments in the voltage on the grid in order to better optimize the system. The presence of smart meters on the distribution system, acting as smart sensors, will also assist the Utility in knowing which residences and businesses are without power and can choose to deploy work crews based on the greatest need or on updated emergency contingency plans. Reliability will also increase as the grid will be able to heal itself without manual intervention. Automatic reclosers and other kinds of technology will trigger processes that will reconnect the power if it is interrupted. This greatly enhances the performance and reliability in the grid by decreasing the danger to line-workers and creating less need for people to go out and re-connect the electricity when there is an outage.

Common Interoperability Standards are another piece of the smart grid puzzle that helps with reliability. Interoperability ensures “two [or more] different systems or components [are able] to communicate, share, and use information that has been exchanged without need for custom integrations or end user intervention.”<sup>54</sup> Practically, electric utilities, home appliance manufacturers, grid component technology manufacturers, and consumers all need a uniform system. This idea is just like electric sockets. Everywhere you go within the United States you can be sure to find electric outlets that will be able to serve your various electric appliances because there are interoperability standards. You don’t have to have a different adapter for everything. The smart grid needs this kind of compatibility too.

SDG&E has opted to take advice from the National Institute of Standards and Technology (NIST). NIST sets standards for things like exactly how much weight a pound is. It has also made suggestions for certain standards for the operation of the smart grid. SDG&E plans to follow NIST’s interoperability standards in the areas of: Operations; Markets; Service Provider; Bulk Generation; Distribution; Transmission; Customer; General; and Security.<sup>55</sup> Matching the federal standards for these

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<sup>54</sup> Hertzog, Christine. *Smart Grid Dictionary*. [United States]: GreenSpring Marketing, 2010. 151. Print.

<sup>55</sup> SDG&E SGDP Pg. 125

particular facets of grid operation will help decrease cost and increase practicable usage of smart grid technologies well into the future. Importantly, these technologies can also increase incentives for customer adoption of demand response programs as well by ensuring that accurate electricity use information is being exchanged between the customers and the utility. SDG&E hopes that instituting standards for reliability and interoperability will also help control stranded costs.<sup>56</sup> These efforts in interoperability should also help “prosumers (those that both produce and consume energy),”<sup>57</sup> connect to the grid more easily so that distributed generation is enhanced in SDG&E’s service territory and beyond.

## **DISTRIBUTED GENERATION**

California’s Renewable Portfolio Standard (RPS) calls for 33% renewable generation by 2020.<sup>58</sup> In 2006 the California senate passed the “Million Solar Roofs Program”.<sup>59</sup> The goal is to install 3,000 MW of distributed electric solar photovoltaic (PV) systems by 2016. SDG&E hopes to install 180.3 MW of the state total. The California legislature further passed Feed-In Tariffs in 2006 and 2008 to help make solar more cost effective and feasible. In 2012 SDG&E connected “4,426 new systems (primarily solar)... for a total of 17,969 residential and commercial systems connected (over 1% of SDG&E’s customer base).”<sup>60</sup>

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<sup>56</sup> *Id.* at 126-27.

<sup>57</sup> *Id.* at Pg. 129.

<sup>58</sup> <http://www.cpuc.ca.gov/PUC/energy/Renewables/index.htm>

<sup>59</sup> <http://www.cpuc.ca.gov/PUC/energy/Solar/aboutsolar.htm>

<sup>60</sup> SDG&E Smart Grid Deployment Plan 2012 Update, Pg. 2  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf)

The CPUC enacted Renewable Auction Feed-In Tariffs.<sup>61</sup> CPUC approved an additional 100MWs of PV through SDG&E's Solar Energy Project (SEP). Additionally, combined heat and power (CHP) projects, planned for completion by 2020, will displace about 30,000 gigawatts (GWh) of demand from elsewhere in the fuel mix.<sup>62</sup> That's roughly equivalent to the electricity needed to power 257,939 homes for a year or, roughly half the annual CO<sub>2</sub> emissions of the average coal-fired power plant.<sup>63</sup>

SDG&E customers strongly support distributed rooftop solar. SDG&E customers have already installed more megawatts (MW) of rooftop solar in San Diego than utility customers in any other U.S. city. According to SDG&E estimates by June 2012, SDG&E customers owned more than 137MW of rooftop solar capacity. SDG&E's high penetration of PV is likely to require SDG&E to be a leader in using smart grid technology to address both the quantity of distributed generation on its distribution system as well as the intermittency of this growing source of generation.

Increased technology in storage and voltage control should help mitigate some of the problems that come with distributed generation (DG). By 2020 SDG&E will likely have installed sufficient smart transformers, inverters, synchrophasors, and capacitors to control voltage and VAR fluctuations to make it an industry leader in this area. SDG&E plans to use "energy storage...advanced control and management...and solid state voltage regulation."<sup>64</sup> This will increase distributed generation penetration and increase efficiency.

One of the regulatory questions often raised with implementing smart grid is cost allocation. Clearly, the initial costs of deployment will be large. Initially, SDG&E filed with the CPUC to have a

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<sup>61</sup> <http://www.cpuc.ca.gov/PUC/energy/Renewables/feedintariffssum.htm>

<sup>62</sup> SDG&E SGDP Pg. 214-15

<sup>63</sup> <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

<sup>64</sup> *Id.* at Pg. 48

network usage charge (NUC) that would individualize, rather than socialize the system costs of distributed solar generation. The charge would in essence base customers' costs on how much they use the grid. So, "prosumers",<sup>65</sup> customers pulling electricity from the grid *and* putting electricity back on it, would be utilizing the distribution system in a fundamentally different manner than customers that just draw from it. In January 2012, the CPUC rejected the NUC stating, "NUC would base the [distributed solar] generator customer's charges on network usage that is unrelated to net kWh consumption."<sup>66</sup> Basically, the CPUC would rather the costs for network updates to facilitate increased distributed solar generation be recovered from all the SDG&E customers, and not just those who install photovoltaic (PV) solar panels. The CPUC argued that allocating costs discriminatorily to people with PV was not justified.

NUC's filing included two other proposals: (1) a basic service fee; and (2) a voluntary pre-pay program. First, in a PG&E rate case the CPUC said in May, 2011, "[w]e find no statutory restrictions categorically prohibiting a fixed residential customer charge."<sup>67</sup> The CPUC said they will extend that decision in deciding whether SDG&E's basic service fee is legal. In regards to the pre-pay program, the CPUC, in part, accepted the consumer advocates arguments in opposition to the SDG&E proposals and asked SDG&E to remove the NUC and to provide input on the legality of the basic service fee and the voluntary pre-pay program. SDG&E filed a new request for approval of charged rates on February 17<sup>th</sup>, 2012.<sup>68</sup>

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<sup>65</sup> SDG&E SGDP Pg 129.

<sup>66</sup> <http://docs.cpuc.ca.gov/efile/RULC/157634.pdf> , Pg. 8

<sup>67</sup> Application of Pac. Gas & Elec. Co. To Revise Its Elec. Marginal Costs, Revenue Allocation, & Rate Design, including Real Time Pricing, to Revise its Customer Energy Statements, & to Seek Recovery of Incremental Expenditures. (U 39 M), 10-03-014, 2011 WL 2246067 (May 26, 2011)

<sup>68</sup> <http://docs.cpuc.ca.gov/efile/A/157735.pdf>

According to a July 2, 2012 report in Smart Grid Today, SDG&E is undertaking a microgrid project that will jointly evaluate solar generation capabilities, energy storage, and customer behavior. The project located in Borrego Springs, about 90 miles outside of San Diego, will evaluate the benefits of storage on a system that generates too much solar power for the transmission system to take out of the community. In order to smooth solar output, SDG&E will install a 0.5-1.5 MW storage system at a substation, three 25 KW by 50 KWH community energy storage sites, and three 4.5 KW by 12 KWH sites at individual customer residences. While Borrego Springs will remain grid connected, a goal of the project is to improve system reliability for the local customers. SDG&E is also testing customer behavior through by installing smart appliances at 125 residential and small commercial customer sites in the area. This SDG&E initiative is jointly funded by \$7.5 million from the U.S. Department of Energy and \$3 million from the California Energy Commission.<sup>69</sup>

## **ESTIMATED COSTS**

The full costs of SDG&E Smart Grid Deployment Plan implementation are calculated for the 2006-2020 period at \$3.5-3.6 billion. They include: “capital expenditures and operating and maintenance (O&M) expenses”.<sup>70</sup> Other costs are already billed to customers in the electric rates. Included in the total is \$1.042 billion for previously authorized investments, \$1.424 billion for the 2012 Test Year General Rate Case, \$237 million for active applications like demand response and dynamic pricing, \$299-364 million for CPUC estimated incremental investments, and \$466-555 million in FERC estimated incremental investments.<sup>71</sup> Provisional ranges for 2016-2020 show that costs could be 25% higher or lower than the base case. This is due to external factors like how some technologies

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<sup>69</sup> “In Middle of Desert, SDG&E will Explore Solar Smoothing” Smart Grid Today, July 2, 2012.

<sup>70</sup> SDG&E SGDP pg. 265, FN 44

<sup>71</sup> SDG&E SGDP Pg. 268



implemented in this range may not have been developed yet, the health of the economy could get better or worsen, and that cost projections are inherently indeterminate. Cost estimates come from a number of investments like customer empowerment, renewable growth, electric vehicle (EV) growth, reliability, safety, security, operational efficiency, research and development, integrated and cross-cutting systems, and workforce development. Between July 1, 2011 and June 30, 2012 SDG&E had smart grid deployment costs that totaled 156,188,000.<sup>72</sup>

## ESTIMATED BENEFITS

SDG&E projects the benefits of smart grid technology deployment will significantly exceed projected costs. Between 2011 and 2020, the Utility expects about \$3.8 – 7.1 billion in overall benefits, which includes \$760 million – 1.9 billion in societal and environmental benefits like a healthier environment and better quality of life.<sup>73</sup>

Category	Benefit Type
Economic	Improved Asset Utilization
	Transmission & Distribution Capital Savings
	Transmission & Distribution Operating Expenses Savings
	Theft Reduction
	Energy Efficiency
	Electricity Cost Savings
Reliability	Power Interruptions
	Power Quality
Environmental	Air Emissions
Other	Safety & Security
	Customer Satisfaction
	Energy Independence

<sup>72</sup> Smart Grid Deployment Plan 2012 Annual Report, Pg. 19  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf)

<sup>73</sup> SDG&E SGDP Pg. 289

The 2012 Smart Grid Deployment Annual Report shows that in 2012 there were demonstrated benefits of 39,870,000.<sup>74</sup> SDG&E's Benefits Framework consists of four categories of issues:<sup>75</sup> The benefits include avoided emissions from: energy reductions and peak load shifting, integrating centralized renewable energy, integrating distributed generation, and integrating more electric vehicles. These comprise \$391 million – 1.324 billion of the total monetary benefits and about 7.7 million tons of carbon dioxide equivalent (CO<sub>2</sub>e) avoided. EVs specifically will save about \$369-615 million and about 207 million gallons of gasoline. Between 2006 and 2020 SDG&E has estimated benefits for Economic and Reliability Benefits and Terminal Value. There is approximately \$1.378 billion in benefits from previously authorized funding. The expected projects like the TY2012 General Rate case, active applications like demand response, and incremental investment benefits total an estimated \$1.682 billion – 3.799 billion.<sup>76</sup>

Other benefits pertaining to reliability, security, and the environment were qualitatively counted.

<b>COSTS vs. BENEFITS</b>	<b>SDG&amp;E Projected Benefits<sup>77</sup></b>		<b>SDG&amp;E Projected Costs<sup>78</sup></b>
<b>Range</b>	\$3.8 – 7.1 billion In overall benefits.		\$3.5-3.6 billion During the 2006-2020 period
<b>Margin of Error</b>	High <sup>79</sup> +30-75%	Low -75% to - 50%	+/- 25%

<sup>74</sup> Smart Grid Deployment Plan 2012 Annual Report, Pg. 20  
[http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf)

<sup>75</sup> SDG&E SGDP Pg. 295.

<sup>76</sup> *Id.* at Pg. 292

<sup>77</sup> SDG&E SGDP atPg. 286-313.

<sup>78</sup> *Id.* atSDG&E SGDP Pg. 265-86286.

<sup>79</sup> *Id.* atSDG&E SGDP Pg. 298.

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benefits remain qualitative and not quantitative because they meet policy goals, they rely on technology that does not yet exist, or because they just have no widely-recognized monetary value.<sup>80</sup> Benefits like customer empowerment have the chance to save money and prevent emissions because ideally customers will use less electricity, but customer empowerment has intrinsic value as well. The monetary values associated with customer empowerment come from installation of smart meters at the residential and commercial level, increased penetration of distributed generation like rooftop solar, and greater adoption of plug-in electric vehicles (EV). Increased reliability through increased supervisory control and data acquisition (SCADA) and grid self-healing will enhance the benefits derived from customer empowerment. Customers should gain faith in the reliability of the smart grid and remain satisfied with their service with these improved monitoring technologies. Smart Transformers manage electricity flow to and from residences and enable reliability with rooftop solar and EVs are among the specific technology advancements that increase the efficiency of the grid itself, but will also create other indirect benefits.<sup>81</sup>

## **PRIVACY**

Currently, SDG&E protects its customer data via contractual agreements with its customers and third parties.<sup>82</sup> It also complies with local, state, and federal privacy protections. In the future, SDG&E will need to consider the heightened necessity for privacy protections with the increased amount of behavioral electricity usage data collected by smart meters. California Senate Bill 1476 enabled the

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<sup>80</sup> *Id.* at Pg. 296

<sup>81</sup> Berst, Jesse. "Smart Transformer Breakthrough – but Will We Be Too Slow to Take Advantage?" *Smart Grid: Smart Grid News - Grid Modernization and the Smart Grid*. SmartGridNews.com, 20 June 2011. Web. 13 Sept. 2011. <[http://www.smartgridnews.com/artman/publish/Delivery\\_Grid\\_Optimization/Smart-transformer-breakthrough-but-will-we-be-too-dumb-to-take-advantage-3764.html](http://www.smartgridnews.com/artman/publish/Delivery_Grid_Optimization/Smart-transformer-breakthrough-but-will-we-be-too-dumb-to-take-advantage-3764.html)>.

<sup>82</sup> Vermont Law School's Institute for Energy and the Environment's model privacy policy can be found at: [www.vermontlaw.edu/smartgrid](http://www.vermontlaw.edu/smartgrid).

CPUC to take their own initiative to require the major California Investor Owned Utilities (PG&E, SCE, SDG&E) to establish their own Smart Grid Customer Privacy Policies.<sup>83</sup>

In addition to adopting NIST interoperability standards, SDG&E supports the “four dimensions of privacy” suggested by NIST as key components of its security and privacy programs:<sup>84</sup>

- (1) *Personal information*—any information relating to an individual, who can be identified, directly or indirectly, by that information and in particular by reference to an identification number or to one or more factors specific to his or her physical, physiological, mental, economic, cultural, locational or social identity;
- (2) *Personal privacy*—the right to control the integrity of one’s own body;
- (3) *Behavioral privacy*—the right of individuals to make their own choices about what they do and to keep certain personal behaviors from being shared with others; and
- (4) *Personal communications privacy*—the right to communicate without undue surveillance, monitoring, or censorship.<sup>85</sup>

SDG&E has become an industry leader by ensuring customer data privacy in the smart grid, including introducing privacy into its design. In a joint whitepaper issued with the Information and Privacy Commissioner of Ontario Canada, titled “Applying Privacy by Design, Best Practices to SDG&E’s Smart Pricing Program” announced its collaboration with the Information and Privacy Commissioner and acknowledged the “importance of proactively building privacy into its design.” SDG&E created a position for a Chief Customer Privacy Officer and assigning a director responsible for customer privacy.<sup>86</sup> The Utility will decide if data is absolutely necessary to collect in the first place before they collect it. If it does collect information, it will protect it with security controls that will be tested for weaknesses to prevent loss or theft of the information. Third parties will only be able to access information absolutely necessary to perform work promised for the Utility under contractual obligations.

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<sup>83</sup> Ann.Cal.Pub.Util.Code § 8380; available at <http://docs.cpuc.ca.gov/published/Graphics/140370.PDF>.

<sup>84</sup> SDG&E SGDP Pg. 120

<sup>85</sup> NIST “Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid” Pg. 1 (.pdf in the Privacy folder on the K:/ Drive). Emphasis in original.

<sup>86</sup> Brill, Tom, SDG&E. "RE: Quick SGDP Question for You." Message to the author. 16 Sept. 2011. E-mail.

SDG&E will only share customers' information with affected customers' consent. And, last, SDG&E will continue to be held to applicable laws, regulations, and industry best practices.<sup>87</sup>

In the near future SDG&E intends to address the following sub-areas of customer data protection:

- Customer Data Collection
- Sharing, and Retention
- Data Accuracy and Reliability
- Protection Against Data Loss or Misuse
- Sharing Customer Information and Energy Data
- Third Party Data Usage Purpose
- Information Security and Privacy for Shared Data
- Limitations and Restrictions on Third-Party Data
- Enforcement of Limitations and Restrictions
- Individuals' Access to Their Data
- Audit, Oversight, and Enforcement Mechanisms.<sup>88</sup>

SDG&E continues to contract with third party vendors like software companies. Some personally identifiable information will be used by these third party vendors to perform necessary services.

SDG&E contractors will be under contractual obligation to maintain privacy. The Utility must furnish third parties with "appropriate non-disclosure agreements regarding customer related data."<sup>89</sup>

Specifically, to maintain privacy for customers' information, SDG&E has developed several measures to ensure security via the contracts with its vendors. SDG&E will cast a wide net over information within the term "Confidential Information". Vendors will be restricted from using confidential customer data for their own commercial benefit. The vendors themselves also must practice reasonable safety measures with onsite security evaluations. The third party information privacy contract provisions for smart grid utility customers will remain in effect for perpetuity.<sup>90</sup> SDG&E will also

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<sup>87</sup> SDG&E SGDP Pg. 121

<sup>88</sup> *Id.* at Pg. 78-85.

<sup>89</sup> *Id.* at Pg. 83

<sup>90</sup> SDG&E SGDP Pg. 83-84

protect customer data in its own normal operation procedures. Like all other California utilities, SDG&E has an existing procedure for auditing of SDG&E internal protocol and procedure. Safety, Privacy, and Security will continue to be at the forefront of planning for the smart grid. Customers' data and property must be secure in order for the smart grid to be considered a success.<sup>91</sup> To this end, SDG&E must be sure to enforce the third party contract provisions that protect customer data. Consistent with CPUC policy, SDG&E is also a leader in offering its customers timely access to their data and has been a leading utility in participating with the federal governments Green Button initiative. The CPUC has also required that California IOUs file annual privacy reports. The CPUC has also extended similar customer privacy protection requirements to Electric Service Providers and Community Choice Aggregators which provide competitive energy services to California IOUs customers.

SDG&E was the first utility in the nation to respond to the White House's challenge and commit to implementing the Green Button, which provides a standardized platform for the secure and private transfer of customer energy usage information to the customer.<sup>92</sup> In late 2012, SDG&E launched the service, "Green Button – Connect My Data," which enables customers to choose third-party information services provider to whom SDG&E will then securely transfer usage data. These third-party information services providers have already created over 60 Green Button applications that enable customers to access, engage with, and better understand their personalized energy use data via their computers, smart phones, and tablets.<sup>93</sup>

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<sup>91</sup> There is a model privacy policy in the appendix to this report. It is also available at [www.VermontLaw.edu/smartgrid](http://www.VermontLaw.edu/smartgrid)

<sup>92</sup> San Diego Gas & Electric. *Smart Grid Development Plan 2012 Annual Report*. October 1, 2012. P. 8. Available at [http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf).

<sup>93</sup> San Diego Gas & Electric. *Smart Grid Development Plan 2012 Annual Report*. October 1, 2012. P. 8. Available at [http://www.sdge.com/sites/default/files/documents/1138900767/SDGE\\_Annual\\_Report\\_Smart\\_Grid\\_Deployment.pdf](http://www.sdge.com/sites/default/files/documents/1138900767/SDGE_Annual_Report_Smart_Grid_Deployment.pdf).

## OPT - OUT POLICY

In March, 2012, the California Public Utility Commission passed an order requiring SDG&E to have an opt-out policy for its customers who refuse installation of a smart meter.<sup>94</sup> The Utility is allowed to charge an extra fee of up to \$75/ customer, plus \$10/month<sup>95</sup> for customers that opt out of the installation. Opt out fees were set by the CPUC for the initial order, and “will be subject to adjustment upon conclusion of the second phase of this proceeding.”<sup>96</sup> The decision came out of a Utility Consumers’ Action Network (UCAN) filing to request SDG&E’s Advanced Metering Infrastructure (AMI) Project be amended to include an opt-out provision for customers who are concerned about the impact of radio frequency radiation from the wireless smart meters.<sup>97</sup>

SDG&E has received far less opposition from its customer base than some other utilities have experienced.<sup>98</sup> Where opposition does exist in the SDG&E service territory, the concerns are because a small segment of customers fear that “the computerized meters [are] a potential privacy invasion liability, and a health risk.”<sup>99</sup> The Utility Consumer Action Network was instrumental in getting the opt-out provision for SDG&E customers.<sup>100</sup> These concerns have not been widespread in SDG&E territory

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<sup>94</sup> CPUC Agenda ID #11156, Application 11-03-015 (Filed March 24, 2011)  
<http://docs.cpuc.ca.gov/efile/PD/161677.pdf>

<sup>95</sup> St. John, Jeff. "SDG&E, SoCal Edison Get Smart Meter Opt-Out Orders." *GreenTechGrid*. GreenTech Media, 16 Mar. 2012. Web. 01 Apr. 2012. <<http://www.greentechmedia.com/articles/read/sdge-socal-edison-get-smart-meter-opt-out-orders/>>.

<sup>96</sup> CPUC Agenda ID #11156, Application 11-03-015 (Filed March 24, 2011) Pg. 2.

<sup>97</sup> CPUC (D.) 07-04-043

<sup>98</sup> St. John, Jeff. "SDG&E, SoCal Edison Get Smart Meter Opt-Out Orders." *GreenTechGrid*. GreenTech Media, 16 Mar. 2012. Web. 01 Apr. 2012. <<http://www.greentechmedia.com/articles/read/sdge-socal-edison-get-smart-meter-opt-out-orders/>>.

<sup>99</sup> Steussy, Lauren. "Smart Meter Customers Must Pay to Opt Out: SDG&E." *NBC San Diego*. NBCUniversal, Inc., 7 Feb. 2012. Web. 01 Apr. 2012. <<http://www.nbcsandiego.com/news/local/Customers--138805844.html>>.

<sup>100</sup> UCAN. "UCAN to PUC: Smart Meters Shouldn't Be Forced Upon SDG&E Customers." *Energy*. Utility Consumers' Action Network (UCAN), 22 May 2011. Web. 01 Apr. 2012.  
<[http://www.ucan.org/energy/electricity/advanced\\_metering/ucan\\_puc\\_smart\\_meters\\_shouldnt\\_be\\_forced\\_upon\\_sdge\\_customers/](http://www.ucan.org/energy/electricity/advanced_metering/ucan_puc_smart_meters_shouldnt_be_forced_upon_sdge_customers/)>.

compared to other utilities experiences and the CPUC has allowed SDG&E to proceed with installation but with an opt out policy in place to address individual concerns.<sup>101</sup> While SDG&E had argued that customers who opt out should receive a meter that is capable of recording interval data, with any wireless communication disabled, the CPUC ultimately disagreed and required that customers that opt out be offered more traditional analog meters. SDG&E has estimated the total number of customers who ultimately opt out to number approximately 3,000 residential customers.

## **WORKFORCE DEVELOPMENT**

SDG&E emphasized employee re-education and training to prepare for smart grid deployment and maintenance. It plans to continue to include local organizations and schools in creating vocational training to empower its workforce with skills to support the future needs of the grid. SDG&E includes community colleges, trade schools, and universities to encourage smart grid based curricula and training for smart grid implementation skills. Additionally, it plans to work with the San Diego Workforce Partnership and other union organizations in order to “develop agreements that are forward-thinking and collaborative.”<sup>102</sup> Current employees will be expected to develop new skills to adapt to the new technological and business processes. Human Resources will adapt to create a flexible workforce capable of providing the needs of a smart grid.<sup>103</sup>

There are a number of specific programs SDG&E will implement to do this. First, the Smart Grid Organizational Change Management will institute job training and employee management to develop new job skills for some employees, create some new jobs, and business procedures to ensure reliability

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<sup>101</sup> The Commission authorized SDG&E’s AMI Project in 2007 and SDG&E has almost completed its deployment of smart meters. Consequently, the standard for metering in SDG&E’s territory is now a wireless smart meter. Requiring SDG&E to provide an option that deviates from the standard will require the company to incur additional costs, as identified in the November 28, 2011 filing. CPUC Agenda ID #11156, Application 11-03-015 (Filed March 24, 2011) Pg. 18.

<sup>102</sup> SDG&E SGDR pg. 20.

<sup>103</sup> SDG&E SGDR pg. 20.



and safety while the Smart Grid Deployment Plan is instituted. Second, employees will be polled to gauge their attitudes and understanding of the various components of the new smart grid plan. Third, employees will be equipped with the new tools they need to meet the requirements of the new smart grid plan. Fourth, SDG&E is integrating hiring and training of employees with skills in electrical engineering and computer engineering. As a result, the IT and engineering departments are collaborating to provide the kind of employees ready for the integrated technology of tomorrow's grid. Fifth, SDG&E will implement tools to ensure an effective organizational shift from old practices and procedures into an evolved smart-grid-ready program.<sup>104</sup>

This kind of focus on vocational training of its workforce and collaboration with other community interests prepares SDG&E to deploy smart grid technology. SDG&E is wise to think ahead and have a workforce prepared to handle the grid challenges posed by the “newer” grid technologies. This focus should keep workers safe and electric power service reliable.

## **ENVIRONMENTAL DEFENSE FUND EVALUATION**

In addition to its direct work with SDG&E, EDF has been monitoring smart grid deployment in all of the California utilities under the jurisdiction of California Senate Bill 17 (SB 17), using the Evaluation Framework for Smart Grid Deployment Plans that it developed in consultation with national experts.<sup>105</sup> In August 2011, it issued “mid-term”<sup>106</sup> grades for the three Investor Owned Utilities in

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<sup>104</sup> SDG&E SGDP pgs. 260-62

<sup>105</sup> Cal. Pub. Util. Code § 8360-69 (West 2009).

<sup>106</sup> Reply of Environmental Defense Fund Regarding the Consolidated Applications REPLY OF ENVIRONMENTAL DEFENSE FUND REGARDING THE CONSOLIDATED APPLICATIONS OF SAN DIEGO GAS & ELECTRIC COMPANY, SOUTHERN CALIFORNIA EDISON, AND PACIFIC GAS & ELECTRIC COMPANY, FOR ADOPTION OF SMART GRID DEPLOYMENT PLANS., <http://www.edf.org/sites/default/files/A1106006%20EDF%20Reply%20to%20Application%20-%20August%2011.pdf>, pg. 4

California, Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and SDG&E

(collectively the “California IOUs”).

The Evaluation Framework’s guiding principles, based on the PUC decision and input from other stakeholders were:

- Smart grid deployments should seek to share costs between utilities and consumers, and deliver benefits to consumers commensurate with investments
- The smart grid should empower customers to make choices about their energy use, both to save money and to support clean energy.
- The smart grid should create a platform for a wide range of innovative energy technologies and management services.
- The smart grid should enable and support the sale of demand-side resources into wholesale energy markets, on equal footing with traditional generation resources.
- The smart grid should deliver environmental and public health benefits.

Based on these principles, EDF’s framework identified 8 criteria:<sup>107</sup>

- Asset Utilization;
- System losses;
- Criteria pollutants;
- Greenhouse gas emissions
- Renewables;
- Water use;
- Land use; and
- Solid waste.

EDF’s mid-term scores assigned to the California IOUs are based on EDF’s evaluation of the IOU’s

level of compliance with the stated goals of CA SB 17 in the areas of:

- Dynamic Pricing Options;
- Demand Management;
- Plug-and-Play, Generation Choice;
- Consumer Technologies;
- Electric Vehicles;
- Information;
- Customer Service;
- Customer Bills;
- Customer Equity;

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<sup>107</sup> *Id.* at Pg. 8

- Data Access and Privacy;
- Power Quality and Power Reliability.

This framework guided EDF’s review of the California IOUs. Each of these criteria was discussed in at least one of the three California IOUs Deployment Plans, and many were discussed in all three.

However, according to EDF, creating downward pressure on customer bills, improving and supporting customer equity, reducing barriers to plug-and-play devices, expanding generation choice, expanding consumer technologies for net energy metering and expanding 3<sup>rd</sup> party access to data for demand-side resource sales were not discussed in any of the plans.<sup>108</sup> SDG&E does not fully agree with this conclusion since they believe projects within the plan such as Customer Energy Network, Community Solar, and Home Area Network Infrastructure and Lab address issues such as sharing customer data with authorized third parties, expanding customer generation choices, and reducing barriers to plug and play devices.

Utility	Score (out of 40)	Corresponding grade
PG&E	28.9	C (72%)
SCE	31.8	B - (80%)
SDG&E	32.3	B - (81%)

Overall, EDF gave scores to PG&E, SCE, and SDG&E of C, B-, and B- respectively. Under EDF’s framework, SDG&E and the other utilities lost points for the lack of strong environmental metrics and goals, though EDF found that the other sections of their plans were carefully thought out and well crafted. For example, according to EDF’s analysis “[w]ords such as ‘more’ and ‘better’ and ‘most’ were used rather than quantity words like ‘all’ or ‘X %’ or ‘Y number of customers’ – therefore it will be difficult to use the roadmap sections to inform actual deployments or track whether deployments

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<sup>108</sup> *Presentation of EDF at CPUC Smart Utility Hearing on January 30, 2012*

are delivering the promised benefits.”<sup>109</sup> SDG&E responded to its score saying, “[w]e are currently reviewing the EDF scorecard and will be looking for ways that we can improve our score as we move forward with our smart grid Deployment Plans.”<sup>110</sup> In a recent CPUC filing, EDF recommended adoption of SDG&E’s and the other utilities’ plans, with the understanding that the environmental metrics and goals would be developed under a different proceeding.<sup>111,112</sup> Third parties who evaluate smart grid deployments for other utilities in the future can use a framework like this, which lets the utility clearly see what will be expected from the evaluation in advance. Then the utility can work with stakeholders and the third party evaluators to increase positive performance on selected principles like safety, privacy, and environmental responsibility.<sup>113</sup>

In support of additional transparency on smart grid implementation, the CPUC has required that the California IOUs file annual reports on a variety of smart grid implementation metrics which were to be further developed in a series of technical working groups.

## OBSERVATIONS AND LESSONS LEARNED

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<sup>109</sup> REPLY OF ENVIRONMENTAL DEFENSE FUND REGARDING THE CONSOLIDATED APPLICATIONS OF SAN DIEGO GAS & ELECTRIC COMPANY, SOUTHERN CALIFORNIA EDISON, AND PACIFIC GAS & ELECTRIC COMPANY, FOR ADOPTION OF SMART GRID DEPLOYMENT PLANS., <http://www.edf.org/sites/default/files/A1106006%20EDF%20Reply%20to%20Application%20-%20August%2011.pdf> , Pg. 10

<sup>110</sup> Guevarra, Leslie. "Smart Grid Report Card Finds CA Utilities Barely Average." *GreenBiz.com*. GreenBiz Group, 17 Aug. 2011. Web. 23 Aug. 2011. <<http://energynow.com/energypanel/2011/08/17/smart-grid-report-card-finds-ca-utilities-barely-average>>.

<sup>111</sup> <http://docs.cpuc.ca.gov/EFILE/CM/162090.htm>

<sup>112</sup> Interview with Thomas Brill, SDG&E." Telephone interview. 22 Aug. 2011.

<sup>113</sup> Image Source: REPLY OF ENVIRONMENTAL DEFENSE FUND REGARDING THE CONSOLIDATED APPLICATIONS OF SAN DIEGO GAS & ELECTRIC COMPANY, SOUTHERN CALIFORNIA EDISON, AND PACIFIC GAS & ELECTRIC COMPANY, FOR ADOPTION OF SMART GRID DEPLOYMENT PLANS., <http://www.edf.org/sites/default/files/A1106006%20EDF%20Reply%20to%20Application%20-%20August%2011.pdf> , pg. 4

## **FOCUS ON THE BIG PICTURE**

The State of California is advanced in its deployment of smart grid technology. The elements of the smart grid are gears in a rather large machine that enable benefits for the utilities, customers, and the environment. But, the pieces individually are not worth the same as the sum of their parts. SDG&E has begun to assemble various parts of the smart grid such as time of use rates, plug-in electric vehicles, and automated demand response to work together to provide storage, decreased peak energy use, and energy efficiency in one package. According to analyses of smart grid benefits, a utility that deploys the smart grid successfully will see the potential for vast improvements for operations, reliability, and environmental improvement.<sup>114</sup>

For example, looking forward, the State of California and SDG&E both have placed importance on interoperability standards. This focus on standards has the potential to ensure that the smart grid investments made today are compatible with the investments other utilities will make all over the country, now and into the future. This will help ensure that customers have a smooth experience whether in California's service territories or elsewhere.

## **CLEAR POLICIES AND GOALS LEAD TO INNOVATIVE RESULTS**

SDG&E has benefitted from clear expectations and guidelines in its plans for the smart grid.<sup>115</sup> This is of course, part of the "big picture" mentioned above, but it is especially important for state legislatures and public utilities commissions to understand. SB 17 and the subsequent CPUC decision clearly set out for the California IOUs goals to plan how smart grid technology and services should

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<sup>114</sup> United States. Department of Energy. Pacific Northwest National Laboratory. *The Smart Grid: An Estimation of the Energy and CO2 Benefits*. By RG Pratt, et. al. 28 Jan. 2010. Web. 25 Feb. 2012. <[http://energyenvironment.pnnl.gov/news/pdf/PNNL-19112\\_Revision\\_1\\_Final.pdf](http://energyenvironment.pnnl.gov/news/pdf/PNNL-19112_Revision_1_Final.pdf)>.

<sup>115</sup> "Interview with Thomas Brill, SDG&E." Telephone interview. 22 Aug. 2011.

follow. Similar to utilities across the country, the California IOUs must get CPUC approval to increase rates. The CPUC only approves rates that are prudent, just, and reasonable.<sup>116</sup> Smart grid investments are very capital intensive and utilities must obtain the approval of its public utility commission's for cost recovery of smart grid investments in the rate base. Utilities making smart grid investments must have clear policy goals and have a high level of assurance that they are making a prudent investment.

One primary reason why SDG&E has been able to develop and effectively begin to implement such a comprehensive smart grid Deployment Plan is because the State of California gave such clear guidance for the CPUC to follow to create an environment where the California electric corporations can be highly confident that they will be able to recover the costs of their smart grid investments.<sup>117</sup> The State of California passed a comprehensive law that set the clear expectations and smart grid goals.<sup>118</sup> Then, the CPUC, followed up on this legislative policy with clear guidelines for what was expected from the IOUs in their smart grid Deployment Plans.<sup>119</sup>

These guidelines required very comprehensive plans from the utilities that would then be subject to review and approval by the CPUC. Once the utilities got this guidance from the CPUC, they were able to be innovative with their plans for smart grid deployment while understanding that their plans were consistent with State policy. They all submitted very comprehensive smart grid Deployment Plans for the CPUC's review and approval.<sup>120</sup> The California utilities are now able to make technology investments in the smart grid; with little anticipation that their actions will be second guessed, especially

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<sup>116</sup> Cal.Pub.Util.Code § 451 (West 1977).

<sup>117</sup> "Interview with Thomas Brill, SDG&E." Telephone interview. 22 Aug. 2011.

<sup>118</sup> Cal. Pub. Util. Code § 8360-69 (West 2009).

<sup>119</sup> CPUC D.10-06-047.

<sup>120</sup> SDG&E SGDP: <http://docs.cpuc.ca.gov/efile/A/136633.pdf>

PG&E SGDP: <http://docs.cpuc.ca.gov/efile/A/138415.pdf>

SCE SGDP: <http://docs.cpuc.ca.gov/efile/A/138423.pdf>

in regards to policies and goals. This kind of leadership from the state government should ultimately result in earlier and more successful smart grid implementation; the example of SDG&E has begun to demonstrate clear benefits.

### **ADVANCE CUSTOMER EDUCATION ENHANCES CUSTOMER ACCEPTANCE**

Smart grid implementation has not always been without controversy in California. For Pacific Gas & Electric (PG&E), another California IOU, one of the biggest obstacles to its smart grid deployment has been the backlash of its customers. It has received so much public attention that there's a term for it: "The Bakersfield Effect," which spawned for PG&E's first attempt at rolling out smart meters. Their initial installation was in the heat of the summer, so some customers believed they experienced higher bills once they installed smart meters. As an example the media reported that one 71-year-old woman's bill shot up from \$55.52 in April to \$222.20 in July 2009.<sup>121</sup> A subsequent CPUC required audit of the PG&E meters determined that the meters were accurate but that did not prevent further complaints about health and privacy issues.

SDG&E is seemingly more fortunate because it has a customer base that is largely approving of, and willing to accept, its smart grid deployment goals. Because it has the highest penetration of EVs and rooftop solar in the country, SDG&E has both high customer acceptance of new technologies as well as special technical challenges. While, the SDG&E customer base has been mostly in favor of increased investments in the smart grid, SDG&E deserves some of this credit given that one of the key pieces of the SDG&E Smart Grid Deployment Plan is its communication with their customers and the communities that they operate within about the process and how it affects all stakeholders. Furthermore,

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<sup>121</sup> Cox, John. "PG&E Explains Soaring Bills." *Bakersfield Californian, The (CA)* [Bakersfield, California] 4 Oct. 2009: A1. Print.

SDG&E communication with customers and community members in its service territory for years before filing their Smart Grid Deployment Plan with the CPUC.

Specifically, the Utility worked to educate its customers about the environmental and cost benefits of smart meters well before they started to deploy them. SDG&E made an effort to communicate on an individual customer basis by sending out information and notification when the Utility was preparing to install smart meters. The Utility was careful to speak to customers about the issues that affect them closely and identify the issues customers are interested in. Not surprisingly, customers have not shown much interest in the synchrophasors on the electric lines, but they do care about reliability and functionality. One more important opportunity for the Utility to communicate with customers is dynamic pricing. Customers who opt into Time-of-Use rates are best served by being educated about the ways dynamic pricing can benefit their pocketbook and the environment.<sup>122</sup> Likely because of its efforts to communicate and be transparent, SDG&E has not experienced significant customer backlash for the integration of smart grid technologies,<sup>123</sup> with the noted exception of building and siting larger scale projects such as the Sunrise Powerlink.<sup>124</sup>

### **INCREASED TRANSPARENCY THROUGH THIRD PARTY EVALUATION**

The California IOUs have benefited by the third party evaluation of the smart grid implementation plans by the Environmental Defense Fund. Having a credible independent third party evaluate utility smart grid implementation plans is something that other regions should consider in order to both improve on implementation and increase customer acceptance of the plan. Building upon the work of EDF in

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<sup>122</sup> "Interview with Thomas Brill, SDG&E." Telephone interview. 22 Aug. 2011.

<sup>123</sup> Stone, Ken. "(Update) SDG&E: Few Have Health Complaints About Smart Meters - La Mesa, CA Patch." *La Mesa, CA Patch - News, Sports, Events, Businesses & Deals*. Patch Network, 8 Sept. 2011. Web. 10 Sept. 2011. <http://lamesa.patch.com/articles/sdge-says-only-a-handful-of-la-mesans-have-health-complaints-about-smart-meters>.

<sup>124</sup> "New Safety Concerns Raised After Powerlink Tower Mishaps." *10News.com*. 15 June 2011. Web. 4 Aug. 2011. Available at <http://www.10news.com/news/28253731/detail.html>.



California, third party evaluators can utilize a developed framework for evaluation of Smart Grid Deployment Plans which can be modified to incorporate the state or regional goals for things like renewable energy portfolio standards, electric vehicle integration, reliability, and privacy. Independent third party can provide the utility with useful feedback and at the same time it can also help educate and inform the public about the project's goals and utility's implementation plan.

SDG&E's implementation plan, coupled with clear state policy goals, place SDG&E in a national leadership role for comprehensive smart grid implementation. While SDG&E's experience to date represents significant progress, the Electric Power Research Institute has estimated that, nationally, fully implementing a smart electric grid will cost between \$1.3 and \$2.0 trillion, with benefits likely exceeding costs by a factor of three or more.<sup>125</sup> For SDG&E this suggests the opportunity for a significant amount of additional investment to be made in future years and will involve ongoing negotiation with regulators and other parties.

Research from Pacific Northwest National Laboratory has estimated that with full implementation of a smart electric grid by 2030 U.S. energy consumption and carbon emissions could be reduced by 12%.<sup>126</sup> Yet, as noted previously, it will take time to develop and offer additional technologies and rates to customers. In some areas, however, the smart grid will likely spur greater electricity use, such as smart charging of electric vehicles, in order to achieve efficiencies in total energy use across the economy. Continued investment in automation of the utility distribution system will offer future opportunities for improving reliability and optimizing energy use. Furthermore, as renewable energy reaches higher levels of development across the utility service territory, greater investment in smart grid technologies will be needed in order to reliably and cost-effectively manage these resources.

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<sup>125</sup> Elec. Power Research Inst., *Estimating the Costs and Benefits of the Smart Grid* 1–4 (2011).

<sup>126</sup> Pacific Northwest Nat'l Lab., *The Smart Grid: An Estimation of the Energy and CO2 Benefits* 3.3 (2010).

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**About the authors:**

**Katie R. Thomas**, JD candidate and MELP 2013, is a member of the VLS Smart Grid Project team and the lead researcher for the SDG&E case study. Katie is also a co-author of the Smart Grid Project's model data privacy policy. She can be reached at: [kthomas1@vermontlaw.edu](mailto:kthomas1@vermontlaw.edu).

**Kevin B. Jones, PhD**, is the Deputy Director and Smart Grid Project Leader at the Institute for Energy and the Environment. He can be reached at: [kbjones@vermontlaw.edu](mailto:kbjones@vermontlaw.edu).

For further information contact:

Institute for Energy and the Environment  
Vermont Law School  
PO Box 96  
South Royalton, VT 05068  
802-831-1054