

Energy Division Central Files Document Coversheet

<p>A. Document Name</p> <p>Today's Date (Date of Submittal): 10/01/2018</p> <p>Name:</p> <ol style="list-style-type: none"> Utility Name: SDG&E Document Submission Frequency (Annual, Quarterly, Monthly, Weekly, Once, Ad Hoc): Annual Report Name: Smart Grid Deployment Plan Reporting Interval (the date(s) covered by the data, e.g. 2015 Q1): 2017 Q3 – 2018 Q2 Name Suffix: Cov (for an Energy Division Cover Letter), Conf (for a confidential doc), Ltr (for a letter from utility) (for a confidential doc), Ltr (for a letter from utility) Document File Name (format as 1+2 + 3 + 4 + 5): SDG&E Annual <i>Smart Grid Deployment Plan</i> 2017 Q3-2018 Q2 CovCov Identify whether this filing is <input checked="" type="checkbox"/>original or <input type="checkbox"/>revision to a previous filing. <ol style="list-style-type: none"> If revision, identify date of the original filing:
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<p>D. Document Summary</p> <p>Provide a Document Summary that explains why this report is being filed with the Energy Division. This information is often contained in the cover letter, introduction, or executive summary, so you may want copy it from there and paste it here.</p> <p>This report has been prepared in response to CPUC Decisions 10-06-047 and 14-12-004, and provides a status update on SDG&E's Smart Grid metrics, deployment costs, and benefits for the Reporting Period.</p>
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A  Sempra Energy utility®

SMART GRID Deployment Plan



2018 ANNUAL REPORT

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1 KEY TAKEAWAYS AND HIGHLIGHTS

Customer adoption of technologies and the state’s energy policy goals continue to drive the development and deployment of Smart Grid in the San Diego region. San Diego Gas and Electric (SDG&E) strives to be the cleanest, safest and most reliable utility in America.

Customers are choosing renewable energy technologies, electric vehicles (EVs), energy management tools, energy storage, and information services at a rapid pace. That said, challenges remain for the cost-effective realization of California’s ambitious energy policy goals.

Changes to SDG&E’s power supply resource mix are impacting nearly every aspect of the region’s electricity system. Substantial growth in centralized and distributed renewable energy resources place new demands on system planners, engineers, and operators to ensure reliability and power quality in a very dynamic environment. Today, during days of peak production from renewable generation, the San Diego region has over 2,000 megawatts (MW¹) of solar and wind energy flowing to SDG&E customers.

At the same time, SDG&E’s customers are installing rooftop solar energy systems on their homes and businesses in greater numbers, resulting in 18.4% overall growth in Net Energy Metering (NEM) generation capacity to nearly 922 MW during the 12 months ending June 30, 2018 (the “Reporting Period”). SDG&E currently has 134,754 customers with rooftop solar in their service territory.

SDG&E customers now have generation capacity of nearly 922 MW.

SDG&E believes energy storage is an area that holds great promise for providing higher levels of reliability and meeting peak energy demand. SDG&E has been operating energy storage for the past several years.

Today, there are more than 110 MWs of energy storage connected to our local power grid including the largest lithium-ion battery facility in North America. Customers continue to adopt energy storage and have now connected over 34 MW of energy storage to the power grid.

As SDG&E looks for new opportunities, it will focus on installations that provide resiliency and energy security to complement the increasing amounts of renewable energy powering our region. SDG&E expects to add over 200 MW of energy storage. In May 2018, SDG&E received approval for an additional 83.5 MW of energy storage to be added to the power grid between now and 2021.²

¹ Unless otherwise noted, power capacity values (megawatt/MW and kilowatt/kW) are shown as alternating current (AC) nameplate ratings.

² Decision: A.17-04-017 <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K337/215337477.PDF>

Electric vehicle adoption continues in the region with the number of plug-in electric vehicles (PEVs) and plug-in hybrid electric vehicles (PHEVs) operated by San Diego drivers growing to nearly 30,000 during the Reporting Period.³ SDG&E continues to promote electric vehicles for employees. Over 500 employees own electric vehicles and the company has installed 263 charging stations at its facilities at the end of the Reporting Period. The chargers and systems deployed via our Smart Grid projects continue to provide insights that are leveraged by the company's overall PHEV adoption programs.

This *Smart Grid Deployment Plan – 2018 Annual Report* (“*Annual Report*”) provides stakeholders with an update on SDG&E's Smart Grid deployment as the San Diego region continues its rapid advance toward a smarter and cleaner energy future.

Similar to the previous issuances in 2012-2017, this seventh *Annual Report* provides a status update on SDG&E's Smart Grid metrics, deployment costs, and benefits for the Reporting Period.

Highlights of SDG&E's Smart Grid deployment update for the Reporting Period include:

- Overall estimated Smart Grid costs of ~\$96 million and ~\$109 million in benefits
- 26 Smart Grid and related enterprise⁴ projects completed, in progress or planned
- Leading EV adoption by example with 500 SDG&E employees driving electric vehicles and over 263 EV workplace chargers at SDG&E facilities
- PEV growth to nearly 30,000 total vehicles connecting to SDG&E's system, adding approximately 4,100 vehicles⁵
- Strong growth in NEM distributed generation (DG) with customers connecting nearly 21,000 new systems (primarily solar), for a new total of 134,754 residential and commercial DG systems interconnected with the SDG&E grid
- Rapid growth in customer energy storage deployments continues as more products enter the market and the residential market segment prepares for Time of Use (TOU) rate structures
- Today, there are more than 110 MWs of energy storage connected to our local power grid including the largest lithium-ion battery facility in North America.

PROGRESS TOWARD CALIFORNIA'S ENERGY POLICY GOALS

Many California and federal policies underpin SDG&E's *Smart Grid Deployment Plan*, including Senate Bill (SB) 17, the Renewable Portfolio Standard (RPS), Assembly Bill (AB) 32, AB 2868 (Gatto), AB 2514 (Skinner), AB 327 (Perea), the state's distributed generation (DG) and demand response (DR) goals, the Governor's Clean Energy Jobs Plan, building and appliance efficiency standards, implementation of the electric procurement loading order, and cybersecurity compliance requirements such as the North

³ Neighborhood electric vehicles (street legal plug-in vehicles with a maximum speed of 35 mph) are excluded from this count.

⁴ “Enterprise” projects are those that meet the broader needs of SDG&E's business but are also related to Smart Grid.

⁵ An exact number of PEVs connected to SDG&E's system is unavailable, as PEV drivers are not obligated to notify the utility, so estimates are compiled from a variety of data sources.

American Electric Reliability Corporation’s Critical Infrastructure Protection (NERC CIP) standards. The majority of Smart Grid projects SDG&E undertakes are designed to fulfill the utility’s role in realizing the state’s goals or complying with mandatory standards.

STAKEHOLDER ENGAGEMENT

SDG&E continues to work in collaboration with key stakeholders to create the foundation for an innovative, connected, and sustainable energy future and these collaborations have continued to improve productivity and expand in scope during the past year.

On an ongoing basis, SDG&E continues to collaborate with external stakeholders who provide input on its *Smart Grid Deployment Plan*, and who remain engaged with the utility on Smart Grid and other issues. These organizations include environmental interest groups, academic organizations, business organizations, municipal utilities and governments, ratepayer advocates, energy non-governmental organizations, large customer/corporate interests, collaborative organizations, and workforce interest groups.

More generally, SDG&E has continued to engage stakeholders across a wide spectrum of Smart Grid issues, seeking input and ideas related not just to SDG&E’s Smart Grid technology deployment, but the accompanying issues raised, such as customer privacy.

OPPORTUNITIES TO WORK WITH DIVERSE BUSINESS ENTERPRISES

In 2017, SDG&E achieved the highest level of spending with diverse businesses in the history of our company, purchasing 44.6 percent, or over \$703 million, worth of goods and services. This is the fifth consecutive year that SDG&E’s supplier diversity spending has been above 40 percent, far exceeding the California Public Utilities Commission’s (CPUC) goal of 21.5 percent.⁶

SDG&E anticipates there will be many opportunities in the coming years for business owners from diverse backgrounds to be a part of this exciting effort.

1.1 CUSTOMER DRIVERS

SDG&E is investing in Smart Grid solutions in response to two major customer-driven factors:

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https://www.sdge.com/sites/default/files/documents/SDG&E%202017%20Annual%20Report%20and%202018%20Annual%20Plan_0306_LR.pdf

- Installation of intermittent distributed (primarily PV) generation systems, which have variable power output and lack compensating controls for grid reliability (such as those that would be found in smart inverters); and
- Adoption of electric vehicles and energy storage.

Customers are continuing their investments in distributed generation systems with SDG&E's customers generating nearly 922 MW (peak) from almost 134,754 systems installed at their premises. This trend demonstrates the immediacy driving SDG&E's development of Smart Grid solutions, which are necessary to integrate and manage the ever-increasing number of small intermittent generators, while maintaining the level of system reliability that customers expect.

Customers continue to adopt SDG&E's Smart Grid investments with Behind the Meter (BTM) storage. Customers are choosing to reliably and efficiently integrate these new technologies with the Smart Grid. In addition to delivering energy, SDG&E provides standby, power quality, and reliability services to its customers.

1.2 CUSTOMER VALUE

Many of SDG&E's Smart Grid projects are undertaken to create value for customers where the projected benefits outweigh the costs or where the investment is necessary to effectively communicate with customers. The benefits of these customer value-driven and other policy-driven Smart Grid investments continue. For example, SDG&E's Smart Meter infrastructure provides residential and small commercial customers with their hourly (residential) or 15-minute (small commercial) energy consumption data, viewable online through SDG&E's My Account tool or transferred automatically to other service providers in an industry standard format and protocol. Use of commercially available network gateways allows customers to update their consumption information online nearly instantaneously. Actively managing energy consumption can provide value for customers if coupled with rate design that encourages off-peak energy use.

Customer value is also created through environmental benefits related to the integration of distributed energy resources, such as solar power generation, electric vehicles, and demand response. Carbon dioxide equivalent (CO₂e) and particulate emissions associated with fossil fuel generation can be displaced with distributed renewable energy resources or otherwise avoided through the reliable integration of clean power sources and the use of these sources as a clean transportation fuel.

2 SMART GRID DEPLOYMENT PLAN UPDATE

2.1 CHANGES TO THE DEPLOYMENT PLAN RESULTING FROM REGULATORY ACTION OR LEGISLATION

There were no changes in this Reporting Period. Changes reported in previous *Annual Reports* are not repeated here; readers should refer to those earlier reports for that information.

2.2 CHANGES TO SDG&E'S DEPLOYMENT PLAN RESULTING FROM IOU INITIATIVES

While other changes to the *Smart Grid Deployment Plan* are possible due to new information or understanding of issues, solutions, and market and technology developments; SDG&E had no such changes during this Reporting Period as shown in Table 1: Changes to SDG&E's *SGDP* from Utility Initiatives:

Table 1: Changes to SDG&E's *SGDP* from Utility Initiatives

Project	Change from Original <i>SGDP</i>	Reason for Change
Critical Peak Pricing Default (CPP-D) for Medium Commercial Customers	Removed	Completed
Sustainable Communities Programs	Removed	Completed
Managing PEV Charging	Removed	Completed
Smart Isolation and Reclosing	Removed	Completed
SDG&E Grid Communications Systems (SGCS)	Removed	Completed
Solar Energy Project	Removed	Completed
Solar Power Prediction	Removed	Completed
Customer Privacy Program	Removed	Completed
Smart Meter Operations Center (SMOC)	Removed	Completed
Smart Pricing Program (Dynamic Pricing)	Removed	Completed
Data Management and Analytics	Removed	Completed
Green Button Connect My Data	Removed	Completed
Smart Transformers	Removed	Completed
Automated Fault Location	Removed	Completed

2.3 PROJECT UPDATES

2.3.1 PROJECT COSTS

During the Reporting Period, SDG&E’s estimated expenditures of \$180,303 million breakdown as listed in Table 2: Estimated Smart Grid Deployment Costs for the Reporting Period⁷:

Table 2: Estimated Smart Grid Deployment Costs for the Reporting Period

Estimated Spend During the Reporting Period Amounts in Thousands of USD	Reporting Period Value
Customer Empowerment/Engagement	\$ 1,292
Distribution Automation/Reliability	\$ 54,031
Transmission Automation/Reliability	\$ 4,859
Asset Management, Safety & Operation Efficiency	\$ 25,546
Security	\$ 8,212
Integrated & Cross-Cutting Systems	\$ 1,978
Total Estimated Costs	\$ 95,918

Expenditures are estimated and based on total spend, including operations and maintenance (O&M) and capital, excluding Contribution in Aid of Construction (CIAC) and net of grant-based reimbursements from the California Energy Commission (CEC) and Department of Energy (DOE).

2.3.2 ESTIMATED BENEFITS

SDG&E continued using the same comprehensive methodology adopted for its *Smart Grid Deployment Plan* to calculate the estimated benefits for the *Annual Report*.

The framework of this methodology is primarily based on the benefits evaluation model that the Electric Power Research Institute (EPRI) included in the report titled, “Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects.”⁸ SDG&E’s methodology includes estimates of economic benefits, reliability benefits based on a Value-of-Service Reliability model developed by the Lawrence Berkeley National Laboratory,⁹ and environmental and societal benefits based on a model developed by SDG&E in collaboration with the Environmental Defense Fund¹⁰. As with any utility and technology investment, estimated benefits are expected to be realized over the life of the investment, which in nearly all cases is long beyond the time period in which costs are incurred. For

⁷ Refer to <http://www.cpuc.ca.gov/general.aspx?id=4693> for expenditure information from previous Reporting Periods.

⁸ Final Report No. 1020342, “Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects”, January 2010.

⁹ Final Report No. LBNL-6941E, “Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States”, January 2015.

¹⁰ For further details on the methodology for environmental and societal benefits, see <http://docs.cpuc.ca.gov/PublishedDocs/EFIELD/RESP/140924.PDF>.

example, a particular investment may drive costs for three years, but provides a benefit for as long as the asset is useful, which could be 10 years, 15 years, or even longer. Therefore, it is inappropriate to compare estimated benefits to costs incurred during the Reporting Period due to these time differences. However, some Smart Grid projects with phased implementations, such as Smart Meters or Condition-Based Maintenance (CBM) of gas breakers and transformers, may also accrue benefits during the course of project implementation.

Another aspect to consider when evaluating benefits is that many Smart Grid projects are undertaken to meet requirements and/or energy policy goals. While the specific solutions chosen to meet these mandated requirements and goals will be the least-cost, best-fit response, the quantifiable benefits associated with these solutions may not always exceed their project costs.

For this Reporting Period, the following categories will be used for quantified benefits:

Reliability benefits estimate the societal impact value of avoided outages for customers among residential, commercial, and industrial classes. SDG&E's methodology is based on a Value-of-Service Reliability model developed by the Lawrence Berkeley National Laboratory,¹¹ For example, Supervisory Control and Data Acquisition (SCADA) can provide automation which can restore customers from outages quicker than manual operations, while advanced metering infrastructure (AMI) can detect outages faster than historical methods again reducing outage times.

Physical and Cybersecurity benefits estimate a value of avoided disruption through outages caused by a cyber or physical threat.

Customer Demand Response savings measures the total savings from demand response programs across all customer classes.

Avoided costs are grouped into three categories:

- Operational benefits which include the avoided costs of utility operations enabled by Smart Grid technologies. An example of this would be the avoided hiring of additional employees to process the interconnection request from customers for rooftop solar or the avoided helicopter flights to examine the transmission system due to sensors installed under Smart Grid.
- Capital benefits which include the avoided capital costs enabled by Smart Grid technologies. An example of this would be the Condition Based Maintenance (CBM) project which has extended the life of the transformers and gas breakers via automated testing and monitoring.

¹¹ Final Report No. LBNL-6941E, "Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States", January 2015.

- Environmental benefits which estimate the value of avoided greenhouse gas¹² (GHG) and particulate emissions from renewable energy integration, electric vehicles in the service territory and renewable procurement standard benefits.

SDG&E's Smart Meter deployment continued providing benefits during the Reporting Period. The Smart Meter program has achieved relevant reduction and avoidance of operating expenses due to the elimination of a significant portion of meter reading activities and customer services field activities. In addition, the avoided truck rolls due to the reduction of meter reading and customer service field activities remained at normalized levels compared to the previous period, continuing to provide environmental benefits to the region.

During the Reporting Period, various completed and in progress distribution automation and reliability projects provided benefits to customers, markets, and the utility. Customers benefited from the reduction in outage time experienced since SCADA devices can be controlled remotely without the requirement of sending field personnel to switch devices while improving customer service. Projects such as SCADA Expansion, SCADA Capacitors, and Fault Location Isolation and Service Restoration (FLISR) generated these types of benefits through the increase in the use of distribution automation on the grid and improved reliability.

SDG&E also identified environmental benefits during the Reporting Period related to the integration of renewable energy generation resources, both centralized and distributed, which in SDG&E's case are primarily solar power generation. These environmental benefits include an estimation of the avoided emissions associated with displacing conventional generation with distributed renewable energy resources and the integration of centralized renewable energy for compliance with the RPS.¹³ The avoided emissions for distributed resources is based on the energy load forecast included in the recent California Energy Demand 2018-2028 Forecast prepared by the CEC for solar systems in SDG&E's service territory. In addition, the implementation of the Distribution Interconnection Information System (DIIS) achieved significant improvements in the process for approving rooftop solar interconnections. Customers experienced a reduction in the interconnection time with this system while contractors supporting these customers achieved their own savings resulting from an improved workflow process. The integration of nearly 30,000 electric vehicles into SDG&E's electric grid also generated additional benefits to the environment and the community. This translates into a positive environmental impact to the region by reducing net emissions, the difference between vehicles powered by liquid fuels and electricity generation. In addition, electric vehicle owners also benefited from the avoided fuel cost of the gallons of liquid fuels displaced.

¹² Pricing for GHG based on https://www.arb.ca.gov/cc/capandtrade/auction/auction_archive.htm

¹³ Estimated benefits based on the assumption that the system can accommodate a 20% RPS without Smart Grid technologies.

During the Reporting Period, SDG&E continued to realize benefits from previously completed projects in addition to new projects that were completed during the Reporting Period. It is important to note that these projects generated benefits not only for SDG&E's operations but also for its customers, the environment, and society in general. Table 3 provides a summary of the estimated benefits identified during the Reporting Period¹⁴:

Table 3: Estimated Smart Grid Benefits in the Reporting Period¹⁵

Estimated Benefits During the Reporting Period Amounts in Thousands of USD	Reporting Period Value
Reliability Benefits	\$ 34,057
Physical and Security Benefits	\$ 11,714
Customer Demand Response Savings	\$ 610
Physical and Security Benefits	\$ 62,686
Total Estimated Benefits	\$ 109,067

Safety is always at the forefront of what SDG&E does on a daily basis. Smart Grid enablement has allowed for increased safety via remote automation, reduction of outage times and safer operations. For example, SDG&E continues to pursue the falling conductor project which, when implemented in fire prone areas, can deenergize a falling conductor prior to striking the ground. In addition, the sensors on the power grid structures have limited the miles driven and helicopter flights needed making operations safer for our employees. Finally, the advanced weather network can predict and allow for heightened fire awareness in the ever-changing fire threat in our territory.

2.3.3 PROJECT SUMMARIES AND UPDATES BY PROGRAM AREA

Estimated project costs for the Reporting Period are shown in nominal thousands of dollars.

2.3.3.1 CUSTOMER EMPOWERMENT/ENGAGEMENT

Customer Empowerment/Engagement projects provide customers with readily accessible and reliable information regarding their energy usage. Additionally, projects in this area should help customers gain a better understanding of their energy consumption among their common uses. To further empower customers, price signals must flow to them in a timely and meaningful manner and be integrated into customer energy management and home area network (HAN) systems.

¹⁴ Refer to <http://www.cpuc.ca.gov/general.aspx?id=4693> for benefit information from previous Reporting Periods.

¹⁵ Environmental benefits calculated based on prices from a report prepared by the California Environmental Protection Agency, *Updated Economic Analysis of California's Climate Change Scoping Plan*, March 24, 2010 and SDG&E's internal forecasts.

Generally, projects in this area implement information systems, communication infrastructure, and energy management services along with customer-facing tools, services, and outreach capabilities. Projects included also enable customer-authorized third parties to disseminate important information and educate customers, recognizing that customers often value other sources of information.

Recognizing that smart phone and social media are increasing among many of the utility’s customers, SDG&E must provide the appropriate tools and applications to allow customers to access energy usage data and perhaps other utility-provided information. Projects are designed to meet customers’ new communications preferences and expectations, and to offer tools that provide customers with relevant information, such as price signals, that result in greater customer awareness of energy impacts. Deploying tools and applications that present valuable customer-specific energy data is a critical component to empowering customers and changing to time variant rate structures.

Projects that deliver information, services, and control sought by customers and that enable demand response, dissemination of dynamic pricing information, and HAN capabilities are included in this category. Projects included also provide customers with transparent and relevant pricing information and enable utility and non-utility service providers to offer products and services that provide customer value.

COMPLETED PROJECTS

Project 1: ECO Share/ ECO Choice (Connected..... to the Sun)	Reporting Period Estimated Cost: <\$100
<p>Description: In January 2012, SDG&E filed an application with the California Public Utilities Commission (CPUC) for a pilot program called, “Connected.....to the Sun,” which gives all SDG&E customers two options to buy solar power; whether they own the home or not, cannot afford the upfront cost of solar, or do not have the ability to put photovoltaic (PV) panels on their roof. Under these programs, EcoChoice and EcoShare, customers would be able to purchase up to 100% local solar energy if they chose. Both EcoChoice and EcoShare customers could “lock-in” their solar energy cost and take solar service with them if they relocate within SDG&E’s service area.</p> <p>Funding Source: Decision (“D.”) 15-01-051</p> <p>Status: Both products are released and available to the public. A more detailed report of the program’s success can be found at: https://www.sdge.com/residential/pricing-plans/about-our-pricing-plans/renewable-energy-options.</p>	

IN-PROGRESS PROJECTS

Project 2: Centralized Calculation Engine (CCE)	Reporting Period Estimated Cost: \$1,188
<p>Description: The development of the centralized calculation engine will incorporate multiple data sources to provide price and cost calculations as an output. The calculation engine will be flexible and incorporate all comprehensive rate, price, and cost modeling, as well as have the ability to manipulate curves, types of charges (consumption, demand, fixed, etc.), peak moves, event hour shifts, and a host of other functions. It will ensure consistency of calculations and output across many operations and users.</p> <p>Funding Source: General Rate Case (GRC)</p> <p>Status: The CCE is live and providing benefits to multiple teams across the company. It has completed thousands of runs and produced close to one billion bills. The CCE Phase 3 project added multi-rate calculations for rate comparisons across multiple rates, calculation of additional rates and additional detail in the rate calculation output, automation to reduce the effort required to run scenarios, and user interface improvements.</p>	

Project 3: Demand Response Management System (DRMS)	Reporting Period Estimated Cost: \$104
<p>Description: The DRMS project will enable the management of SDG&E's entire demand response portfolio with the following integrated capabilities: program management, enrollment, eligibility, device management, event management, forecasting, settlement, analytics/reporting, and workflow. The full project implementation will take two to three years to complete with a phased approach. The first phase will implement the functionality necessary to retire a high-cost application; automate manual processes for ongoing benefits; and provide the functionality needed to send text messaging, two-way demand response load control, and price signals to meter-connected HAN devices, and monitor device connectivity. The subsequent phases will cover the rest of the portfolio of demand response programs and add the additional integrations necessary for an enterprise solution.</p> <p>Funding Source: GRC and Smart Meter Decision (D.12-04-019)</p> <p>Status: To ensure CPUC compliance, the project team enabled wholesale market integration, also known as Rule 32 - Direct Participation Demand Response (DPDR)¹⁶. DRMS</p>	

¹⁶ https://www.sdge.com/sites/default/files/elec_elec-rules_erule32.pdf

Phase 2 was completed in July of 2018. DRMS Phase 2 delivered demand response post-event settlement capabilities for the capacity bid program and business reporting.

ENTERPRISE PROJECTS

2.3.3.2 DISTRIBUTION AUTOMATION AND RELIABILITY

Distribution Automation and Reliability (DAR) includes projects which improve SDG&E's information and control capabilities for distribution systems. These capabilities may be used to address the complexities associated with integrating distributed energy resources and electric vehicles, advanced outage management, and/or Volt/VAr control. DAR provides the ability to safely and reliably incorporate high penetrations of distributed energy resources by mitigating voltage fluctuations resulting from intermittent power generation. DAR projects also provide the ability to safely and reliably incorporate the increasing load of charging EVs. DAR detects and isolates faults when they occur, immediately restoring service to customers, and providing information about outages in real-time. Self-healing circuits will reduce the number of customers affected by sustained system disturbances and will enable faster service restoration. DAR also provides optimization of voltage and reactive power on the system to enhance power quality and decrease energy consumption, including system losses.

DAR helps enable electricity markets to flourish and helps deliver a Smart Grid that has the infrastructure and policies necessary to enable and support the integration of demand response, energy efficiency, distributed generation, and energy storage into energy markets.

COMPLETED PROJECTS

Project 4: Advanced Energy Storage (AES) – Expedited Storage Projects	Reporting Period Estimated Cost: \$12,851
<p>Description: To address the lack of supply of natural gas and the resulting risk of outages, the CPUC issued Emergency Resolution E-4791, ordering SDG&E to quickly procure, design and construct energy storage facilities in the local resource adequacy markets. In the summer of 2017, SDG&E submitted an advice letter for approval of the project and the project began. In eight months, the project facilities were commissioned and actively participating in the markets.</p> <p>Funding: Emergency Resolution E-4791</p> <p>Status: The two energy storage systems located in Escondido and El Cajon were commissioned in March 2017. The facility in Escondido is the largest lithium-ion energy storage system in North America with 30MW/120MWh. The El Cajon facility is 7.5MW/30MWh. Today, both facilities are participating in the CAISO markets.</p>	

IN-PROGRESS PROJECTS

Project 5: Borrego Springs Microgrid	Reporting Period Estimated Cost: \$4,724
<p>Description: The objective of the original project, initiated in 2012, was to establish a microgrid demonstration at an existing substation to prove the effectiveness of integrating multiple distributed energy resources (DER) technologies, energy storage, feeder automation system technologies, and outage management system (OMS) with advanced controls and communication systems, for the purposes of improving reliability and affecting feeder/substation capacity in normal/outage event conditions. The second phase of the Borrego Springs Microgrid project, conducted from 2015-2018, is to expand the Borrego Springs Microgrid to the entire distribution substation which consists of one 69 kV tie line and two 12.5 MVA transformers that feed three 12 kV circuits. The Borrego Springs Microgrid is capable of islanding all three circuits out of Borrego Springs, which has a peak load of approximately 14 MW and serves approximately 2,500 residential and 300 commercial and industrial customers. The air-insulated substation also has one 6000 kVAR capacitor bank connected at 12 kV for VAR control. SDG&E can utilize a large, third party 26 MW PV system, two 1.8 MW diesel generators, two substation batteries (1500 kW, 4500 kWh total) to island the entire community during the day and dropping to critical loads at night.</p> <p>Funding Source: DOE, CEC and GRC</p> <p>Status: The Distributed Energy Resource Management System (DERMS) controller was successfully deployed for the Borrego Microgrid.</p>	

Project 6: Phasor Measurement Units (PMU) – Distribution Fire Threat Zone Area Protection (FTZAP)	Reporting Period Estimated Cost: \$3,384
<p>Description: Advanced SCADA Devices (ASD) installed on electric distribution circuits are high-fidelity, high-resolution, data and control devices connected via high-speed Internet Protocol (IP) data transport. ASD provides all the functionality of current legacy SCADA devices, with all the advancements of a PMU: GPS time stamped/time aligned devices, high-speed data transport; providing advanced data accuracy with multiple data formats from a single device, enables enhanced cyber security, millisecond accuracy for timed operations, and sequence of events (true system state) displayed on advanced visualization tools.</p> <p>Funding Source: GRC</p> <p>Status: Distribution PMU deployment activity focused on deployment of falling conductor devices and related algorithms in Fire Threat Zones and High-Risk Fire Areas in support of de-energizing a conductor within seconds, reducing risk of contact with persons or</p>	

property. Device and application installations are done in conjunction with other fire hardening projects as a standard deployment on Fire Risk Mitigation program (FiRM).

Project 7: Supervisory Control and Data Acquisition (SCADA) Capacitors	Reporting Period Estimated Cost: \$138
<p>Description: The objective of this project is to convert existing distribution line capacitors to SCADA control, providing improved VAR control, increase system efficiency, and operability. SCADA controls will also alert utility personnel of abnormal operating issues. This will increase capacitor bank reliability, reduce downtime, and expedite repair work. Full implementation of this project will result in complete elimination of the annual capacitor survey currently conducted.</p> <p>Funding Source: GRC</p> <p>Status: Between June 30, 2017 and July 1, 2018, six capacitors were installed and energized to replace six older overhead and pad-mounted non-SCADA capacitors.</p>	

Project 8: SCADA Expansion – Distribution	Reporting Period Estimated Cost: \$1,496
<p>Description: This project will install 300 SCADA line switches to promote a minimum of one and a half switches on every distribution circuit (mid-points and ties). This project will also install SCADA at 13 legacy (existing) substations. Upon completion, automation will be operative for a significant portion of a circuit following an outage, providing faster isolation of faulted electric distribution circuits that in turn will result in faster load restoration when system disturbances occur.</p> <p>Funding Source: GRC</p> <p>Status: During this Reporting Period, SDG&E installed SCADA at the Carlton Hills substation. Prospective substation sites for SCADA expansion are Descanso, Rancho Santa Fe, Warners, Poway, and Pendleton substations. Capistrano substation will be rebuilt with SCADA as part of the Southern Orange County Reliability Enhancement project recently approved by the CPUC¹⁷. Additionally, SCADA capabilities have been implemented in four existing circuits.</p>	

¹⁷ <http://www.cpuc.ca.gov/Environment/info/ene/socre/attachment/2016-12-15CPCNFinalDecision.pdf>

Project 9: Wireless Fault Circuit Indicators	Reporting Period Estimated Cost: \$2,106
<p>Description: The objective of this project is to install up to 10,000 wireless fault indicator (WFI) devices on the overhead and underground electric distribution system. In the event of a circuit fault, WFIs rapidly transmit fault location data via secure wireless communication to the Distribution Control Center. This information allows distribution operations personnel to direct electric troubleshooters more efficiently, minimizing customer outage time and expediting repair work. The same devices provide a secondary benefit, reporting load data once a day in one-hour increments, for system planning and operating use.</p> <p>Funding Source: GRC</p> <p>Status: SDG&E received upgraded devices in 2017 and approximately 1,200 units were deployed successfully with enhanced firmware to increase fault indicating response. The project will continue in 2018 with an upgraded device that will have increased load accuracy, the ability to power itself from the conductor it is on and GPS location reporting.</p>	

Project 10: Power Your Drive (PYD)	Reporting Period Estimated Cost: \$24,072
<p>Description: Power Your Drive (PYD) was established by SDG&E and approved by the CPUC as a pilot program. It is designed to integrate the charging of electric vehicles (EVs) with the grid through an hourly rate. PYD seeks to satisfy this objective through the approximate installation of 3,500 EV charging stations at 350 sites. Under the terms of PYD, SDG&E maintains ownership of the infrastructure to simplify the experience for customers installing chargers and to ensure the reliability of the charging network. Customers participating in the program assess a nominal one-time payment unless the site is within a designated disadvantaged community (DAC), in which case, the payment is waived. PYD sites are either multifamily dwellings or workplaces with an overall goal to reach at least 40% of installations in multifamily communities (DAC). Additionally, the program aims to provide deployment in areas having higher than average levels of pollution by setting a target of at least 10% of installations in DACs.</p> <p>Funding Source: A. 14-04-014</p> <p>Status: SDG&E focused on customer outreach while developing, implementing, planning, engineering processes, and soliciting and awarding construction contracts. As of June 30, 2018, SDG&E has received 209 signed easements or equivalent, totaling more than 2,503 chargers. Over 487 potential customers have indicated interest in PYD participation during this Reporting Period, for a total of 1,148 customers.</p>	

SDG&E submitted its most recent required semi-annual report to the CPUC on the progress of the vehicle-grid integration (VGI) program in March 2018.¹⁸ Sixty-Seven sites and a total of 733 chargers are completed, with bills being generated utilizing the grid-integrated hourly program rate, the first of its kind for a utility EV charging program. To date, two vendors have completed all required Solutions Acceptance Testing, information security and meter testing, allowing the program to continue to start construction at more sites with eager to charge EV drivers.

Project 11: Distributed Energy Resource Management System (DERMS)	Reporting Period Estimated Cost: \$2,630
<p>Description: The objective of the DERMS project is to develop a software solution to monitor, control, and optimize distributed energy resources (DER) in three major categories:</p> <ol style="list-style-type: none"> 1. Integrates and aggregates batteries, solar, generators and other DERs for reliability and market participation 2. Uses load forecasting, day-ahead price signals, DRMS and other factors to give multiple options for optimization and scenario-based operations 3. Ability for future integration with distribution management system (DMS), geographic information system (GIS), DRMS and numerous other functions <p>Funding Source: GRC</p> <p>Status: The project has successfully deployed its third version of DERMS application to the Borrego Springs Microgrid. This release, which includes three apps—Monitor and Control, Advanced Energy Storage and Microgrid—provides the user with the ability to create reservations for SDG&E’s battery operations, view/modify scheduled operations and operate in real-time. Additionally, the Microgrid app provides improved visibility of operational constraints of the microgrid (e.g. time to live) and functionality based on user-selected objectives (e.g. least cost), which simplifies and dramatically improves microgrid operations. The release deployed in October 2017 incorporated additional DER (ultracapacitor, PV plant, energy storage) and provided enhanced usability and functionality. The Advanced Energy Storage (AES) application allows operators to manage, schedule and dispatch fleets of battery systems in a uniform and consistent manner.</p>	

2.3.3.3 TRANSMISSION AUTOMATION AND RELIABILITY

¹⁸ https://www.sdge.com/sites/default/files/regulatory/FINAL_Power_Your_Drive_Semi_Annual_Rpt.pdf

Transmission Automation and Reliability (TAR) includes projects that provide wide-area monitoring, protection, and control to enhance the resiliency of the transmission system. TAR also includes projects to provide the ability to safely and reliably incorporate utility size intermittent power generation, such as centralized solar and wind energy. TAR projects mitigate voltage fluctuations resulting from integrating intermittent resources.

The wide-area capabilities of TAR provide the ability to monitor bulk power system conditions, including but not limited to voltage, current, frequency, and phase angle across SDG&E's geographic area in near real-time. This functionality provides system operators with current information about emerging threats to transmission system stability, enabling preventive action to avoid wide-scale black outs. In addition, the wide-area capabilities of TAR also include projects for coordination of high-speed communicating transmission protection equipment that detects events or conditions in the transmission systems and automatically responds to stabilize the system.

IN-PROGRESS PROJECTS

Project 12: Automated Fault Location	Reporting Period Estimated Cost: \$396
<p>Description: This project implements a system that automatically retrieves fault event reports from relays on all affected transmission lines, distribution feeders and stores the events into a central server. The software calculates the fault location and type from the retrieved data and generates an informational email notification within seconds. Additionally, it synchronizes the events with the Wide Area Situational Awareness (WASA) visualization display for operators and engineers to view details of the fault for immediate crew dispatch and post-event analyses. Fault calculations are performed with greater accuracy than the single-ended calculation performed by relays today. The project will avoid truck rollouts to physically dispatch technicians to download relay event records, avoid line patrols and helicopter dispatches. The project will assist in rapid service restoration and minimize outage duration, post event analyses, and regulatory reporting.</p> <p>Funding Source: FERC</p> <p>Status: During this Reporting Period, installation was completed at 64 substations. New software/firmware has been installed to retrieve event data within minutes after the event occurs. Traveling Wave fault detection and location has been implemented with newer relays. Additional added/planned functions are:</p> <ol style="list-style-type: none"> 1. Retrieve Digital Fault Recorder (DFR) and Power Quality (PQ) events into the server 2. Develop/install software to display events from relays, DFRs and PQ meters in a unified display, instead of separate software for each type of device. This will make post-event analysis and decision-making faster. 	

3. Develop Geospatial display with GIS map and weather data to visually provide fault location, type of fault and extent of disturbance.

Project 13: Phasor Measurement Units (PMU) – Transmission	Reporting Period Estimated Cost: \$2,967
<p>Description: The objective of this project is to install high-speed and high precision GPS time synchronized PMUs in SDG&E’s bulk power transmission lines and renewable interconnections. Faster real-time synchronized phasor measurements (synchrophasors) can provide accurate and high time resolution snapshots of the grid conditions for the entire Western Interconnected System (WECC). Operators’, engineers’, and planners’ capabilities increase with Wide Area Situational Awareness (WASA) that will help in understanding and mitigating system outages to avoid system instability. SDG&E is also sharing PMU data, and real-time contingency analysis with CAISO and PeakRC.</p> <p>Funding Source: Federal Energy Regulatory Commission (FERC)</p> <p>Status: The project deployed an extensive array of PMUs covering the entire 500 and 230 kV system and transmission level renewable interconnections. A new network architecture for future Critical Infrastructure Protection (CIP) compliance and production-grade hardware and software for Grid Operations in both Primary and Backup Control Centers and Data Centers has been installed. The WASA system has been deployed at Grid Operations as a non-operational tool. SDG&E has started installing PMUs at 138 and 69kV substations and, to date, more than 100 PMUs are in service. The existing WASA software has reached its end-of-life and cannot be enhanced further to incorporate advanced applications. An RFP has been issued for an advanced WASA software.</p>	

Project 14: SCADA Expansion – Transmission	Reporting Period Estimated Cost: \$1,496
<p>Description: This project will install 300 SCADA line switches to promote a minimum of one and a half switches on every distribution circuit (mid-points and ties). This project will also install SCADA at 13 legacy (existing) substations. With the completion of this project, automation will be operative for a significant portion of a circuit following an outage providing faster isolation of faulted electric distribution circuits that in turn will result in faster load restoration when system disturbances occur.</p> <p>Funding Source: GRC</p> <p>Status: During the Reporting Period, SDG&E installed SCADA at Carlton Hills substation.</p>	

Engineering plans are addressing the addition of SCADA to Descanso, Rancho Santa Fe, Warners, Poway, and Pendleton substations in the near future. Capistrano substation will be rebuilt with SCADA as part of the Southern Orange County Reliability Enhancement project. Additionally, SCADA capabilities have been added to four existing circuits.

2.3.3.4 ASSET MANAGEMENT, SAFETY AND OPERATIONAL EFFICIENCY

Asset Management, Safety and Operational Efficiency (AMSOE) enhances monitoring, operating, and optimization capabilities to achieve more efficient grid operations and improved asset management. AMSOE includes projects that would allow SDG&E to manage the maintenance and replacement of energy infrastructure based on the health of the equipment versus a time-based approach. This functionality helps to avoid critical energy infrastructure failures as well as manage costs associated with maintaining and replacing equipment.

COMPLETED PROJECTS

Project 15: Advanced Ground Fault Detection	Reporting Period Estimated Cost: \$33
<p>Description: The objective of this project is to provide enhanced ground fault detection schemes for distribution circuits to improve detection of operational issues. Additionally, this project will install protective relay systems to detect high impedance faults, where the fault current may be very low, and the resulting arcing fault may provide erratic current input to the protective relay. The advanced protection system will provide faster isolation of downed conductors, promoting enhanced safety and improved service reliability.</p> <p>Funding Source: GRC</p> <p>Status: Installation of the remaining equipment sites was completed during the Reporting Period and devices are operating as prescribed.</p>	

Project 16: Condition-Based Maintenance (CBM) – Substation Transformers • Substation Advanced Analytics (SAA)	Reporting Period Estimated Cost: \$1,930
<p>Description: The objective of this project is to extend the useful life and improve utilization of distribution substation transformers. The project will utilize technology to monitor the</p>	

performance/condition of system assets and will provide actionable alerts when attention is required. Substation Advanced Analytics technology includes:

1. Advanced analytical features for substation assets to use in business planning, operations, and engineering
2. Improved dissolved gas analysis (DGA) software for both the main tank of a transformer, and a transformer’s load tap changer (LTC)
3. Automated calculations required to determine the real-time loading capability of a transformer (What If/Load Spike Software) and determine a transformer’s true remaining life utilizing existing CBM data (Loss of Life Software)

Funding Source: GRC and FERC

Status: This project was inadvertently reported as closed previously. Vendor upgrade of a critical chipset of the installed base requires final wiring, testing, and migration of system monitoring from staging to production. Design and chipset installation have been completed. This work is in-flight to complete final conversion tasks of 323 banks.

Project 17: Advanced Distribution Management System (ADMS)	Reporting Period Estimated Cost: \$4,212
<p>Description: The scope of the ADMS project is to implement new functions within the new Outage Management System/Distribution Management System (OMS/DMS) to support current and future Smart Grid initiatives for managing the electric distribution grid. The purpose of phase 2 is to model and integrate DER into DMS. This phase will model the capabilities of these assets in the Network Management System (NMS), improve power flow forecasts, enhance DMS functionality, and provide transparency to the impacts of these assets on the electric distribution grid. Phase 3 optimized power flow and other DMS functions, provided better visualization to the operators, and rolled out Fault Location Isolation and Service Restoration (FLISR) in automatic mode to the entire eligible SDG&E service territory. The next phase will include an NMS upgrade and an implementation of a new analytics solution.</p> <p>Funding Source: GRC</p> <p>Status: During the Reporting Period, NMS received a database and software upgrade, and completed testing on a new codeline, which will be deployed in July 2018. This will include</p>	

FLISR improvements, an automated outbound customer call interface for outages, a voltage read function for Smart Meters, and the inclusion of customer history data.

IN-PROGRESS PROJECTS

Project 18: Distribution Interconnection Information System (DIIS)	Reporting Period Estimated Cost: \$247
<p>Description: DIIS was implemented in February 2013 and is used for solar contractors and self-installers to submit / track their Net Energy Metering (NEM) applications. DIIS phase 2 and 3 enhanced the Remote Meter Configuration (RMC) automated process to reduce both the back-end supporting activities and cost of supporting the NEM program. This project has implemented CPUC-mandated additional questions to the online NEM application forms, increasing interface benefits to the external end-users and internal support staff. Additional changes streamlined the NEM application “fast track” option. The program has been recognized by the CPUC as the best method for processing NEM applications and the application received a patent in 2017.</p> <p>Funding Source: GRC</p> <p>Status: DIIS Phase 3 delivered a tool to calculate the loading on transformers, forms for NEM Paired (solar paired with advanced energy storage) applications, replacement of the existing My Partners web portal, improvement to the RMC for changing meters over-the-airways, auto approval of applications within certain parameters, and enhancements to improve business process efficiency and customer experience.</p>	

Project 19: Condition-Based Maintenance (CBM) – Gas Breakers	Reporting Period Estimated Cost: \$1,790
<p>Description: This project aims to extend the useful life and make greater utilization of the transmission sulfur hexafluoride (“SF6”) gas insulated substation circuit breakers. The project will utilize technology to monitor the performance and condition of system assets to identify issues prior to causing a serious unplanned outage and prior to losing the expensive assets prematurely. The project will comply with the 1% SF6 Emissions Regulations in 2020, reduce major overhaul periodicity related to contact interrupter wear, enhance the tracking and “manual” CBM program and monitor the gas within the circuit breaker allowing for early detection of any leaks ensuring compliance with applicable environmental regulations.</p> <p>Funding Source: FERC</p>	

Status: Monitors installed produced benefits immediately by "providing information on the health of the circuit breaker's contacts/interrupters, potentially allowing major overhaul maintenance to be deferred from 10 to 18 years. Rather than performing intrusive maintenance by opening the breaker to determine the health of its contacts, we can obtain this information from the monitor and perform a minor (non-intrusive) overhaul.

Project 20: Smart Grid Enabled Energy Efficiency	Reporting Period Estimated Cost: \$<\$100
<p>Description: D.18-05-041 approved the Rolling Portfolio budget for SDG&E's Business Plan for years 2018 through 2025, with an annual Energy Efficiency (EE) program budget of approximately \$116.456 million in EE funding and an additional \$4.64 million for Demand Response components of Integrated Demand Side Management activities.</p> <p>SDG&E 2017 EE annual report and 2018 Q1 status reports are available at http://eestats.cpuc.ca.gov/. Easy to read EE dashboards for Q1 2018 are available at https://cedars.sound-data.com/upload/dashboard/list/.</p> <p>Funding Source: Energy Efficiency (D.14-10-046)</p> <p>Status: For 2017, SDG&E's efforts resulted in savings of approximately 482 gigawatt hours (GWh), reduced energy demand by approximately 87 MW, and saved approximately 2.1 million therms resulting in customer bill savings of approximately \$115.4 million. In addition to helping customers save energy and money, these gas and electric energy savings have reduced CO2 emissions by over 453,000 tons.</p> <p>For the first quarter of 2018, SDG&E reported approximately net savings of 61.1 GWh, 10.5 MW and 861,720 therms.</p> <p>SDG&E filed its 2019 EE Annual Budget Advice Letter (3267-E/2700-G)¹⁹ describing its proposed EE activities that will address the 2019 goals resulting from SB 350. SDG&E will be soliciting third party programs as required by D.18-05-041. In addition, new statewide programs have been assigned to each utility to solicit and administer.</p>	

2.3.3.5 SECURITY

¹⁹ <http://regarchive.sdge.com/tm2/pdf/3267-E.pdf>

Physical and cyber security protection of the electric grid is essential and becomes more so as more intelligent edge devices are deployed. The communications and control systems that are required to enable Smart Grid capabilities have the potential to increase the reliability risks of Smart Grid deployments if they are not properly secured. The security program includes a comprehensive set of capabilities to address the increased physical and cyber security requirements associated with the development, implementation, operation, and management of Smart Grid systems and edge devices. These projects would place and execute security throughout the network to resist attack, manage compliance and risk, and support security from the physical to the application layers.

IN PROGRESS PROJECTS

Project 21: Cybersecurity Projects	Reporting Period Estimated Cost: 20
<p>Description: SDG&E’s cybersecurity projects include efforts in risk and vulnerability management, operations, compliance, research, and improving the protection of customer privacy. Costs for the physical and cyber security of all Smart Grid systems are not isolated within these projects. Other Smart Grid projects also include additional, specific cybersecurity costs related to the project scope or technology. All other Smart Grid investments include additional security-related costs, particularly those that are specific to the project scope or technology.</p> <p>Funding Source: GRC</p> <p>Status: As this <i>Annual Report</i> is a public document, details of SDG&E’s security projects are omitted.</p>	

Project 22: Substation Physical Security Hardening	Reporting Period Estimated Cost: \$25,546
<p>Description: Project installs and upgrades physical and electronic security at substation locations in accordance with industry best practices, regulatory requirements, and changing geopolitical threat vectors. Technology installs and upgrades, physical deterrence implementations, revisions to business processes, and personnel training are included in scope.</p> <p>Funding Source: FERC</p>	

²⁰ No Cybersecurity projects related to the Smart Grid took place during the Reporting Period.

Status: This *Annual Report* is a public document, details of SDG&E's security projects are omitted.

2.3.3.6 INTEGRATED AND CROSS-CUTTING SYSTEMS

Integrated and Cross-Cutting Systems refer to projects that support multiple Smart Grid domains, such as grid communications, application platforms, data management and analytics, advanced technology testing, and workforce development and technology training. An integrated approach for these projects will ensure that investments are managed efficiently while creating the platform to deliver a stream of benefits across SDG&E's operations and to its customers.

Integrated communications systems will provide solutions to connect and enable sensors, metering, maintenance, and grid asset control networks. In the mid-to-long term, integrated and cross-cutting systems will enable information exchange with SDG&E, service partners, and customers using secure networks. Data management and analytics projects will improve SDG&E's ability to utilize vast new streams of data from transmission and distribution automation and Smart Meters for improved operations, planning, asset management, and enhanced services for customers.

Advanced technology testing and standards verification are foundational capabilities for SDG&E to evaluate new devices and test them in a demonstration environment prior to deployment onto the electric system. This reduces the risks associated with new technology projects and helps SDG&E maximize technology performance and interoperability prior to deployment.

Workforce development and advanced technology training enables the successful deployment of new technologies, ensuring that SDG&E's workforce is prepared to make use of new technologies and tools in order to maximize the value of these technology investments.

COMPLETED PROJECTS

Project 23: Integrated Test Facility (ITF)	Reporting Period Estimated Cost: \$ ²¹
Description: The SDG&E Integrated Test Facility (ITF) is used to support electric system and information technology integration for smart concept evaluation and testing for both	

²¹ Project costs incurred at this facility default to costs of corresponding capital projects requiring functional testing support.

devices and software. Integration spans both utility and customer-owned equipment and systems. Key aspects of this project include simulation, experimentation, analysis, visualization, integration, demonstration, testing, and validation.

Funding Source: GRC

Status: SDG&E continued to leverage the ITF facility during the Reporting Period. Project test results have provided valuable information to key areas of study. Each lab produced meaningful work that has been presented at industry events and shared with industry peers and stakeholders.

IN-PROGRESS PROJECTS

Project 24: Electric Program Investment Charge (EPIC) Program	Reporting Period Estimated Cost: \$1,847
<p>Description: SDG&E's First and Second Triennial Electric Program Investment Charge (EPIC) applications have been approved by the CPUC. The EPIC projects are limited to pre-commercial demonstrations by order of the CPUC. SDG&E's currently approved projects fall into the following areas: Advanced Distribution Automation, Renewable and Distributed Energy Resource Integration, Grid Modernization and Optimization, and Integration of Customer Systems into Electric Utility Infrastructure. SDG&E's application for the third EPIC cycle has been filed and is under review by the CPUC.</p> <p>Funding Source: CEC and CPUC</p> <p>Status: Eleven projects were previously approved—five from the EPIC-1 triennial application and six from the EPIC-2 triennial application. Ten of these projects have been completed, and the 11th project is scheduled to be completed in 2018. Formal EPIC status reports are filed annually with the CPUC, as ordered by the CPUC. Comprehensive final project reports are filed with the CPUC, as the projects are completed.</p>	

Project 25: Unmanned Aircraft System (UAS)	Reporting Period Estimated Cost: \$131
<p>Description: The objective of the program is to research and evaluate SDG&E Unmanned Aircraft System (UAS) use cases. The program will enhance the unmanned aircraft system to meet SDG&E requirements (e.g., camera technologies, proximity sensors, on-board data</p>	

storage, enhanced data streaming, infrared, gas sensors, multispectral), as well as investigate and research capabilities of flight pattern software (preprogrammed flight pattern), data storage, anomaly detection software and a customer notification system. The desired result would be to have the UAS technology available to use by field crews as another tool in their tool box.

Funding Source: GRC

Status: The Federal Aviation Administration (FAA) Part 107 rules have now been implemented, which allow anyone to take an FAA Remote Pilot test to obtain a Remote Pilot Certificate, which is required for UAS Commercial Operations. Our Aviation Services Department created a UAS Training Program which will allow for internal employees to be trained and certified. Once the training has been completed, the employee is granted the permissions internally to utilize a UAS within their daily work operations as needed. SDG&E began to deploy the units to employees within the company and have become the UAS Program Management group which oversees of all internal/contractor operations. We have four Call When Needed contractors which were selected using the request for proposals (RFP) process and can be tapped on by anyone within SDG&E for UAS services. They can complete missions such as LiDAR, infrared (IR), photos, videos and orthomosaics. As technology improved, SDG&E purchased an IR sensor which can be utilized as a radiometer data which is required to analyze “hot spots” within our ground base and overhead electric equipment. This allows IR data to be collected at a closer proximity which collects more accurate temperature reads. SDG&E has tested and can successfully provide anyone a live stream of the video data being collected by the UAS. We had a successful mission of utilizing a UAS to pull a low-stretch polyester material across a 1,000-foot canyon in a sensitive vegetation area. The crews were then able to pull the fiber optic cable that they needed across the span as this was an issue for this job and area.

ENTERPRISE PROJECTS

<p>Project 26: Workforce Development</p>	<p>Reporting Period Estimated Cost: <\$100</p>
<p>Description: This project focuses on internal employee development and external employee acquisition in locations like universities.</p> <p>Funding Source: GRC</p> <p>Status: Workforce development initiatives continue to ensure that existing employees’ skills advance, and future hires have the necessary experience for a career at the smart utility. SDG&E maximizes its opportunities of expanding industry knowledge by cross-training all technicians, business analysts and engineers. Internal employee development continues to build the company’s future.</p>	

2.4 CUSTOMER ROADMAP

2.4.1 INTRODUCTION / BACKGROUND

SDG&E's overarching goals of Smart Grid customer marketing, education, and outreach are to enable and motivate customers' energy management through smart energy devices, new products and services, increased energy-efficiency/demand response, and adoption of plug-in electric vehicles and renewable resources. Those goals can be achieved with the use of in-home displays, control of individual appliances, and/or energy management systems and whole home controllers.

SDG&E's Customer Roadmap describes the customer outreach and engagement plans needed to support the Smart Grid projects that directly impact customers. A summary of SDG&E's assessment of customer impacts and detailed engagement plan summaries and timeline are included.

2.4.2 CUSTOMER OUTREACH AND ENGAGEMENT PLANS

In its March 2012 *Smart Grid Workshop Report*, CPUC staff requested that the following information be included in utilities' *Smart Grid Annual Reports*:

- Timeline that connects specific projects with specific marketing, education, and outreach efforts
- Identification of current customer engagement roadblocks and strategies to overcome them

As requested by CPUC staff, SDG&E is providing marketing, education, and outreach information using the sample template in Appendix 1 to the March 2012 *Smart Grid Workshop Report*.

Timeline: SDG&E has adapted the CPUC staff's template to reflect the existing and planned work that is related to its various Smart Grid projects.

Customer Engagement: For each of the project initiative categories, SDG&E has provided details on existing or proposed marketing, education, and outreach in accordance with the proposed template from the CPUC's *Smart Grid Workshop Report*.

2.4.3 OVERVIEW OF THE CUSTOMER ENGAGEMENT PLAN

Customer choice is a potent driver of SDG&E's *Smart Grid Deployment Plan*. SDG&E customers are adopting rooftop solar and plug-in electric vehicles at rates that are among the highest in the nation. They are seeking real-time information about their energy usage and rates in order to make more informed decisions. Some are looking for opportunities to participate in energy markets through demand response, TOU rates, distributed generation, and energy storage.

SDG&E's goal is to offer the right information to the right customer through the right channel at the right time to enable customers to adopt smart energy solutions and make informed energy management decisions. Collectively, these are the projects that, "...will create a utility foundation for an innovative, connected, and sustainable energy future."²²

Through these projects, SDG&E will work with customers and service providers to increase customer engagement with and adoption of new energy management technologies and behaviors. From a Smart Customer perspective, this will give consumers the opportunity to capture the benefits of a wide range of existing and emerging energy technologies and associated energy management products and services.

These projects allow customers to "... be aware, informed, and knowledgeable about their energy choices, and have the tools to act upon those choices."²³ As stated in its *Smart Grid Deployment Plan*, "SDG&E recognizes that engaging with and proactively reaching out to customers is critical to the success of its Smart Meter deployment and Smart Grid utilization efficiency." These projects continue that journey.

2.4.4 SMART GRID BY ENGAGEMENT INITIATIVE

In this section, SDG&E describes the customer engagement elements as requested by CPUC staff in its March 1, 2012 *Smart Grid Workshop Report*.

Table 4: Customer Engagement Initiative - Enablement Tools

	Enablement Tools
Project Description	Marketing, Education and Outreach (ME&O) to provide energy usage information directly to customers to help them manage their energy use and reduce their energy costs.
Target Audience	Primarily residential and small commercial customers (< 20 kW peak load).
Sample Message	Download your electricity use data with the simple click of a button.

²² SDG&E *Smart Grid Deployment Plan 2012 Annual Report*, Oct. 1, 2012.

²³ Ibid.

	Enablement Tools
Source of Messaging	Utility and third-party partners.
Current Roadblocks	<ul style="list-style-type: none"> - Customers are not aware of how much energy they use, when they use it, or how much it costs. - Energy usage is a low-engagement activity, and many customers would rather not spend time thinking about it or their costs. - Customers don't know what new energy-saving technologies are available.
Strategy to Overcome Roadblocks	<ul style="list-style-type: none"> - Find new and better ways to engage customers using personalized energy reports and energy usage alerts via email and text messages. - Understand customer segments and how they want to be engaged. - Act as a trusted energy advisor by promoting programs and pricing options as they become available.

Table 5: Customer Engagement Initiative - Customer Premise Devices

	Customer Premise Devices
Project Description	ME&O to enable customers to have an unprecedented understanding of their energy usage and ensure the Home Area Network (HAN) capabilities in Smart Meters continue to be tested and developed.
Target Audience	<ul style="list-style-type: none"> - All customers across the SDG&E service territory with a Smart Meter. - Primarily residential and small commercial customers (< 20 kW peak load).
Sample Message	<ul style="list-style-type: none"> - Smart Meters help save energy and money. - Smart Meters allow for two-way communication between the customer and the utility. - This new technology will also help you make smart choices to save energy and money on your bill.
Source of Messaging	Utility
Current Roadblocks	<ul style="list-style-type: none"> - Customers who might benefit from reducing use on critical days have a low awareness level. - Customer HAN devices might appear confusing to average customers, so adoption levels are low.
Strategy to Overcome Roadblocks	<ul style="list-style-type: none"> - Educate customers about TOU rates options as they are introduced. - Provide customers with information about Smart Meters, focusing on the benefits and simple energy management tools they enable.

Table 6: Customer Engagement Initiative - Rates and Programs

	Rates and Programs
Project Description	<ul style="list-style-type: none"> - ME&O to inform customers of TOU and tiered rate options to better meet their energy usage needs in a cost-effective way. - Connected... to the Sun program will give customers options to buy solar power even if they do not own a home, cannot afford the upfront costs, or do not have the ability to put solar panels on their roof. - Provide customers with information on EV TOU rates and help them understand the benefits of charging their car when prices are at their lowest.
Target Audience	<ul style="list-style-type: none"> - All customers across the SDG&E service territory with a Smart Meter who could benefit from load shifting with the proper pricing plan options. - Connected... to the Sun: residential and business customers. - EV drivers, those looking to purchase or lease EVs, and fleet operators.
Sample Message	<ul style="list-style-type: none"> - Save energy during on-peak periods to reduce your energy costs and on Reduce Your Use days, you can be rewarded with a credit on your SDG&E bill. - SDG&E's EV TOU rates will help you pay the lowest price for your EV fuel when you charge from midnight to 5 a.m. - Assist California in continuing to meet its climate action goals in reducing greenhouse gasses.
Source of Messaging	Utility
Current Roadblocks	<ul style="list-style-type: none"> - Most customers are not aware of current or upcoming TOU rate options. - Small commercial customers that transition to TOU pricing by default may not be aware how this will impact their bill based on current usage patterns and might not be able to shift their usage due to their type of business. - Customers often have concerns about their privacy and how their data is being used by the utility or third parties. Third parties sometimes claim that it is difficult to obtain customer data that they are authorized to receive.
Strategy to Overcome Roadblocks	<ul style="list-style-type: none"> - Sustained, ongoing outreach to customer segments about new rate options, along with bill comparison tools to enable customers to make informed choices. - Inform customers about the Reduce Your Use program with financial incentives for energy savings on critical days.

	Rates and Programs
	<ul style="list-style-type: none"> - Use mass media and customer’s preferred channel to communicate when Reduce Your Use days are called. - Develop services that: a) provide customers with more control regarding the sharing of their data and make it easier for them to allow and revoke access to third parties; and b) allow authorized third parties to access customer data using more self-service mechanisms.

Table 7: Customer Engagement Initiative - Pilot Deployment Projects

	Pilot Deployment Projects
Project Description	<ul style="list-style-type: none"> - Develop microgrids to improve reliability and leverage renewable energy to power an entire remote community in SDG&E’s territory. - Ensure that the VGI Pilot Program is readily available to customers who need it.
Target Audience	<ul style="list-style-type: none"> - Long duration parking opportunities such as multi-unit dwellings and workplaces where electric vehicle charging is not currently available.
Sample Message	<ul style="list-style-type: none"> - Microgrid technologies can help improve electric system reliability and use abundant renewable resources. - Microgrids help charge EVs when energy costs are low and supply is plentiful, such as renewable resources.
Source of Messaging	Utility
Current Roadblocks	<ul style="list-style-type: none"> - Microgrid technologies can be complex and difficult to explain. - TOU and other dynamic rates can be challenging for some customers.
Strategy to Overcome Roadblocks	<ul style="list-style-type: none"> - Use direct interactions (e.g., community meetings) and easy-to-understand materials to explain benefits of microgrids, such as videos. - Develop easy-to-use tools for customers to simplify management of TOU and other dynamic rates.

2.5 KEY RISKS BY CATEGORY

The following table discusses key Smart Grid risk categories and their likelihood, potential impact, and actions taken by SDG&E to reduce or mitigate risks in these areas. Each risk is assigned a residual risk level based on the exposure remaining after action is taken to mitigate the potential threat. The risks identified here are only Smart Grid related and should not be compared to SDG&E’s enterprise level risks.

Table 8: Risk Assessment Information by Category

Key Risk Category	Likelihood/Probability	Impact/Consequences	Current Actions Taken
1. Reliability	<p>Medium</p> <p>Many factors, including the intermittency of renewable generation sources, changes in load patterns, breaches of system security, and new technologies, lend themselves to a high probability of having the potential to negatively affect system and local distribution reliability.</p>	<p>Medium</p> <p>Particularly where intermittent distributed renewables, electric vehicles, and other new technologies are concentrated into clusters, the impacts of intermittent supply or demand can be impactful.</p>	<p>Many of SDG&E's Smart Grid projects are designed to maintain or improve overall and distribution system reliability, including projects in each of the six program areas addressed in this <i>Annual Report</i>.</p>
2. Rates	<p>High</p> <p>The probability that current retail rate designs will trigger significant consequences to the deployment of renewables and require Smart Grid technologies is high.</p>	<p>High</p> <p>Current electric rate policies provide inequitable and inaccurate pricing signals to customers.</p>	<p>SDG&E is working with the CPUC and stakeholders to develop changes in residential rate structures that would more equitably allocate the costs for electric reliability</p>

Key Risk Category	Likelihood/Probability	Impact/Consequences	Current Actions Taken
3. Security	<p>High</p> <p>No networked system can be perfectly secure, thus the probability that some security-related issue will affect the operation of the system is high.</p>	<p>High</p> <p>Security-related threats to Smart Grid systems have the potential to impact the reliability of the transmission and/or distribution networks, and could affect worker and public safety.</p> <p>Physical security risks related to damage of critical infrastructure resulting from illicit activities continues to be a concern for utilities.</p>	<p>services provided by the utility.</p> <p>SDG&E has a comprehensive risk-based security program that addresses and mitigates these risks, employing defense-in-depth and other strategies.</p>
4. Safety	<p>Low</p> <p>While the Smart Grid has the potential to introduce new safety risks, the well-established safety culture of the utility and robust processes that help maintain workforce and public safety diminish the</p>	<p>High</p> <p>The consequences of safety risks that are realized can be devastating.</p>	<p>SDG&E works to continually improve its safety standards, education, and awareness and has a number of Smart Grid and other projects that</p>

Key Risk Category	Likelihood/Probability	Impact/Consequences	Current Actions Taken
	probability that any will be realized.		contribute to maintaining or improving safety of its workforce and the public. Strategic location of assets decreases likelihood of safety issues.
5. Technology	<p>High</p> <p>Smart Grid deployment involves a great deal of new or emerging technologies, many of which lack consistent, interoperable industry standards. It is highly probable that a lack of or inconsistency in standards will impact deployments. Potential issues with adequate workforce development also pose a risk to Smart Grid deployments.</p>	<p>Low</p> <p>Many other major technology deployments have been similarly affected in the past. Mitigation efforts can keep these risks from having high impacts on Smart Grid deployments.</p>	<p>SDG&E continues to leverage its Integrated Test Facility to test interoperability and reduce technical risks in deployment projects. Workforce development programs are being proposed to transfer utility knowledge and develop employees for the future.</p>

3 SMART GRID METRICS

In SDG&E's metrics reporting in the following section, the Reporting Period is defined as the period from July 1, 2017 through June 30, 2018. Metrics are reported per the definitions in D.12-04-025, retrievable at http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/164808.PDF.

A. Customer / AMI Metrics

1. Number of advanced meter malfunctions where customer electric service is disrupted, and the percentage this number represents of the total of installed advanced meters.

	Units	Number of meters	% of meters
The number of advanced meter malfunctions where customer electric service is disrupted, and the percentage this number represents of the total of installed advanced meters	Number of meters / percentage	611	4%

2. Load impact in MW of peak load reduction from the summer peak and winter peak due to Smart Grid-enabled, utility-administered Demand Response (DR) programs (in total and by customer class).

	Units	Residential	C&I < 500 kW	C&I > 500 kW	Other (a/c cycling, small commercial)	Total
Load impact in MW of peak load reduction from the summer peak and from winter peak due to Smart Grid-enabled, utility administered demand response (DR) programs (in total and by customer class)	Winter MW	n/a	n/a	n/a	n/a	n/a
	Summer MW	8	16	7	1	32

Note: Some SDG&E DR programs are available in the winter months, but SDG&E did not call an event during the winter of 2017-18. Therefore, there is no load reduction from the winter peak to report.

3. Percentage of demand response enabled by AutoDR (Automated Demand Response) in each individual DR impact program

	Units	Capacity Bidding Program (CBP)	Critical Peak Pricing (CPP)
The percentage of demand response enabled by AutoDR (Automated Demand Response) in each individual DR impact program	%	15%	1%

4. The number and percentage of utility-owned advanced meters with consumer devices with Home Area Network (HAN) or comparable consumer energy monitoring or measurement devices registered with the utility (by customer class, CARE status, and climate zone)

	Units					
The number and percentage of utility-owned advanced meters with consumer devices with Home Area Network (HAN) or comparable consumer energy monitoring or measurement devices registered with the utility (by customer class, CARE status, and climate zone)	By Customer Class	Residential	C&I < 500 kW	C&I > 500 kW	Other (a/c cycling, small commercial)	Total
	Number of customers	18,674	154	25	0	18,853
	% of customers	99.05 %	0.82 %	0.13 %	0.00 %	100.00 %
	By Care Status	Care	Non-Care	Total		
	Number of customers	1,520	17,333	18,853		
	% of customers	8.06 %	91.94 %	100.00 %		
	By Climate Zone	Coastal	Inland	Mountain	Desert	Total
	Number of customers	7,905	10,611	254	83	18,853
	% of customers	41.93 %	56.28 %	1.35 %	0.44 %	100.00 %

5. The number and percentage of customers that are on a time-variant or dynamic pricing tariff (by type of tariff, by customer class, by CARE status, and by climate zone)

The number and percentage of customers that are on a time-variant or dynamic pricing tariff (by type of tariff, by customer class, by CARE status, and by climate zone)	Units						Total	
	By Tariff	Critical Peak Pricing (CPP)	Time of Use (TOU)	Peak Time Rebate (PTR)	Plug In Electric Vehicle (PEV)			
	Number of customers	135,466	151,045	70,138	217		356,866	
	% of customers	38 %	42 %	20 %	0 %		100 %	
	By Customer Class	Residential	C&I < 500 kW	C&I > 500 kW	Total			
	Number of customers	142,199	143,885	644	286,728			
	% of customers	50 %	50 %	0 %	100 %			
	By Care Status	Care	Non-Care	Total				
	Number of customers	22,140	264,588	286,728				
	% of customers	8 %	92 %	100 %				
	By Climate Zone	Coastal	Inland	Mountain	Desert	Customers without climate zone	Total	
	Number of customers	169,263	112,186	4,109	702	468	286,728	
% of customers	59 %	39 %	1 %	0 %	0 %	100%		

6. The number and percentage of escalated customer complaints related to (1) the accuracy, functioning, or installation of advanced meters or (2) the functioning of a utility-administered Home Area Network with registered consumer devices

The number and percentage of escalated customer complaints related to (1) the accuracy, functioning, or installation of advanced meters or (2) the functioning of a utility-administered Home Area Network with registered consumer devices	Units					
	By Complaint Category	AMI Meters	AMI Programs	Device Registration (HAN)	Communication issues (HAN)	HAN, other
Number of customers	0	0	0	0	0	0

7. The number and percentage of advanced meters replaced before the end of their expected useful life during the course of one year, reported annually, with an explanation for the replacement.

	Units				
The number and percentage of advanced meters replaced before the end of their expected useful life during the course of one year, reported annually, with an explanation for the replacement	By Customer Class	Replaced due to hardware/component failures	Replaced due to firmware related failures	Replaced due to environmental related failures	Replaced due to unknown or communication related failures
	Number of meters	247	308	9	47
	% of meters	1.7 %	2.1 %	0.1 %	.3 %

8. The number and percentage of advanced meters replaced before the end of their expected useful life during the course of one year, reported annually, with an explanation for the replacement.

	Units		
The number and percentage of advanced meters replaced before the end of their expected useful life during the course of one year, reported annually, with an explanation for the replacement		Field tested at the request of customers	Field tested at the request of customers with results outside accuracy band
	Number of meters	142	0
	% of meters	0.01%	0

9. The number and percentage of customers using a utility web-based portal to access energy usage information or to enroll in utility energy information programs or who have authorized the utility to provide a third-party with energy usage data

	Units			
The number and percentage of customers using a utility web-based portal to access energy usage information or to enroll in utility energy information programs or who have authorized the utility to provide a third-party with energy usage data		My Energy pages	Reduce Your Use alert signups	Number/percentage of customers using a utility web-based portal to authorize the utility to provide a third party with energy usage data
	Number of meters	503,893	951,393	13,428
	% of meters	52.96%	47.04%	1.39%

10. Various Smart Meter related information²⁴

Units	Total
Number of Smart Meters installed	1,452,750
Number of Smart Meters activated	1,452,750
Number of Opt-Outs	4,217
Number of non-Smart Meters manually read	4,217
Number of Smart Meters manually read	1,279

B. Plug-in Electric Vehicle Metrics

1. Number of customers enrolled in time-variant electric vehicles tariffs.

	Rate	Number of Customers
Number of customers enrolled in time-variant electric vehicles tariffs	EV TOU	209
	EV TOU 2	12,396

For SDG&E, the applicable tariffs for this metric are EV-TOU and EV-TOU-2.

²⁴ Metric Requested by CPUC Energy Division in August 15, 2017 email.

C. Storage Metrics

1. MW and MWh per year of utility-owned or operated energy storage interconnected at the transmission or distribution system level. As measured at the storage device electricity output terminals.

	Units MW	MWh 'in'	MWh 'out'
MW and MWh per year of utility-owned or operated energy storage interconnected at the transmission or distribution system level. As measured at the storage device electricity output terminals.	87	112,307	85,404

D. Grid Operations Metrics

1. The system-wide total number of minutes per year of sustained outage per customer served as reflected by the System Average Interruption Duration Index (SAIDI), Major Events Included and Excluded for each year starting on July 1, 2011 through the latest year that this information is available.

Metric - SAIDI	Year	Major Events Included	Major Events Excluded
System-wide total number of minutes per year of sustained outage per customer served as reflected by SAIDI	7/1/11 - 6/30/12	574.03	60.59
	7/1/12 - 6/30/13	63.03	62.79
	7/1/13 - 6/30/14	87.41	66.16
	7/1/14 - 6/30/15	58.50	53.46
	7/1/15 - 6/30/16	84.28	65.64
	7/7/16 - 6/30/17	85.02	71.65
	7/7/17 - 6/30/18	114.17	74.51

2. How often the system-wide average customer was interrupted in the reporting year as reflected by the System Average Interruption Frequency Index (SAIFI), Major Events Included and Excluded for each year starting on July 1, 2011 through the latest year that this information is available.

Metric - SAIFI	Year	Major Events Included	Major Events Excluded
How often system-wide average customer interrupted in reporting year as reflected by SAIFI	7/1/11 - 6/30/12	1.4583	0.4592
	7/1/12 - 6/30/13	0.5339	0.5330
	7/1/13 - 6/30/14	0.6797	0.5770
	7/1/14 - 6/30/15	0.5108	0.4954
	7/1/15 - 6/30/16	0.7498	0.5996
	7/7/16 - 6/30/17	0.6528	0.6117
	7/7/17 - 6/30/18	0.6228	0.5911

3. The number of momentary outages per customer system-wide per year as reflected by the Momentary Average Interruption Frequency Index (MAIFI), Major Events Included and Excluded for each year starting on July 1, 2011 through the latest year that this information is available.

Metric - MAIFI	Year	Major Events Included	Major Events Excluded
Number of momentary outages per customer system-wide per year, as reflected by MAIFI, major events included and excluded	7/1/11 - 6/30/12	0.2671	0.2668
	7/1/12 - 6/30/13	0.2663	0.2663
	7/1/13 - 6/30/14	0.2099	0.2079
	7/1/14 - 6/30/15	0.2752	0.2587
	7/1/15 - 6/30/16	0.4931	0.4354
	7/7/16 - 6/30/17	0.3872	0.3585
	7/7/17 - 6/30/18	0.2954	0.2939

4. Number and percentage of customers per year and circuits per year experiencing greater than 12 sustained outages for each year starting on July 1, 2011 through the latest year that this information is available.

Metric	Year	Circuits > 12 Outages Major Events Included	Circuits > 12 Outages Major Events Excluded
Number of customers per year and circuits per year, experiencing greater than 12 sustained outages	7/1/11 - 6/30/12	12	10
	7/1/12 - 6/30/13	8	8
	7/1/13 - 6/30/14	6	5
	7/1/14 - 6/30/15	7	7
	7/1/15 - 6/30/16	12	9
	7/7/16 - 6/30/17	9	8
	7/7/17 - 6/30/18	12	10

5. System load factor and load factor by customer class for each year starting on July 1, 2011 through the latest year this information is available.

	Year	Residential	C&I <500 kW	C&I >500 kW	Other (Agricultural)	Total/System Load Factor
System load factor and load factor by customer class (%)	7/1/11 - 6/30/12	53 %	48 %	79 %	44 %	54 %
	7/1/12 - 6/30/13	47 %	50 %	80 %	53 %	53 %
	7/1/13 - 6/30/14	44 %	54 %	76 %	49 %	49 %
	7/1/14 - 6/30/15	42 %	53 %	72 %	46 %	47 %
	7/1/15 - 6/30/16	45 %	49 %	80 %	29 %	48 %
	7/7/16 - 6/30/17	40 %	63 %	78 %	83 %	50 %
	7/7/17 - 6/30/18	39 %	55 %	72 %	77 %	51 %

6. The number of and total nameplate capacity of customer-owned or operated, grid-connected distributed generation facilities by program (7/1/11 - 6/30/2018)

Metric	Number of Facilities	Capacity (MW)
Distributed generation facilities (Solar PV)	100,915	725.79
Distributed generation facilities (Non-Solar PV)	439	169.24
Distributed generation facilities (Solar and Non-Solar PV)	101,354	895.03

Distributed generation (DG) facilities include those under NEM tariffs as well as non-NEM DG owned by the utility or third parties.

7. Total electricity deliveries from customer-owned or operated, grid-connected distributed generation facilities, reported by month and by ISO sub-Load Aggregation Point.

	Year	Month	Exports (GWh)
Total electricity deliveries from customer-owned or operated, grid-connected distributed generation facilities, reported by month and by ISO sub-Load Aggregation Point.	2017	Jul	235.7
	2017	Aug	235.7
	2017	Sept	274.0
	2017	Oct	219.9
	2017	Nov	227.8
	2017	Dec	268.5
	2018	Jan	134.1
	2018	Feb	134.8
	2018	Mar	173.7
	2018	Apr	223.7
	2018	May	247.6
	2018	Jun	265.4

8. The number and percentage of distribution circuits equipped with automation or remote-control equipment, including Supervisory Control and Data Acquisition (SCADA) systems.

	# of Automated Circuits	Total Circuits	% Automated
The number and percentage of distribution circuits equipped with automation or remote-control equipment, including Supervisory Control and Data Acquisition (SCADA) systems.	818	1,048	78%

If the definition of remote-control equipment is considered broadly, one interpretation of the term could match to the turn on/turn off functionality within SDG&E’s Smart Meters. In that more general case of remote control, 100% of SDG&E’s distribution circuits have Smart Meters and, therefore, remote control capabilities.

9. Metrics for avoided outage minutes.

Smart Grid avoided 5 Year Average	Actual 5 Year outage minutes
242	61