SDGE

A Sempra Energy utility℠

Smart Grid Deployment Plan

2016 Annual Report

CONTENTS

1 Key Takeaways and Highlights 1

1.1 Customer Drivers 5

1.2 Customer Value 6

2 *Smart Grid Deployment Plan* Update 7

2.1 Changes to the Deployment Plan Resulting from Regulatory Action or Legislation 7

2.2 Changes to SDG&E's Deployment Plan resulting from IOU Initiatives 7

2.3 Project Updates 7

2.3.1 Project Costs 7
2.3.2 Estimated Benefits 8
2.3.3 Project Summaries and Updates by Program Area 10
2.3.3.1 Customer Empowerment/Engagement 10
2.3.3.2 Distribution Automation and Reliability 16
2.3.3.3 Transmission Automation and Reliability 23
2.3.3.4 Asset Management, Safety and Operational Efficiency 25
2.3.3.5 Security 32
2.3.3.6 Integrated and Cross-Cutting Systems 34

2.4 Customer Roadmap 39

2.4.1 Introduction / Background 39
2.4.2 Customer Outreach and Engagement Plans 40
2.4.3 Customer Engagement Timeline 40
2.4.4 Overview of the Customer Engagement Plan 41
2.4.5 Smart Grid by Engagement Initiative 41

2.5 Key Risks by Category 45

2.6 Security Risk and Privacy Threat Assessment Updates 47

2.6.1 Threat Landscape 47
2.6.2 Governance, Risk, and Compliance 48
2.6.3 Conclusion 49

2.7 Compliance with NERC Security Rules and Other Security Guidelines 49

3 Smart Grid Metrics 51

A. Customer / AMI Metrics 51

B. Plug-in Electric Vehicle Metrics 55

C. Storage Metrics _____ **56**

D. Grid Operations Metrics _____ **56**

Table of Tables

Table 1: Changes to SDG&E's *SGDP* from Utility Initiatives 7

Table 2: Estimated Smart Grid Deployment Costs for the Reporting Period 7

Table 3: Estimated Smart Grid Benefits in the Reporting Period 9

Table 4: Customer Outreach and Engagement Timeline by Initiative 40

Table 5: Customer Engagement Initiative - Enablement Tools 41

Table 6: Customer Engagement Initiative - Customer Premise Devices 42

Table 7: Customer Engagement Initiative - Rates and Programs 43

Table 8: Customer Engagement Initiative - Pilot Deployment Projects 44

Table 9: Risk Assessment Information by Category 45

Table of Projects

Project 1: Critical Peak Pricing Default (CPP-D) for Medium Commercial Customers 11

Project 2: Centralized Calculation Engine (CCE) 12

Project 3: Connected…to the Sun 12

Project 4: Green Button Connect My Data 13

Project 5: Demand Response Management System (DRMS) 13

Project 6: Smart Pricing Program (Dynamic Pricing) 14

Project 7: Smart Meter Operations Center (SMOC) 14

Project 8: Community and Stakeholder Engagement 15

Project 9: Sustainable Communities Programs 17

Project 10: Advanced Energy Storage (AES) – Distribution 17

Project 11: Solar Energy Project 18

Project 12: Borrego Springs Microgrid 18

Project 13: Phasor Measurement Units (PMU) – Distribution 19

Project 14: Supervisory Control and Data Acquisition (SCADA) Capacitors 19

Project 15: SCADA Expansion – Distribution 20

Project 16: Wireless Fault Circuit Indicators 20

Project 17: Power Your Drive (PYD) 21

Project 18: Distributed Energy Resource Management System (DERMS) 22

Project 19: Automated Fault Location 24

Project 20: Phasor Measurement Units (PMU) – Transmission 24

Project 21: SCADA Expansion – Transmission 25

Project 22: Managing PEV Charging 26

Project 23: Smart Isolation and Reclosing 26

Project 24: Advanced Ground Fault Detection 26

Project 25: Condition-Based Maintenance (CBM) – Substation Transformers 27

Project 26: Distribution Interconnection Information System (DIIS) 28

Project 27: Smart Transformers 29

Project 28: Advanced Distribution Management System (ADMS) 29

Project 29: Solar Power Prediction 30

Project 30: Condition-Based Maintenance (CBM) – Gas Breakers 30

Project 31: Smart Grid Enabled Energy Efficiency 32

Project 32: Cybersecurity Projects 33

Project 33: Customer Privacy Program 33

Project 34: Substation Physical Security Hardening 34

Project 35: SDG&E Grid Communications Systems (SGCS) 35

Project 36: Integrated Test Facility 35

Project 37: Electric Program Investment Charge (EPIC) Program and GRC 2012 RD&D Projects 36

Project 38: Unmanned Aircraft System (UAS) 36

Project 39: Workforce Development 37

Project 40: Data Management and Analytics 38

Project 41: The California Systems for the 21st Century Collaboration (CES-21) 39

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.

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

Changes to San Diego Gas & Electricity's (SDG&E) 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 1,000 megawatts (MW[1]) 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 26% overall growth in Net Energy Metering (NEM) generation capacity to nearly 617 MW during the 12 months ending June 30, 2016 (the "Reporting Period"). SDG&E has nearly 93,000 NEM customers and continues to encourage growth by providing innovative customer solutions, like the renewable meter adapter which can significantly lower the costs for some customers to install solar.

SDG&E customers have installed distributed generation systems with a peak capacity of nearly 617 megawatts.

SDG&E is engaging customers who now have many more choices in the tools available to help them manage their energy use. Home Area Network (HAN) devices that are compatible with SDG&E's Smart Meter network, such as energy information displays and other energy management devices, are now available from multiple manufacturers and listed on SDGE.com. In 2015, SDG&E opened the SDG&E Marketplace, an online store that helps customers make energy efficient changes in their home by making it easy to learn about rebate-eligible and energy-efficient products. The SDG&E Marketplace can also provide personalized energy savings recommendations based on the customer's Smart Meter data[2]. As of July 2016, 100,000 customers have visited the SDG&E Marketplace since its inception. Customers can also choose between a variety of online energy information services and mobile

[1] Unless otherwise noted, power capacity values (megawatt/MW and kilowatt/kW) are shown as alternating current (AC) nameplate ratings.
[2] https://marketplace.sdge.com/

applications for valuable, detailed analysis of their Smart Meter data via the open standards-based Green Button Connect My Data platform. Finally, customers can easily and securely authorize third parties to automatically receive energy usage data on a daily basis through a simple registration process on SDG&E's My Account portal.

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 over 21,000 during the Reporting Period.[3] Because of their unique load characteristics, Smart Grid solutions are essential to the reliable integration of PEVs and PHEVs into the electric grid while minimizing capital infrastructure costs. SDG&E continues to promote electric vehicles for employees. Over 266 employees own electric vehicles and the company has installed 181 charging stations at its facilities at the end of the Reporting Period.

This *Smart Grid Deployment Plan – 2016 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 2012-2015, this *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 **~$107.1** million and **~$112.9** million in benefits
- 41 Smart Grid and related enterprise[4] projects completed, in progress or planned
- Being the first major California utility to reach the net metering cap of 5% of peak demand or 617 MW on June 29, 2016.[5] All subsequent installations will occur under the new NEM 2.0 framework approved by the commission in January 2016.[6]
- CPUC approval of SDG&E's Electric Vehicle Grid-Integration pilot program in January 2016 allowing the company to own and install electric vehicle (EV) charging stations at up to 350 businesses and multi-family communities throughout the region, with 10 chargers at each location.
- Leading EV adoption by example with 266 SDG&E employees driving electric vehicles, over 180 EV workplace chargers at SDG&E facilities and shareholder approval to provide $7.5 million for EV education to help drive adoption and support state and local climate goals.[7]

[3] Neighborhood electric vehicles (street legal plug-in vehicles with a maximum speed of 35mph) 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] http://www.utilitydive.com/news/sdge-becomes-first-california-utility-to-hit-net-metering-cap/421819/
[6] http://www.utilitydive.com/news/california-regulators-preserve-retail-rate-net-metering-in-3-2-vote/412930/
[7] http://www.sandiegouniontribune.com/news/2016/may/16/sdge-charging-stations/

- PEV growth to more than 21,000 total vehicles connecting to SDG&E's system, adding nearly 4,000 vehicles[8]
- Strong growth in NEM distributed generation (DG) with customers connecting nearly 34,000 new systems (primarily solar), for a new total of nearly 93,000 residential and commercial DG systems interconnected with the SDG&E grid
- Rapid growth in customer energy storage deployments including a greater than 200% growth rate in energy storage installations as energy storage product offerings increased.
- Installing approximately 3,700 Renewable Meter Adapters (RMA), a solution developed by SDG&E and launched in June 2015, which connects rooftop solar systems directly to the existing electric meter panel in as little as one hour and reduces the costs of residential rooftop solar installation by an average of $1,200 for customers. The RMA technology allows rooftop solar customers to avoid the need for invasive and time consuming circuit breaker panel upgrades that typically cost over $2,500 not including the structural impacts to walls, stucco and landscaping, especially for older homes[9].
- Pursuant to California Public Utilities Commission (CPUC) Resolution E-4791[10], approval of two new lithium ion battery storage projects with total capacity of 37.5 MW to manage potential local electric reliability issues. The projects will be on-line and operational in Q1 2017.[11]

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 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 American Electric Reliability Corporation's Critical Infrastructure Protection (NERC CIP) standards. In SB 350, the California state legislature voted to increase the state's renewable portfolio standard from 33% to 50% and doubling the amount of California's energy efficiency savings by 2030.[12] Furthermore, SB 350 declares that transportation electrification is essential to reducing emissions of greenhouse gases to 40 percent below 1990 levels by 2030 and to 80 percent below 1990 levels by 2050[13]. 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.

[8] 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.
[9] http://www.sdge.com/environment/renewable-meter-adapter
[10] http://www.cpuc.ca.gov
[11] https://www.sdge.com/newsroom/press-releases/2016-08-19/sdge-add-more-storage-improve-regional-reliability
[12] http://www.utilitydive.com/news/california-lawmakers-pass-bill-mandating-50-renewables-by-2030/405566/
[13] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

SDG&E made significant progress procuring renewables, both centralized and distributed, during the Reporting Period. In June 2015, SDG&E reached the state's goal of 33% RPS, a full five years ahead of the state-mandated target.[14] At the end of June 2016, SDG&E was the first major California utility to hit the NEM cap of 5% of SDG&E's peak load or 617MW.[15] The need to deliver energy from these clean, yet intermittent, sources continues to be a major driving factor in SDG&E's Smart Grid plans, which will integrate renewables, PEVs, and other technologies safely and reliably.

During the Reporting Period, SDG&E issued the 2016 Preferred Resource Local Capacity Requirements Request for Offers (RFO) soliciting a variety of resources and technologies, such as energy efficiency (EE), demand response, renewables, energy storage, and distributed generation. The 2016 Preferred Resource RFO was the second solicitation issued by SDG&E in response to D.14-03-004 (Decision Authorizing Long-Term Procurement for Local Capacity Requirements due to the Permanent Retirement of the San Onofre Nuclear Generation Station). That decision indicated that 25 MW must be procured from energy storage technology and a minimum of 200 MW from preferred resources[16]. The qualified best offers will then be negotiated and submitted to the CPUC for approval in late 2016 or early 2017.

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 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

[14] "SDG&E Sets Renewable Energy Record" http://www.kpbs.org/news/2015/aug/25/sdge-sets-renewable-energy-record/
[15] http://www.utilitydive.com/news/sdge-becomes-first-california-utility-to-hit-net-metering-cap/421819/
[16] Decision (D.) 14-03-004 – Decision Authorizing Long-Term Procurement for Local Capacity Requirements due to Permanent Retirement of the San Onofre Nuclear Generation Station

Smart Grid projects represent exciting new initiatives that will bring more opportunities for SDG&E to work together with Diverse Business Enterprises (DBEs) and help the region's communities thrive. For the year ending in 2015, 42.7% of SDG&E's purchases were from DBEs. Smart Grid-related DBE purchases were accomplished through focused efforts that included DBE requirements in requests for proposals and identification of qualified DBEs for logistics, warehousing, installation, software, and other products and services.

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.

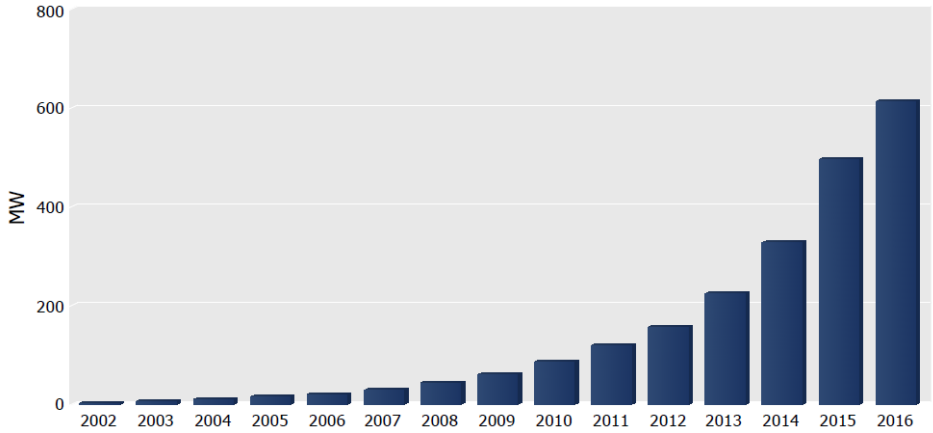
1.1 CUSTOMER DRIVERS

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

- 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.

As shown in Figure 1, SDG&E customers are continuing their investments in distributed generation systems, primarily PV technology, with SDG&E's customers generating nearly 617MW (peak) from almost 93,000 systems installed at their premises at the end of the Reporting Period. 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.

Figure 1 - Cumulative Capacity of NEM Customer Generation: Growth in Net Energy Metered Distributed Generation Capacity of Residential and Commercial and Industrial (C&I) Customers of SDG&E as of June 30, 2016



SDG&E's Smart Grid investments that respond to these customer choices are intended to reliably and efficiently integrate these new technologies. 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 (CO_2e) 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. SDG&E's previous *Annual Reports* can be retrieved from http://www.sdge.com/smart-grid-deployment-plan.

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 *SGDP*	Reason for Change
None		

2.3 PROJECT UPDATES

2.3.1 PROJECT COSTS

During the Reporting Period, SDG&E's estimated expenditures of $107.1 million breakdown as listed in Table 2: Estimated Smart Grid Deployment Costs for the Reporting Period:

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	$	44,757
Distribution Automation/Reliability	$	19,983
Transmission Automation/Reliability	$	4,204
Asset Management, Safety & Operational Efficiency	$	7,019
Security	$	15,382
Integrated & Cross-Cutting Systems	$	15,776
Total Estimated Costs	**$**	**107,121**

Expenditures are estimated and based on total spend, including operations and maintenance (O&M) and capital, excluding Allowance for Funds Used During Construction (AFUDC), 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."[17] 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,[18] and environmental and societal benefits based on a model developed by SDG&E in collaboration with the Environmental Defense Fund[19]. 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 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.

Economic benefits are primarily the result of reduced and avoided costs of utility operations. Reliability benefits estimate the societal value of avoided outages for customers among residential, commercial, and industrial classes. Environmental benefits estimate a value of avoided greenhouse gas and

[17] Final Report No. 1020342, "Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects", January 2010.
[18] Final Report No. LBNL-6941E, "Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States", January 2015.
[19] For further details on the methodology for environmental and societal benefits see http://docs.cpuc.ca.gov/PublishedDocs/EFILE/RESP/140924.PDF.

particulate emissions, while societal benefits include other costs avoided by customers, such as the avoided cost of gasoline for transportation fuel when electric vehicles or helicopters are used as alternatives.

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 Period:

Table 3: Estimated Smart Grid Benefits in the Reporting Period[20]

Estimated Benefits During the Reporting Period Amounts in Thousands of USD	Reporting Period Value
Economic Benefits	$ 36,478
Reliability Benefits	$ 33,316
Environmental Benefits	$ 13,838
Societal Benefits	$ 29,311
Total Estimated Benefits	**$ 112,943**

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 services field activities remained at normalized levels compared to the previous period, continuing to provide environmental benefits to the region. The Smart Meter program also continued to facilitate the implementation of Reduce Your Use (RYU), a Smart Grid Demand Response program.

During the Reporting Period, various completed and in progress Distribution Automation and Reliability projects provided benefits to customers, markets, and the utility. Customers benefit 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 the Borrego Springs Microgrid, SCADA Expansion, SCADA Capacitors, Fault Location Isolation and Service Resotration (FLISR), and Wireless Fault Indicators generated these types of benefits through the increase in the use of distribution automation on the grid and improved reliability.

[20] 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.

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 reduction associated with displacing conventional generation with distributed renewable energy resources and the integration of centralized renewable energy for compliance with the RPS.[21] The avoided emissions reduction for distributed resources is based on the energy load forecast included in the recent California Energy Demand 2016-2025 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 roof top 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 over 21,000 electric vehicles into SDG&E's electric grid also generated additional benefits to the environment and the community. SDG&E estimated that the light-duty electric vehicles integrated into the system during the Reporting Period avoided the consumption of over 2,703,314 gallons of gasoline. 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.

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 HAN systems.

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.

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

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 providing 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: Critical Peak Pricing Default (CPP-D) for Medium Commercial Customers	
Funding Source: GRC **Project Timeframe**: **10/2013 to 01/2016**	Reporting Period Estimated Costs: $23,000
Description: In 2008, SDG&E rolled out CPP-D as the first dynamic rate to the large commercial and industrial (C&I) segment (~1,700 customers). The Smart Pricing Program is rolling out dynamic rates for the residential and small C&I customer segments. The project scope includes the following: • Automating business processes such as: rate eligibility, enrollment and dis-enrollment (opt-out), anniversary management, Demand Response event day management, event day notifications, post-event analytics, marketing, and reporting and metrics. • Providing services to the customers via online tools for viewing their usage, meter data, cost of usage (including CPP-D events), running rate comparisons between other applicable rates, and choosing a capacity reservation charge (CRC). • Functionality for group bill such as viewing, paying, payment processing, accessing historical group bills, downloading, printing, and paperless options. • Integrating eligibility, enrollment, dis-enrollment, notifications, rate comparison, CRC election, and group bill pay with My Account through Web Center.	
Update: Implementation was completed in January 2016.	

IN-PROGRESS PROJECTS

Project 2: Centralized Calculation Engine (CCE)	
Funding Source: General Rate Case (GRC) **Project Timeframe: In Progress**	Reporting Period Estimated Costs: $3,714
Description: The development of a centralized calculation engine which will incorporate multiple data sources and provide price and cost calculations as output. The calculation engine will be flexible and incorporate all comprehensive rate, price, and cost modeling, as well as the ability to manipulate curves, types of charges (consumption, demand, fixed, etc.), peak moves, event hour shifts, and more. It will ensure consistency of calculations and output across many operations and users.	
Update: SDG&E has completed both Phase 1 and Phase 2 of CCE. Phase 2 was completed in March 2016 and configured the majority of the rate structures across residential, commercial, and agricultural customers.	

Project 3: Connected…to the Sun	
Funding Source: Application D.15-01-051 **Project Timeframe: 01/2016 to 03/2017**	Reporting Period Estimated Costs: <$100
Description: In January 2012, SDG&E filed an application with the CPUC for a pilot program called, "*Connected…..to the Sun*,"[22] which will give all SDG&E customers two options to buy solar power, even if they do not own a home, cannot afford the upfront cost of solar, or do not have the ability to put PV panels on their roof. Under these programs, the customer would be able to purchase up to 100% local solar energy if they choose. Customers could "lock in" their solar energy cost and take solar service with them if they relocate within SDG&E's service area.	
Update: In November 2015, SDG&E received funding approval to automate enrollment in Ecochoice, formerly the Sun Rate, which allows the customer to choose what percentage of renewable energy they desire to use. In addition, the project successfully began the process of automating Share the Sun enrollment which provides customers the opportunity to participate in a community solar program.	

[22] http://www.sdge.com/environment/connected-to-the-sun

Project 4: Green Button Connect My Data	
Funding Source: GRC **Project Timeframe: 01/2012 and ongoing**	Reporting Period Estimated Costs: $578
Description: Green Button Connect My Data is the automated sending of energy usage data to third parties (per customer request/consent) via a standard interface North American Energy Standards Board Energy Services Provider Interface (NAESB/ESPI). Customers' data is sent using one of two models: One and done (one-time data transmission of customer consumption) and Ongoing with or without a specified end-date (data transmitted on an ongoing basis as long as customer is enrolled with third party, or until a date selected by customer for up to 36 months).	
Update: As of June 30, 2016, there are 29 active, registered Green Button Connect Third Parties that customers can authorize to share energy usage data via Green Button Connect. Twelve are for residential-use, 13 are for commercial use and four are both residential and commercial. On April 10, 2016, SDG&E deployed its last release of enhancements to comply with mandates, which include: cost data, quality of reading (Revenue Quality Meter Data) indicator in ESPI file, gas usage in the ESPI file and full OAuth integration to support a real-time API.	

Project 5: Demand Response Management System (DRMS)	
Funding Source: GRC and Smart Meter Decision (D.12-04-019) **Project Timeframes: 08/2010 to 12/2018**	Reporting Period Estimated Costs: $3,560
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.	
Updates: The project team performed DRMS Release 1, which includes the majority of Phase 1 functionality. Incremental releases will focus on Entryway/HAN and include the Centralized Calculation Engine (CCE) and MyAccount integration. DRMS Release 2 (the final release for	

Project 5: Demand Response Management System (DRMS)	
Phase 1) will be deployed in Q3 2016. DRMS Release 2 plans to deliver Demand Response post-event settlement capabilities for the capacity bid program and business reporting.	

Project 6: Smart Pricing Program (Dynamic Pricing)	
Funding Source: Application D.12-12-004 and D.14-12-036 **Project Timeframe: 09/2010 to 12/2016**	Reporting Period Estimated Costs: $11,989
Description: SDG&E's Smart Pricing Program was proposed via application A.10-07-009 filed on July 6, 2010 and modified as described in the Joint Party Settlement Agreement filed on June 20, 2011. The application and settlement agreement adopted by the CPUC in D.12-12-004 describes SDG&E's plans to implement various time of use (TOU) and dynamic rates, along with the necessary information technology (IT) and billing system upgrades as well as the customer outreach and educational efforts necessary for residential and small business customers to be aware of the new rates and have the tools to make informed rate decisions. In December 2014, the CPUC adopted D.14-12-036, which grants SDG&E's Petition for Modification of D.12-12-004 to extend the implementation deadline for the outreach and education activities for residential and small business customers to December 31, 2016.	
Update: Over the past year, the Smart Pricing Program took the necessary steps to transition small business customers to TOU rates (Time of Use and Time of Use Plus) as mandated by D.12-12-004. SDG&E began default communications to its small business customers during summer 2015 about the upcoming transition and continued to communicate to them throughout the entire process. Beginning in November 2015 and through April 2016, SDG&E transitioned all of its small business customers to TOU rates (approximately 72,000). As of June 30, 2016 over 61,000 were enrolled in the TOU Plus plan which contains a critical peak pricing component.	

Project 7: Smart Meter Operations Center (SMOC)	
Funding Source: GRC **Project Timeframe: Phase 1, SMOC NMV:07/2013 to 06/2014**; **Phase 2, SMOC EM**: **07/2014 and 09/2016**	Reporting Period Estimated Costs: $1,916
Description: Phase 2 of the Smart Meter Operations Center, Exception Management (SMOC	

Project 7: Smart Meter Operations Center (SMOC)	
EM) will provide a solution that will improve Advanced Metering Operations' (AMO) operational efficiency and reduce device downtime by providing analysts with results rather than raw data needed for exception management and troubleshooting processes to optimize network performance. SMOC EM will provide a centralized information repository of Smart Meter data, accessible to other initiatives supporting Customer Service and other company initiatives associated with Smart Grid.	
Update: Smart Meter Operations Center – Exception Management (SMOC EM) released four major content releases between August 2015 and August 2016. The Operations group has gained operational efficiencies and analytical awareness on the health, performance, and network activities of network and metering devices, and is able to make more intelligent and timely decisions on fielding devices or performing back office corrective action based on a variety of key analytical data points. The SMOC EM project will end in September 2016. The application has yielded additional insights and possible new use cases that may be developed in upcoming (future) phases. Additionally, infrastructure and a data lake database was implemented as an Enterprise platform for data storage.	

ENTERPRISE PROJECTS

Project 8: Community and Stakeholder Engagement	
Funding Source: Various **Project Timeframe: Ongoing**	
Description: SDG&E's community and stakeholder engagement effort is intended to provide coordination in the utility's engagement effort and ensure that the overarching connections between programmatic outreach and education efforts are present. Encompassed in this effort is a wide variety of stakeholder-focused efforts, all significantly associated with Smart Grid and specifically SDG&E's Smart Grid efforts. SDG&E has actively worked with business associations, international counterparts, and residential groups to educate them on the changing landscape of the energy industry. SDG&E is working hard to ensure its stakeholders – in particular, customers – look to SDG&E as a trusted energy advisor.	
Update: SDG&E's fourth annual Electric Vehicle Day saw the largest gathering of electric cars in the San Diego region's history with 1,100 people attending and 792 test drives in the latest electric drive transportation technology. More than 165 local electric vehicle drivers had the opportunity to bring their own cars to the event, put them on display, and network with fellow	

Project 8: Community and Stakeholder Engagement	
residents interested in driving the cars. SDG&E hosted the event as part of National Drive Electric Week and along with Center for Sustainable Energy, Cleantech San Diego, Plug-in America, Sierra Club, and the Electric Auto Association provided information on the Power Your Drive pilot, electric vehicle rates, incentives and charging. During the Reporting Period; SDG&E, Sumitomo Electric Industries, Ltd., and New Energy and Industrial Technology Development Organization of Japan (NEDO)[23] began jointly developing a demonstration project utilizing a megawatt scale system of vanadium redox flow batter. The project will analyze the technological and economic efficiency of the system. The fast response and long duration applications could allow for increased solar penetration and power quality.	

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 will provide the ability to safely and reliably incorporate high penetrations of distributed energy resources by mitigating voltage fluctuations resulting from intermittent power generation. DAR projects will also provide the ability to safely and reliably incorporate the increasing load of charging EVs. DAR will detect and isolate faults when they occur, immediately restore service to customers, and provide 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 will also provide 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.

[23] http://www.nedo.go.jp/english/news/AA5en_100015.html

COMPLETED PROJECTS

Project 9: Sustainable Communities Programs	
Funding Source: GRC **Project Timeframe: Concluded 12/2015**	Reporting Period Estimated Costs: $495
Description: This is a set of projects that aim to advance and promote the use of clean DER – such as solar PV, fuel cells, and energy storage—by integrating it into the electric distribution system. These projects focus on reducing energy demand and integrating clean energy systems while encouraging sustainably designed buildings and communities.	
Update: The system at Civita has been energized and commissioned. The final Civita project configuration includes an 87 kW PV array and a 125 kW/200 kWh battery energy storage system. The program has concluded new construction activities and maintenance and operations activities are ongoing at the sites.	

Project 10: Advanced Energy Storage (AES) – Distribution	
Funding Source: GRC **Project Timeframe: 10/2011 to 06/2016**	Reporting Period Estimated Costs: $1,544
Description: The objective of this project is to install advanced energy storage projects that will mitigate the impact of intermittent renewables and provide SDG&E with experience developing, implementing, and operating new energy storage technologies. The scope will include developing utility scale (300 kW+) energy storage units at substations and other locations, and distributed energy storage systems (DESS - typically 25 to 50 kW) on distribution feeders. DESS are also known as Community Energy Storage (CES) systems.	
Update: During the Reporting Period, the fleet of energy storage units performed scheduled and ad-hoc functions, such as peak shaving and islanding, while the project team refined the use cases of the fleet. This concluded the implementation of the energy storage projects from the GRC. Future energy storage projects will be funded via future applications, advice letters and GRCs as applicable.	

IN-PROGRESS PROJECTS

Project 11: Solar Energy Project	
Funding Source: Application (A.08-07-017) **Project Timeframe: 01/2008 to 06/2016**	Reporting Period Estimated Costs: $5,806
Description: The CPUC approved this 100MW$_{dc}$ solar project in 2010. It includes a program to develop as many as 26MW$_{dc}$ of utility-owned solar generation and 74 MW$_{dc}$ of merchant-owned generation, to be delivered via power purchase agreements. The 74 MW$_{dc}$ portion has since been added to the 80MW Renewable Auction Mechanism Feed-in Tariff (RAM-FiT) program. The utility-owned portion calls for SDG&E to install multiple PV systems, as large as 5MW, on the distribution system. SDG&E anticipates employing smarter inverters, like those advocated by the Western Electric Industry Leaders, at these sites with specific capabilities dependent upon local grid needs and size of the PV installation. The successful bidder bid eight projects to be built on existing utility owned property for a total of 17MW$_{dc}$. All but three projects were eliminated due to financial constraints uncovered during detailed site screening.	
Update: The third site was eliminated as projected costs for development exceeded CPUC approved cost cap. The two remaining sites entered in to the construction phase of this project in Q2 2016 with expected commercial operation in Q4 2016.	

Project 12: Borrego Springs Microgrid	
Funding Source: DOE, CEC and GRC **Project Timeframe: 04/2014 to 12/2017**	Reporting Period Estimated Costs: $2,306
Description: The objective of this project is 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 and outage/event conditions. The second phase of the Borrego Springs Microgrid project will enhance the existing Borrego Springs Microgrid, by increasing operational flexibility and automation to better respond to a variety of potential outage situations, and leverage various new technologies and resources for increased microgrid capabilities. This project is being performed in partnership with the CEC.	
Update: Additional SCADA operable switches were installed to allow for remote reconfiguration of the system. A critical one-mile section of wood poles was replaced with steel poles to help ensure deliverability of electricity to critical loads. Discussions have begun with local- third	

Project 12: Borrego Springs Microgrid	
party solar producers on how best to integrate them into the microgrid.	

Project 13: Phasor Measurement Units (PMU) – Distribution	
Funding Source: GRC **Project Timeframe: 06/2012 and ongoing**	Reporting Period Estimated Costs: $3,340
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, nanosecond accuracy for timed operations, and sequence of events (true system state) displayed on advanced visualization tools.	
Update: Distribution PMU deployment activity is focused on testing and production implementation of Falling Conductor Protection (FCP) application. FCP allows for automated termination of power flow to a specific portion of a circuit in the event of a failing conductor. Power is terminated within milliseconds of a conductor failure and prior to coming in contact with the ground or other objects. This application reduces risk to life, limb and property. Thirty-seven (37) circuits have been analyzed for Distribution PMU supported FCP application installation with production turn-up starting in September 2016.	

Project 14: Supervisory Control and Data Acquisition (SCADA) Capacitors	
Funding Source: GRC **Project Timeframe: 03/2011 and ongoing**	Reporting Period Estimated Costs: <$100
Description: The objective of this project is to convert existing distribution line capacitors to SCADA control in order to provide improved VAr control and improved system efficiency and operability. SCADA controls will also alert utility personnel of operating issues. This will increase capacitor bank reliability, minimize downtime, and expedite repair work. Once fully implemented, the annual capacitor survey will be eliminated as a result of this project.	
Update: Between June 20, 2015 and July 30, 2016, 14 capacitors were installed and energized to replace 14 older overhead and pad-mounted non-SCADA capacitors. Improved control	

Project 14: Supervisory Control and Data Acquisition (SCADA) Capacitors	
methods and algorithms continue to be considered for application and assessment. The project is designing automatic alerts to notify engineers and/or operators regarding anomalous behavior.	

Project 15: SCADA Expansion – Distribution	
Funding Source: GRC **Project Timeframe: 01/2012 and ongoing**	Reporting Period Estimated Costs: $6,231
Description: This project will install 300 SCADA line switches to promote a minimum of 1.5 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.	
Update: During the reporting period, SDG&E installed SCADA at Coronado and San Mateo. In Q4 2016, the project team will finalize the installation at Carlton Hills. No work or installations of 1.5 switches on distribution circuits were completed during the reporting period as the reliability team focused on non-SCADA circuits.	

Project 16: Wireless Fault Circuit Indicators	
Funding Source: GRC **Project Timeframe: 09/2011 and ongoing**	Reporting Period Estimated Costs: <$100
Description: The objective of this project is to install as many as 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.	
Update: SDG&E is working with the vendor to resolve technical issues associated with the	

Project 16: Wireless Fault Circuit Indicators	
latest firmware update. The vendor is in the process of upgrading the equipment, which will include enhanced fault location indicating ability even when the continuous current on the line is less than 5 amps. New equipment will be installed over the next few years.	

Project 17: Power Your Drive (PYD) • **Aka Vehicle to Grid Integration (VGI)**	
Funding Source: A. 14-04-014 **Project Timeframe: 09/2011 and ongoing**	Reporting Period Estimated Costs: $374[24]
Description: The pilot project will help accelerate the deployment of smart electric vehicle charging stations and drive the state towards its environmental and fossil fuel reduction goals.[25] These solutions will enable PEVs, PHEVs, and their charging infrastructure to become grid-integrated and to leverage TOU and other alternative rate designs. It may allow SDG&E to integrate even higher levels of renewables in the future by absorbing excess production during the solar generation peak hours, and ramping down charging demand as solar production drops.	
Update: In January 2016, the CPUC approved the nation's largest transportation electrification program – Power Your Drive. This program will install 3,500 EV charging stations at 350 residential multi-unit dewellings. At least 10% of the charging stations will be installed in disadvantaged communities. One of the key reasons the CPUC approved SDG&E's program is because of the first-of-a-kind technology it offers, incentivizing customers through a day-ahead hourly rate to charge at times of day when there is the most capacity on the grid. Of the over 300 customers on the interest list, about 30% are multi-family and 70% are workplace (employee/fleet). The 3-year sign up period commences when all regulatory approvals are received, which is expected September 2016. SDG&E continues to promote electric vehicles to its employees and in the community and has received over 60 partnership proposals from non-profit organizations to promote Power Your Drive as part of its $7.5 million shareholder-funded educational campaign. As of August 2016, 284 SDG&E employees drive electric vehicles and over 200 EV workplace chargers are located at SDG&E facilities. SDG&E is committed to growth	

[24] as of July 31, 2016

[25] http://www.sdge.com/clean-energy/electric-vehicles/poweryourdrive

Project 17: Power Your Drive (PYD) • **Aka Vehicle to Grid Integration (VGI)**	
of EVs and supportive of both state and local climate goals. SDG&E submitted its first required semi-annual report to the CPUC on the progress of the vehicle-grid integration (VGI) program. Also referred to as Power Your Drive. The report can be found here: http://www.sdge.com/regulatory-filing/10676/sdge-electric-vehicle-grid-integration-pilot-program This first iteration of the report provides background and details regarding the decision which approved the program. The report also provides an explanation on what is being measured / evaluated in each field. Appendix B contains the measurable data. Since the program is new there are some fields which do not currently have data. Those will be populated in future iterations.	

Project 18: Distributed Energy Resource Management System (DERMS)	
Funding Source: GRC **Project Timeframe: 04/2013 and ongoing**	Reporting Period Estimated Costs: $9,120
Description: The purpose of the DERMS project is to develop a software solution to monitor, control, and optimize distributed energy resources. • Integrates and aggregates batteries, fuel cells, solar, generators, and other distributed energy resources for reliability and market participation • Uses load forecasting, day-ahead price signals, DRMS, etc. to give multiple options for optimization and scenario-based operations • Integrates with DMS, GIS, DRMS, etc.	
Update: During the Reporting Period, the project has deployed an updated release of the DERMS application to monitor and control the Borrego Springs Microgrid. The update in March included control and integration of the second 1MW lithium-ion battery installed at the Borrego Microgrid, as well as defect remediation. The upcoming release will provide enhanced usability and functionality to the application for generalized microgrid management, will manage the energy storage resource fleet, and will allow for the integrated assets to be scheduled.	

2.3.3.3 TRANSMISSION AUTOMATION AND RELIABILITY

Transmission Automation and Reliability (TAR) includes projects that would 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 would mitigate voltage fluctuations resulting from integrating intermittent resources.

The wide-area capabilities of TAR would 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 would detect events or conditions in the transmission systems and automatically respond to stabilize the system.

In-Progress Projects

Project 19: Automated Fault Location	
Funding Source: FERC **Project Timeframe: 04/2012 and ongoing**	Reporting Period Estimated Costs: $338
Description: This project implements a system that automatically retrieves event reports from relays on all affected transmission lines and distribution feeders and stores the events in a central Event Archiving server. The TEAM software calculates the fault location and type from the retrieved data, and sends out email notifications within seconds. It also synchronizes the events with Wide Area Situational Awareness (WASA) visualization display for the operators and engineers to view details of the fault for immediate crew dispatch, and post-event analyses. The fault calculation is performed with greater accuracy than the single ended calculation performed by the relays today. The project will avoid truck rollouts to physically dispatch technicians to download relay event records, and avoid line patrols and helicopter dispatches. The project will assist in rapid service restoration and minimize outage duration, post event analyses, and regulatory reporting.	
Update: During the reporting period, installation was completed at 20 substations. Currently the events are being retrieved remotely. An automated solution is in the pilot phase testing at 5 substations.	

Project 20: Phasor Measurement Units (PMU) – Transmission	
Funding Source: FERC **Project Timeframe: 2010 and ongoing**	Reporting Period Estimated Costs: $2,939
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. PMUs take real-time synchronized phasor measurements (synchrophasors) at 30 to 60 samples per second compared to the current EMS (Energy Management System) at every 4 seconds. This information can provide accurate and high time resolution snapshots of the grid conditions for the entire Western Interconnected System. The information can also be used to provide the operators, engineers, and planners with Wide Area Situational Awareness (WASA) that will help in understanding and mitigating system outages to avoid system instability. The SDG&E synchrophasor data is being shared with PeakRC (formerly WECC) and California Independent System Operator (CAISO). The data will also be exchanged with neighboring utilities. The WASA system based on synchrophasors will provide the System Operators with applications / tools to quickly asses the dynamic system conditions and events and enable them	

Project 20: Phasor Measurement Units (PMU) – Transmission	
to take quick actions to avoid wide area system blackouts, such as the real-time Voltage Stability and Oscillation detection capability and offer corrective actions.	
Update: The major project focus during the reporting period was on Wide Area Situational Awareness (WASA) system hardware architecture development, procurement of servers, storage devices and communications equipment at Data and Control Centers. In Phase I of the WASA system deployment, software has been installed and is being tested by engineers and planners with input from System Operations. Improvement of installed synchrophasor data based applications is continuing. The goal is to bring the production WASA system to Grid Operations by 2018. During the reporting period, SDG&E completed installation of one PMU. Future PMU installations are planned at other critical substations. SDG&E is also a participant in the PRSP (Peak Reliability Synchrophasor Project) with PeakRC co-funded by the DOE FOA 970 grant to develop Real-time Voltage Security Assessment (VSA) and Linear State Estimator (LSE) tools.	

Project 21: SCADA Expansion – Transmission	
Funding Source: FERC **Project Timeframe: 09/2011 and ongoing**	Reporting Period Estimated Costs: $924
Description: This project will install SCADA at existing substations. This automation will allow for faster isolation of faults, result in faster load restoration, and enhance customer satisfaction when system disturbances occur.	
Update: During the reporting period, SDG&E installed SCADA at Carlton Hills and San Ysidro substations. These three substations will immediately increase the reliability in their respective areas.	

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 replacements of energy infrastructure based on the health of the equipment versus a time based approach. This functionality would help to avoid critical energy infrastructure failures as well as manage costs associated with maintaining and replacing equipment.

COMPLETED PROJECTS

Project 22: Managing PEV Charging • **Optimization of Pricing & Resource Allocation (OPRA)**	
Funding Source: GRC **Project Timeframe: 01/2012 to 12/2015**	Reporting Period Estimated Costs: $220
Description: SDG&E developed and implemented a pilot program to aggregate and bid distributed energy storage and PEVs into the CAISO's Energy, Spinning and Non- Spinning Reserve markets. Specifically, SDG&E aggregated stand-alone stationary storage at three separate sites with EV charging load at different sites across SDG&E's service territory. The aggregation participated in the CAISO's markets utilizing the Proxy Demand Resource (PDR) framework though the end of 2015.	
Update: The OPRA pilot ended in Q1 2016. SDG&E is currently leveraging lessons learned from this pilot, particularly in the interconnection and integration of a 37.5 MW storage project into the CAISO's markets. This project is being developed in response to the Aliso Canyon emergency energy storage resolution, and will come on line in Q1 2017.	

Project 23: Smart Isolation and Reclosing	
Funding Source: GRC **Project Timeframe: 04/2012 to 12/2016**	Reporting Period Estimated Costs: $<100
Description: The objective of the Smart Isolation and Reclosing project is to apply off-the-shelf pulse closing technology at additional points on the system. SDG&E has already applied this technology, which limits the amount of energy that the utility re-closes back into faulted circuits, improving public safety.	
Update: The project completed 16 new installations. Each new installation improves overall circuit reliability and ensures safer operation of the distribution system with risk mitigation of property damage being a major emphasis.	

IN-PROGRESS PROJECTS

Project 24: Advanced Ground Fault Detection	
Funding Source: GRC **Project Timeframe: 06/2011 and ongoing**	Reporting Period Estimated Costs: $501

Project 24: Advanced Ground Fault Detection	
Description: The objective of this project is to provide enhanced ground fault detection schemes for distribution circuits to improve detection of operational issues. The project will also 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 effort is concentrated on the protective relays for distribution feeder and on pole-mounted service restorers. The advanced protection system will provide faster isolation of downed conductors, promoting enhanced safety and improved service reliability.	
Update: The project is in the final deployment phase. 181 reclosers (94% of total) have had their software upgraded for advanced ground fault protection. 78 (89% of total) replacement controllers have been installed to accommodate the new software. All remaining software upgrades and controller cabinet are scheduled for installation by the end of 2016.	

Project 25: Condition-Based Maintenance (CBM) – Substation Transformers • **Substation Advanced Analytics (SAA)**	
Funding Source: GRC and FERC **Project Timeframe: 01/2007 to 01/2017**	Reporting Period Estimated Costs: $1,285
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 performance/condition of system assets and will provide actionable alerts when attention is required. Substation Advanced Analytics technology includes: • Advanced analytical features for substation assets to use in business planning, operations, and engineering • Improved dissolved gas analysis (DGA) software for both the main tank of a transformer, and a transformer's load tap changer (LTC) • 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)	

Project 25: Condition-Based Maintenance (CBM) – Substation Transformers • **Substation Advanced Analytics (SAA)**	
Update: Software for advanced analytical features was deployed into production in July of 2016. The main CBM program has completed all installations of monitoring equipment. Installations of T3 substation monitoring equipment software to replace previous E3 substation software is ongoing.	

Project 26: Distribution Interconnection Information System (DIIS)	
Funding Source: GRC **Project Timeframe: 09/2008 to 06/2017**	Reporting Period Estimated Costs: $899
Description: DIIS was implemented in February 2013 and is used for solar contractors and self-installers to submit and track their Net Energy Metering (NEM) applications. DIIS phases 2 and 3 enhanced the Remote Meter Configuration (RMC) automated process to reduce back-end supporting activities in order to reduce the cost of supporting the NEM program. The projects also implemented CPUC mandated additional questions to the online NEM application forms, and made several user interface improvements benefitting the external end-users as well as internal support staff. In addition, changes were made to simplify and streamline the NEM application "fast track" option. The program has been recognized by the CPUC as the best method for processing NEM applications.[26]	
Update: DIIS Phase 3 expanded the DIIS system deployed in 2013 to include fields mandated by the *Proposed Decision to Transfer Responsibility for Collecting Solar Statistics from the California Solar Initiative to the Net Energy Metering Interconnection Process* (DG OIR R.12-11-005). DIIS Phase 3 also 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 Remote Meter Configuration (RMC) for changing meters over-the-airways, and auto approval of applications within certain parameters, and enhancements to improve business process efficiency and customer experience.	

[26] D. 14-11-001 11/6/2014 http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M141/K115/141115074.PDF

Project 27: Smart Transformers	
Funding Source: GRC **Project Timeframe: 10/2011 and ongoing**	Reporting Period Estimated Costs: $<100
Description: The objective of the Smart Transformers project is to install monitoring devices on all transformers serving customers with charging stations for PEVs that are purchased between 2010 and 2020. Sensing devices attached to the transformers will be used to monitor real-time loading and establish accurate load profiles. The project will also include analysis and evaluation of transformer bushing mounted devices presently on the market.	
Update: During the Reporting Period, SDG&E installed 12 monitors with improved current sensors on polemounted transformers. SDG&E installed 18 monitors on single phase padmount transformers. SDG&E also grounded the transformer tanks on 34 polemounted transformers where load monitors were previously installed to resolve voltage accuracy issues.	

Project 28: Advanced Distribution Management System (ADMS)	
Funding Source: GRC **Project Timeframe: 09/2013 to 06/2017**	Reporting Period Estimated Costs: $1,363
Description: The scope of the ADMS project is to implement new functions within the new Outage Management System/Distribution Management System (OMS/DMS) system 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 will focus on providing additional power flow improvements for DMS including additional data points from the system and incorporate the impacts of temperature.	
Update: During the Reporting Period, Phase 2 was implemented which integrates distributed energy resources and solar forecasts to improve power flow solutions for DMS, and provides a framework to support the integration of Distributed Energy Resource Management. Phase 3 began and implemented functionality which provides the ability to view feeder load management results for any device on the system. It also improved Fault Location Isolation and Service Restoration (FLISR) configurations for the utility.	

Project 29: Solar Power Prediction	
Funding Source: GRC **Project Timeframe: 11/2012 to 12/2015**	Reporting Period Estimated Costs: $336
Description: The Solar Power Prediction Engine (SPEE) website is active and data for 12 sites is refreshed daily. Files contain Day Ahead (DA), standard solar power generation prediction data which is provided up to five days ahead at one-hour granularity. Solar power generation prediction data is provided up to two hours ahead at five-minute granularity.	
Update: During implementation the stakeholders discovered an alternate solution that would not provide the data granularity as in the first solution; however, it would cover all of the SDG&E service territory and provide an index product that could be used by the NMS team. The alternate solution had a cost that was significantly lower than the previous solution, and it could be processed by existing services and give flexibly across multiple application platforms.	

Project 30: Condition-Based Maintenance (CBM) – Gas Breakers	
Funding Source: FERC **Project Timeframe: 09/2013 to 12/2019**	Reporting Period Estimated Costs: $2,653
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 asset prematurely. The project scope is to comply with 1% SF6 Emissions Regulations in 2020 and reduce major overhaul periodicity related to contact interrupter wear. The deployment of gas circuit breaker SF6 monitoring equipment will enhance the tracking and "manual" CBM program. This technology will also monitor the gas within the circuit breaker allowing for early detection of any leaks to ensure compliance with applicable environmental regulations.	

Project 30: Condition-Based Maintenance (CBM) – Gas Breakers	
Update: During the Reporting Period, the team installed and commissioned 189 monitors. These monitors are producing benefits immediately by "providing information on the health of the circuit breaker's contacts/interrupters, thus allowing major overhaul maintenance to be deferred from 10 years to 18 years. Rather than performing intrusive maintenance by opening the breaker to determine the health of its contacts, we are able to obtain this info from the monitor and perform a minor (non-intrusive) overhaul. The savings realized is the cost differential between the two maintenance activities.	

Project 31: Smart Grid Enabled Energy Efficiency	
Funding Source: Energy Efficiency (A.12-07-002) **Project Timeframe: 01/2013 and ongoing**	Reporting Period Estimated Costs: $291
Description: In response to AB 802[27], SDG&E has proposed two high opportunity programs; a multifamily program and retrocommissioning program. These programs would enable savings to be calculated based on the customer's existing conditions. SDG&E EE programs and status reports are available at http://eestats.cpuc.ca.gov/.	
Update: SDG&E's efforts resulted in savings of over 786 million kWh, reduced energy demand by approximately 145 MW, and saved over 4.8 million therms. All together, these savings are enough to supply energy to over 131,000 homes annually. In addition to helping customers save energy and money, these gas and electric energy savings have reduced CO2 emissions by over 528,280 tons, the equivalent of removing over 112,400 cars from the road. As a result, SDG&E is aligning with the state's goal of reducing greenhouse gas emissions.	

2.3.3.5 SECURITY

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 application layers.

[27] http://www.energy.ca.gov/benchmarking/documents/

IN PROGRESS PROJECTS

Project 32: Cybersecurity Projects	
Funding Source: GRC **Project Timeframe: Ongoing**	Reporting Period Estimated Costs: $8,548
Description: In conjunction with Smart Grid deployment, SDG&E is executing several cybersecurity projects. SDG&E's risk-based enterprise security program also contains multiple projects that further augment the security of the company, its operations, and the grid. 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. As this *Annual Report* is a public document, details of SDG&E's security projects are omitted.	

Project 33: Customer Privacy Program	
Funding Source: GRC **Project Timeframe: Ongoing**	Reporting Period Estimated Costs: $505
Description: In March 2011, as the CPUC's decision to implement new privacy rules for the electric investor-owned utilities was being revised, SDG&E developed its customer privacy program. This program established a cross-functional privacy committee reporting to a lead director on privacy and ultimately the Chief Customer Privacy Officer of the company. In October 2012, the Office of Customer Privacy took over formal responsibility for the company's privacy-related framework, controls workbook, impact assessments, employee training, and its process for sharing customer data with third parties.	
Update: SDG&E's Privacy GreenLight is fully operational as a response to the Data Request & Release Process (DRRP). Privacy GreenLight access assists third parties with requests for customer energy data that cannot be satisfied by public records. Privacy GreenLight helps ensure that authorized third parites are eligible to receive data, have a relevant business case for receiving the data, and can protect customer energy usage data while it is in their possession.	

Project 34: Substation Physical Security Hardening	
Funding Source: FERC **Project Timeframe: 01/2011 and ongoing**	Reporting Period Estimated Costs: $6,834
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. As 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 from vendors 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 35: SDG&E Grid Communications Systems (SGCS)	
Funding Source: GRC and DOE **Project Timeframe: 01/2012 to 12/2015**	Reporting Period Estimated Costs: $244
Description: SDG&E Grid Communications Services will implement advanced wireless communications systems to allow SDG&E to monitor, communicate with, and control transmission and distribution equipment, thus accelerating deployment of Smart Grid applications and devices. Four diverse network systems will be deployed: • Low Power Communications Network to enable electric transmission and distribution to deploy and monitor Fault Circuit Indicators and Aviation Light monitoring, as well as provide fault notification/integration with OMS/DMS and other management systems • Substation Communications will provide standardized communication protocols and support for IP-based intelligent electrical devices at 44 locations • Field Broadband Connections network will support implementation of phasor measurement units and monitoring of distribution circuits in near real-time • SCADA Optimization will pilot and deploy IP wireless narrowband technology, doubling system capacity and increasing reliability and control of the electrical grid in the event of major blackouts or natural occurrences, such as wildfires	
Update: All program deliverables and production transition were completed as scheduled. Department of Energy (DOE) grant and post-audit activities were closed out successfully.	

IN-PROGRESS PROJECTS

Project 36: Integrated Test Facility	
Funding Source: GRC **Project Timeframe: 09/2012 and ongoing**	Reporting Period Estimated Costs: $1,294
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 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.	

Project 36: Integrated Test Facility	
Update: The ITF facility expanded its capabilities by installing additional equipment such as, but not limited to, RTDS racks, Smart Inverters, Grid Simulators, Telecom equipment etc. Project test results have provided valuable information to key stakeholders and several new projects have commenced in early 2016. Each lab produced meaningful work that has been presented at industry events and shared with industry peers and stakeholders.	

Project 37: Electric Program Investment Charge (EPIC) Program and GRC 2012 RD&D Projects	
Funding Source: EPIC and CPUC **Project Timeframe: Ongoing**	Reporting Period Estimated Costs: $14,237
Description: SDG&E's First and Second Triennial EPIC Triennial Applications have been approved by the CPUC. The EPIC projects are limited to pre-commercial demonstrations by order of the CPUC. Projects are funded in triennial cycles, based on approval of triennial plans by 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.	
Update: Ten projects are underway—five from the EPIC-1 triennial application and five more from the EPIC-2 triennial application. The projects are at various stages of execution, ranging from writing a project plan to work on the pre-commercial demonstration laid out in a project plan. None of the projects are yet fully completed. Formal EPIC status reports are filed annually with the CPUC as per the ordering paragraphs of the EPIC decisions. Similarly, comprehensive final project reports will be filed with the CPUC, as the projects are completed.	

Project 38: Unmanned Aircraft System (UAS)	
Funding Source: GRC **Project Timeframe: 01/2013 and ongoing**	Reporting Period Estimated Costs: $387
Description: The objective of the program is to research and evaluate SDG&E 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 storage, and enhanced data streaming), as well as investigate and research capabilities of flight pattern software (preprogramed flight pattern).	

Project 38: Unmanned Aircraft System (UAS)	
Update: In 2015, SDG&E was granted Section 333 approval to fly commercially in San Diego service territory.[28] During 2015 R&D efforts, several systems and sensors were researched and tested to ensure the correct UASs were purchased. During the first part of 2016, the teams has created a UAS Aviation Operations Manual (AOM), UAS training manual, training plan, UAS flight request form and checklist for operations, provide flights for various customers within SDG&E as well as tested the live streaming capability to the Emergency Operations Center (EOC) which was successful. Starting August 29, 2016, FAA Part 107[29] comes into effect which lessens the restrictions for Commercial Operations and will no longer require a Recreational Pilots License. This change will create an opportunity to train internal pilots from the appropriate business units as needed. The team is researching local UAS commercial contracting services to support some of the newer technologies as well as provide flights for large projects within SDG&E. As the UAS field is rapidly changing in regards to new platforms and sensors, this will only enhance the services that can be provided by SDG&E or contractor UAS flight operations.	

ENTERPRISE PROJECTS

Project 39: Workforce Development	
Funding Source: GRC **Project Timeframe: Ongoing**	
Description: This project focuses on internal employee development and external employee acquisition in locations like universities.	
Update: Workforce development initiatives ensure that existing employees' skills advance and future hires have the necessary experience for a career at the smart utility. SDG&E has utilized the Information Technology and Engineering intern programs to cross-train engineers. Internal employee development continues to build the future of the company.	

[28] http://www.sdge.com/key-initiatives/uas

[29] https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20516

Project 40: Data Management and Analytics • Enterprise Analytics System (EAS) • Customer Analytics System (CAS) • Operational Analytics Systems (OAS) • Smart Grid Analytics (SGA)	
Funding Source: GRC **Project Timeframe: 01/2013 and ongoing**	
Description: The Data Management and Analytics project will provide infrastructure to store and analyze the vast amounts of data generated by existing applications and Smart Grid systems. New analytics tools will be deployed and specifically tailored to the Smart Grid business domains to uncover a greater understanding of this new data in areas such as demand forecasting, situational analysis, optimization, and customer usage analytics. Underlying foundational capabilities include ensuring that internal company data is consistently used and aligned with external Smart Grid industry standards.	
Update: The Smart Grid Analytics (SGA) project completed the Net-Metered PV Contribution and placed it into service in April 2016. Historical weather station data will also be made available for analytical use. This effort is expected to be completed during 3Q 2016.	

Project 41: The California Systems for the 21st Century Collaboration (CES-21)	
Funding Source: SB96 and CPUC Authorization Decision **Project Timeframe: 10/2014 to 10/2019**	
Description: CES-21 involves the CPUC and California IOUs collaborating with Lawrence Livermore National Laboratory (LLNL) on two specific research objectives: Cybersecurity and Grid Integration. Cybersecurity will focus on Machine to Machine Automated Threat Response research and Grid Integration will focus on Flexibility Metrics and Standards research.	
Update: During the Reporting Period the Joint IOUs and LLNL continued work on the 10 Cybersecurity Project research objectives as defined in the Cooperative Research and Development Agreement (CRADA) with LLNL and Work Breakdown Structure (WBS) as defined for each of the cybersecurity tasks. In Q1 and Q2 2016 the Idaho National Laboratory CES-21 test bed started to take shape with hardware installation. Overall cybersecurity tasks have gained increasing momentum. The program continues outreach to other cybersecurity research efforts of national significance for leverage and non-duplication of effort visibility. The original Grid Integration Project's four phases were completed. During Q2 2016 the Long Term Procurement Plan (LTPP) data was received and the timeline for the project was extended to Q4 2016 to incorporate the 2016 LTPP data into the models within an additional phase. The LLNL High Performance Computing (HPC) capability was established. The HPC capability will cut the time to run models from days to hours.	

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*:

1. Timeline that connects specific projects with specific marketing, education, and outreach efforts
2. 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 CUSTOMER ENGAGEMENT TIMELINE

The following table illustrates the customer engagement timelines based on the four initiative types: Enablement Tools, Customer Premise Devices, Rates and Programs, and Pilot Deployment Projects.

Table 4: Customer Outreach and Engagement Timeline by Initiative

	2015	2016	FY 2017
Enablement Tools			
Green Button Connect My Data	X	X	X
Green Button Download My Data	X		
Customer Premise Devices			
Smart Meters	X	X	X
HAN Projects	X	X	X
Rates and Programs			
Connected . . . to the Sun	X	X	X
Smart Grid Demand Response	X	X	X
Smart Pricing Program (Dynamic Pricing)	X	X	X
Digital Roadmap	X	X	
Community and Stakeholder Engagement	X	X	X
Smart Grid Enabled Energy Efficiency	X	X	X
Customer Privacy Program	X	X	X
Pilot Deployment Projects			
Borrego Springs Microgrid	X	X	X
Power Your Drive (PYD)	X	X	X

2.4.4 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."[30]

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."[31] 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.

2.4.5 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 5: Customer Engagement Initiative - Enablement Tools

	Enablement Tools
Project Description	Marketing, Education & 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).

[30] SDG&E *Smart Grid Deployment Plan* 2012 Annual Report, Oct. 1, 2012.
[31] Ibid.

	Enablement Tools
Sample Message	Download your electricity use data with the simple click of a button.
Source of Messaging	Utility and third-party partners.
Current Roadblocks	- 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	- 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 6: 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	- All customers across the SDG&E service territory with a Smart Meter. - Primarily residential and small commercial customers (< 20 kW peak load).
Sample Message	- 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	- 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	- 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 7: Customer Engagement Initiative - Rates and Programs

	Rates and Programs
Project Description	- 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	- 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	- 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 meeting its goals to reduce 13 million tons of greenhouse gasses by 2020 – about 40% come from transportation.
Source of Messaging	Utility
Current Roadblocks	- 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	- 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. - Use mass media and customer's preferred channel to communicate when Reduce Your Use days are called.

	Rates and Programs
	- 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 8: Customer Engagement Initiative - Pilot Deployment Projects

	Pilot Deployment Projects
Project Description	- 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	Long duration parking opportunities such as multi-unit dwellings and workplaces where electric vehicle charging is not currently available.
Sample Message	- 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	- Microgrid technologies can be complex and difficult to explain. - TOU and other dynamic rates can be challenging for some customers.
Strategy to Overcome Roadblocks	- 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 9: Risk Assessment Information by Category

Key Risk Category	Likelihood/Probability	Impact/Consequences	Current Actions Taken
1. **Reliability**	Medium 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.	Medium 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.	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 *Annual Report*.
2. **Rates**	High The probability that current retail rate designs will trigger significant consequences to the deployment of renewables and require Smart Grid technologies is high.	High Current electric rate policies provide inequitable and inaccurate pricing signals to customers.	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 services provided by the utility.

Key Risk Category	Likelihood/Probability	Impact/Consequences	Current Actions Taken
3. **Security**	High No networked system can be perfectly secure, thus the probability that some security-related issue will affect the operation of the system is high.	High 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. Physical security risks related to damage of critical infrastructure resulting from illicit activities continues to be a concern for utilities.	SDG&E has a comprehensive risk-based security program that addresses and mitigates these risks, employing defense-in-depth and other strategies.
4. **Safety**	Low 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 probability that any will be realized.	High The consequences of safety risks that are realized can be devastating.	SDG&E works to continually improve its safety standards, education, and awareness and has a number of Smart Grid and other projects that contribute to maintaining or improving safety of its workforce and the public. Strategic location of assets decreases likelihood of safety issues.
5. **Technology**	High Smart Grid deployment involves a great deal of new or emerging technologies, many of which lack consistent,	Low Many other major technology deployments have been similarly affected in the past. Mitigation efforts	SDG&E continues to leverage its Integrated Test Facility to test interoperability and reduce

Key Risk Category	Likelihood/Probability	Impact/Consequences	Current Actions Taken
	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.	can keep these risks from having high impacts on Smart Grid deployments.	technical risks in deployment projects. Workforce development programs are being proposed to transfer utility knowledge and develop employees for the future.

2.6 SECURITY RISK AND PRIVACY THREAT ASSESSMENT UPDATES

In its *Smart Grid Deployment Plan*, SDG&E discussed its vision for physical and cyber security as well as its strategy for achieving its security goals. Its vision for the security of Smart Grid stated:

> *"… by 2020 all Smart Grid participants, from customers to service providers, to regulators, to utilities, must be able to rely on the availability of the system; trust the integrity of the information produced by the system; and be confident that sensitive information is secure from unauthorized access or disclosure. SDG&E's Smart Grid must be resistant to physical and cyber security threats, as well as resilient to attack and natural disasters. It must be aligned with industry standards and best practices. Because resources are finite, it must be built on a security program that uses well-established risk management methodologies to maximize its security investments."*

The approach to fulfilling the vision and strategy continues to be refined as progress is made demonstrating key technologies. During the initial deployment years, the focus is on building the infrastructure necessary to support a resilient, distributed grid system and adapting existing tools and processes to the Smart Grid.

2.6.1 THREAT LANDSCAPE

Cybersecurity threats continue to evolve, targeting critical infrastructure. Computerized systems continue to be integrated in new ways while threat agents learn about controls systems, communications infrastructure, and other potentially vulnerable components. Attacker tools are adding modules designed to be used against SCADA systems, embedded systems, and communication protocols that could potentially reveal vulnerabilities before they can be remediated.

With the national visibility on the issue, new products and technologies are becoming available to improve the security posture of the SDG&E Smart Grid. These include quantum encryption, network anomaly attack detection, advanced persistent threat protection, and substation gateway technologies marketed toward ensuring NERC CIP version 5 compliance.

2.6.2 GOVERNANCE, RISK, AND COMPLIANCE

An example of how SDG&E is addressing risks is through its implementation of governance, risk, and compliance processes and solutions. Compliance, including transparency of compliance activities, is recognized internally at SDG&E as an important part of its Information Security program. Meeting legal, regulatory, and company requirements should be a byproduct of good security and privacy programs. SDG&E has been deploying governance, risk, and compliance management (GRCM) tools that enhance the ability to track information assets and map them to security controls.

This effort has continued to integrate cybersecurity processes into the GRCM tools to advance the infrastructure for identifying and tracking the information and cyber assets used within the Smart Grid and has incorporated security operations activities—such as vulnerability management, threat management, cybersecurity engineering, and incident response—into a dashboard-style executive view as well as technical reports for control owners. Control frameworks are used to support periodic compliance reviews, and any deficiencies are tracked and managed via corrective action plans or risk exceptions within the GRCM solution. Vulnerability management processes integrate with compliance activity to provide visibility into progress, reducing risks due to technology or processes.

Researching and Looking Ahead

SDG&E recognizes that security is not an end state, but a continual process of improvement that will continue as long as the utility is in business. With that said, looking ahead and planning for the future to ensure SDG&E's strategic security goals are met is extremely important. One example of where security-related efforts are focused is in improving threat and network anomaly detection capabilities. SDG&E is currently working to enhance its ability to monitor distribution SCADA systems and networks.

2.6.2.1 CUSTOMER PRIVACY

Over the last year, energy data privacy has remained a common topic in Smart Grid forums. SDG&E takes customer energy privacy very seriously, and in the Reporting Period, made great strides in continuing to implement its customer privacy initiatives company-wide. What began as a simple customer privacy program in 2012 has become the SDG&E Office of Customer Privacy (OCP). Previously, SDG&E selected the Generally Accepted Privacy Principles (GAPP) as its privacy framework and developed its first set of privacy controls, which combines elements of this framework with other

regulatory obligations, and Privacy by Design. The OCP built a Privacy Impact Assessment methodology that is used by project teams and process owners to assess privacy risk in their activities. It has automated its internal process for sharing customer data with third parties to allow for better tracking and information assurance.

Smart Grid privacy mandates require SDG&E to complete an audit report of its privacy and security practices with its General Rate Case filings. In early 2014, SDG&E engaged a vendor to begin this comprehensive audit process in time for its 2014 GRC filing.

The OCP continues to build its program and prepare the company, its partners, and its customers for future privacy risks. In particular, the desire of a growing number and variety of third parties to have access to customer energy data represents a considerable risk to customer privacy. Providing better awareness and guidance to third parties around the protection of customer privacy is a key consideration and has been built into the company's enterprise GRCM system. In addition, SDG&E is working with partners like the Identity Theft Resource Center to improve its privacy program, and with Microsoft on conceptual tools to offer third parties access to customer information in a way that provides them more value while better protecting customer privacy.

Another risk to customer privacy is conflicting legislation between governmental organizations that require utilities to take steps to protect customer privacy, and others that demand customer usage data for their broad environmental agendas. The OCP will remain engaged with federal, state, and local legislators to help manage the balance between reasonable and effective customer privacy and these important environmental goals.

2.6.3 CONCLUSION

Security and privacy remain high priorities for SDG&E. The utility continues to execute the strategy laid out in its *Smart Grid Deployment Plan* by building the centralized management systems to support future distributed security solutions necessary to support the field technologies.

Advanced cybersecurity capabilities provide support to new Smart Grid solutions from both IT and operational perspectives. SDG&E continues to invest in risk and vulnerability management, compliance, operations, research, and privacy solutions. The creation of the Office of Customer Privacy formalizes policies, processes, and procedures to help employees, contractors, authorized third parties, and customers safeguard customer information in an increasingly interconnected system.

Next year, SDG&E will continue to build upon these foundational components to both expand the oversight activities and implement additional security capabilities extending into the field.

2.7 COMPLIANCE WITH NERC SECURITY RULES AND OTHER SECURITY GUIDELINES

SDG&E is an NERC-registered Transmission Owner (TO) and Transmission Operator (TOP). NERC's Critical Infrastructure Protection Reliability Standards (often referred to as cybersecurity) are applicable to entities that are registered TOs and TOPs. The NERC Critical Infrastructure Protection Reliability Standards have been mandatory and enforceable since June 2009, and SDG&E has certified its TO and TOP annual compliance each year since then.

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, 2015 through June 30, 2016. 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.

Metric	Units	Reporting Period Value
Number of meters	Meters	9
Percentage of meters	%	.0006 %

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).

Metric	Units	Reporting Period Value
Residential	MW	17
C&I < 500 kW	MW	18
C&I > 500 kW	MW	8
Other	MW	1
Total		44[32]
Load Impact of Peak Load Reduction from the winter peak:		
Residential	MW	n/a
C&I < 500 kW	MW	n/a
C&I > 500 kW	MW	n/a
Other	MW	n/a
Total		n/a

***Note**: Some SDG&E DR programs are available in the winter months, but SDG&E did not call an event during the winter of 2015-16. Therefore, there is no load reduction from the winter peak to report.*

[32] May not sum to total due to rounding.

3. Percentage of demand response enabled by AutoDR in each individual DR impact program.

Metric	Units	Reporting Period Value
Percentage of demand response enabled by AutoDR – Capacity Bidding Program (CBP)	%	4%
Percentage of demand response enabled by AutoDR – Critical Peak Pricing (CPP) program	%	1%

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

Metric	Units	Reporting Period Value
By Customer Class		
Residential	#/%	11,184 / 0.792%
C&I < 500 kW	#/%	55/ 0.004%
C&I > 500 kW	#/%	0 / 0%
Other	#/%	0 / 0%
Total by Customer Class		**11,239 / 0.796%**
CARE	#/%	840/ 0.059%
Non-CARE	#/%	10,399/ 0.736%
Total by CARE/non-CARE		**11,239 / 0.796%**
Coastal	#/%	4,232 / 0.300%
Inland	#/%	6,811 / 0.482%
Mountain	#/%	50/ 0.004%
Desert	#/%	146/ 0.010%
Total by Climate Zone		**11,239 /0.796%**

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

Metric	Units / Percentage	Reporting Period Value
By Type of Tariff		
Critical Peak Pricing (CPP)	#/%	123,403/ 8.739%
Time of Use (TOU)	#/%	25,603/ 1.813%
Enrolled in Peak Time Rebate[33] (PTR) notifications	#/%	74,433/ 5.271%
Separately metered Plug-in Electric Vehicle (PEV) rates	#/%	272 / 0.019%
By Customer Class		**#/% of Customer Class**
Residential	#/%	13,874 / 1.096%
C&I < 500 kW	#/%	134,767 / 87.061%
C&I > 500 kW	#/%	637/ 96.224%
Other	#/%	n/a
By CARE Status		
CARE	#/%	806/ 0.540%
Non-CARE	#/%	148,472 / 99.460%
By Climate Zone		**# / % of Climate Zone Customers**
Coastal	#/%	88,140/ 10.839%
Inland	#/%	57,548 / 9.686%
Mountain	#/%	2,914 / 16.129%
Desert	#/%	587/ 16.069%

[33] SDG&E's PTR program is branded as "Reduce Your Use."

6. Number of escalated customer complaints related to 1) the accuracy, functioning, or installation of advanced meters or 2) the functioning of a utility-administered HAN with registered consumer devices.

Metric / Category of Complaints	Units	Reporting Period Value
AMI Meter complaints	#	0
AMI Program complaints	#	0
Device Registration (HAN)	#	0
Communication issues (HAN)	#	0
HAN, other (primarily opting out of the various HAN pilots)	#	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.

Metric	Units	Reporting Period Value
Replaced due to hardware/component failures	#/%	300 / 0.021%
Replaced due to firmware-related failures	#/%	485 / 0.034%
Replaced due to environmental-related failures	#/%	34/ 0.002%
Replaced due to unknown or communication-related failures	#/%	97/ 0.007%

8. Number and percentage of advanced meters field-tested at the request of customers pursuant to utility tariffs providing for such field tests, and the number of advanced meters tested measuring usage outside CPUC-mandated accuracy bands.

Metric	Units	Reporting Period Value
Number/percentage of advanced meters field-tested (at the request of customers)	#/%	877/ 0.062%
Number/percentage of advanced meters field-tested at the request of customers with results outside accuracy band	#/%	0/ 0.0000%

9. 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.[34]

Metric	Units	Reporting Period Value
Number/percentage of customers using a web-based utility portal to access energy usage information[35]	#/%	479,550 / 54.4%
Number/percentage of customers using a web-based portal to enroll in utility energy information programs[36]	#/%	881,479 / 58%[37]
Number/percentage of customers using a utility web-based portal to authorize the utility to provide a third party with energy usage data[38]	#/%	3,047 / 0.34%

B. Plug-in Electric Vehicle Metrics

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

Metric	Units	Reporting Period Value
Number of customers	Customers	7,658

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

[34] Gas only customers may be included in the total customer count.
[35] This number represents "unique customers" using SDG&E MyEnergy Portal.
[36] This number includes all active users of My Account, SDGE.com and Mobile apps.
[37] This percentage reflects the ratio of billable accounts at the end of the reporting period utilizing the web-based or mobile platform.
[38] This represents the total number of customers authorizing SDG&E to share directly with a designated third party.

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.

Metric	Units	Reporting Period Value
Grid-connected energy storage: pumped stored hydro[39]	MW	40
Grid-connected energy storage: pumped stored hydro	MWh	50,819 pump load 38,563 generated
Grid-connected energy storage: non-hydro	MW	4.879
Grid-connected energy storage: non-hydro	MWh	97.0 charged 37.0 discharged

D. Grid Operations Metrics

1. The number of sustained outages system-wide, per customer, per year 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 this information is available.

Metric	Units	Reporting Period Value
SAIDI - Major Events Included	SAIDI index	84.28
SAIDI - Major Events Excluded	SAIDI index	65.64

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 this information is available.

Metric	Units	Reporting Period Value
SAIFI - Major Events Included	SAIFI index	0.7498
SAIFI - Major Events Excluded	SAIFI index	0.5996

[39] The pumped stored hydro system referred to here is the Lake Hodges pumped storage facility. The non-hydro energy storage systems are batteries. Battery storage efficiency varies by technology, unit, and operating mode.

3. The number of momentary outages system-wide, per customer, 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 this information is available.

Metric	Units	Reporting Period Value
MAIFI - Major Events Included	MAIFI index	0.4931
MAIFI - Major Events Excluded	MAIFI index	0.4354

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 this information is available.

SDG&E Customers / Circuits Experiencing >12 Sustained Outages		
Metric	**Units**	**Reporting Period Value**
Number of customers	Customers, #/%	0/0.0%
Number of circuits	Circuits, #/%	9/0.09%

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.

Metric	Units	Reporting Period Value
System load factor	% load factor	45%
Load factor - residential	% load factor	49%
Load factor - C&I < 500 kW	% load factor	80%
Load factor - C&I > 500 kW	% load factor	29%
Load factor - other[40]	% load factor	48%

[40] Other is composed of small agriculture.

6. Number of and total nameplate capacity of customer-owned or operated grid-connected distributed generation facilities.

Metric	Units	Reporting Period Value
Distributed generation facilities – solar	Number/capacity of units – MW	93,104/607.7MW
Distributed generation facilities – non-solar	Number/capacity of units – MW	430/280.6 MW
Distributed generation facilities – solar and non-solar total	Number/capacity of units – MW	93,534/888.3 MW

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.

Metric	Units	Reporting Period Value
Total annual electricity deliveries from customer-owned[41] DG	GWh	1,698

8. Number and percentage of distribution circuits equipped with automation or remote control equipment, including SCADA systems.

Metric	Units	Reporting Period Value
Number of circuits	Circuits	803
Percentage of circuits	%	77.8

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.

[41] Form 1.2 – Net Energy Load of the California Energy Demand 2015-2025 Staff Final Forecast – Low Demand Case for SDG&E Planning Area, File 04 SDGE Low.xls, Form 1.2; retrieved from http://energy.ca.gov/2014_energypolicy/documents/demand_forecast_cmf/Low_Case/SDGE_Low.xlsx