PACIFIC GAS AND ELECTRIC COMPANY

SMART GRID ANNUAL REPORT – 2015

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SMART GRID TECHNOLOGIES

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CALIFORNIA PUBLIC UTILITIES COMMISSION

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CHAPTER 1

SMART GRID ANNUAL REPORT

EXECUTIVE SUMMARY

1. Smart Grid Annual Report Executive Summary

In 2014, Pacific Gas and Electric Company (PG&E) introduced its Grid of Things™ vision to aid in the optimization of distributed energy resources. The Grid of Things™ vision integrates new energy devices and technologies with the grid and allows their owners to achieve greater value from their energy technology investments – rooftop solar, electric vehicles (EVs), energy storage, demand response technologies, etc. – by virtue of their grid connectivity. PG&E is the key builder and enabler of this interconnected and integrated platform that will define California's future energy landscape. Through innovative programs such as the Smart Grid Pilot Program and the Electric Program Investment Charge (EPIC), PG&E's investments will help achieve the Grid of Things™ vision while also maintaining a safe and reliable grid.

PG&E's smart grid investments provide the ability to support higher rates of distributed energy resources (DERs). This year, as of August, PG&E has nearly 176,000 solar rooftop customers in its territory. While solar rooftop installations comprise one of the fastest growing DERs, other types are also rapidly increasing in California including:

- Projecting potentially 400,000 EVs by 2020. PG&E is also proposing methods to further electrification of transportation, including the broader adoption of EVs such as through PG&E's proposed network of EV chargers as well as other programs.
- Increasing energy storage. Under the energy storage mandate, PG&E may move from two battery storage installations of 6 MW to procuring up to 580 MW by 2020.

Growth in DERs can be a great benefit to customers, though it also introduces unique issues in managing the grid such as two-way power flow, voltage and power quality issues, as well as supply intermittency. Increased utilization of new grid technologies allows PG&E to manage the increased complexity that DERs introduce to operating the grid, increasing the amount of information available for grid operations, allowing utilities better oversight and subsequent control of DERs.

In its July 2015 Electric Distribution Resource Plan (DRP) filing, PG&E noted the transformation of the electricity grid must ensure that electricity remains affordable for the millions of utility customers; at the same time the future transformed grid will need to recognize the differentiated needs of customers and their flexibility to choose from various services. In other proceedings before the CPUC (namely, Residential Rate Design Reform and NEM 2.0), PG&E has outlined proposed reforms to California's residential electricity rate design to enable grid modernization. Further DER pricing reforms are needed to ensure equitable pricing, protect customers from unbalanced cost-shifting, and also allow for the future investments needed to achieve California's clean energy goals. Without the CPUC's adoption of these reforms, cost-effective grid investments are compromised and many customers could be faced with disproportionately higher, inequitable bills. The need for electricity pricing reform is underscored here due to the critical role of equitable electricity rates in achieving the DRP vision.

Other challenges such as cybersecurity and natural disasters remain a constant potential threat to safety and reliability. Customers are growing more sophisticated in wanting choices in how they use energy and are even becoming energy providers themselves. PG&E must continue to anticipate these types of changes to continue delivering safe, reliable, and affordable power—while helping advance California's clean energy policy goals. The changing dynamics also represent an opportunity for PG&E to enable greater flexibility, resiliency, and customer choice.

In particular, PG&E is building four key to capabilities:

- Integrate clean and distributed energy resources
- Enhance decision making
- Automate and self-heal
- Enable customers

To build these capabilities, PG&E is leveraging various programs which include:

- Smart Grid Pilot Program, which is testing and piloting four smart grid technologies in a real-world but controlled setting. The testing and fielding of these Smart Grid technologies will help determine their business cases for full-scale deployment.

- Electric Program Investment Charge (EPIC), which covers the middle ground of testing and demonstration of pre-commercialized technologies. These projects span a number of PG&E's organizations from Customer Care to Energy Supply and from multiple departments within electric planning to operations.
- PG&E's Electric Distribution Resources Plan (DRP), which outlines improvements to electric distribution planning processes, tools and methodologies so that new DERs can be integrated throughout PG&E's electric grid. These significant improvements can yield benefits not only to PG&E's customers, but also to the economy, the environment, and to new energy market participants.
- The California Energy Systems for the 21st Century (CES-21) is a partnership between the California investor owned utilities (IOU) and Lawrence Livermore National Laboratory (LLNL), which is focused on early stage research and development. The focus is on using advanced analytics to identify utility challenges, specifically related to cyber security and renewables grid integration.

Integrate Clean and Distributed Energy Resources

The first capability is to integrate clean and distributed energy resources. To enhance this capability, PG&E must determine ways to more efficiently to use DERs as a resource which can be dispatched to provide benefits to the DER owners and enhance the grid. With storage today, PG&E is managing and gaining insight from two large utility-scale pilot installations. In line with the Commission's 580 MW energy storage procurement mandate, PG&E will evolve lessons learned from these pilots to better optimize a fleet of energy storage technologies in the future.

One example for how PG&E is planning for this future is the EPIC Energy Storage for Market Operations project. The project examines the development of automated strategies and automation technologies for optimized bidding and scheduling of battery storage. In 2014, the project reached a milestone by demonstrating automatic bidding of frequency services into the California Independent System Operator (CAISO) market. If the pilot confirms the ability to automate resource response to CAISO market awards, it will help quantify the values that wider deployment of battery resources can capture in CAISO markets in the future.

Under the DRP, PG&E will also develop and deploy additional pilots to test DER integration. The recommended pilot concepts are to demonstrate the proposed distribution planning methodologies, the capabilities of DERs to meet grid planning and operational requirements, and the integration of locational net benefits analysis into distribution planning and operations.

Enhance Decision Making

The second capability is to enhance decision making. This encompasses the following: building the capability to gather critical data; making data useful with visualization and analysis; and incorporating data into business processes to benefit customers.

The EPIC 1 Grid Operations Situational Intelligence pilot (GOSI) project is aimed at enhancing decision making. GOSI pilots aggregation of both internal data sources (SCADA, SmartMeter™, asset/crew information, etc.) and external data sources (fire, weather, earthquake, etc.). It draws relationships between disparate data sources to process thousands of data points per second to filter out what is important and displays contextual information in a visual format. This helps users enhance their decision making by quickly viewing an event, such as a fire, determine its potential impact onto grid assets, and respond accordingly. In its 2017 GRC filing, PG&E has included plans to deploy a Grid Operations Situational Intelligence solution, pending successful demonstration of the pilot.

The EPIC 1 System Tool for Asset Risk (STAR) project is a software application that calculates and displays (graphically and geospatially) safety, reliability and environmental risk scores for electric transmission, substation and distribution assets. The STAR project will enable an automated, system-wide application to improve risk identification, prioritization, and investment decisions to support electric system safety. Having completed the demonstration in 2015, PG&E is proposing deployment in its 2017 GRC filing.

Automate and Self-Heal

The third capability is to automate complex and high volume tasks. There are some areas where automation can provide value, such as situations where a human cannot react as fast as a machine or by automating repetitive tasks. This removes human error or ambiguity and allows operators to focus on higher order critical activities.

Intelligent switch automation technology has been installed on nearly 600 distribution circuits throughout PG&E's service area. Intelligent switch technology improves electric system reliability by significantly reducing the length of service interruptions. 2014 is the sixth straight year of record reliability for PG&E, in part due to technology such as intelligent switches.

The Smart Grid Pilot Volt/VAR Optimization (VVO) presents an example of a pilot project aimed at automation. VVO incorporates sensing, communications and computing to more tightly control voltage delivered to customers. The pilot may help evaluate the extent to which VVO can control smart inverters on solar generators as well as energy storage and other grid connected devices to further improve voltage profiles and further enabling the safe and reliable growth of DERs. In the near term, it can also provide customer energy efficiency savings through voltage reduction and demand reduction during peak times. Reducing delivered voltage optimally reduces energy consumption without sacrificing device/appliance performance and customer satisfaction. As of September 2015, the technology has already been deployed on 12 feeders.

Enable Customers

The final capability is to enable customers. More customers are seeking increased choices and information about how they manage their energy consumption. Some of these customers are becoming providers of energy, selling excess generation from their DERs onto the grid. This capability considers how PG&E can interact with its customers on a new level to enable these choices.

The EPIC 1 Load Disaggregation project is one example of exploring ways to improve customer experience. This project seeks to use granular SmartMeter™ data to estimate the energy consumption by customer for each of their major appliances. Past research shows that customers rated itemized billing information as a valuable option. If load disaggregation is proven to be effective, it can also provide value beyond informing customers of their own usage and helping identify who would benefit from demand response or energy efficiency programs. This would not only help customers save money but also further enhance grid operations allowing the utility to target certain geographies with demand side management programs. The pilot is still underway but currently expects to complete by the end of 2015.

Recently, the EPIC 1 Vehicle On Grid Support System pilot (VOGSS) project demonstrated the benefits of this R&D program for customers and other stakeholders. This project involves developing pilot vehicles that can export power to the grid to provide temporary power for customers during planned or unplanned outages. Two of these vehicles were deployed to provide backup power during the 2015 late summer wildfires. During one such response, the kitchen at a Red Cross shelter in Calistoga had to be moved and an export power vehicle was quickly mobilized to provide power so that meals could be served to the evacuees during the evening hours. Another one of these export power trucks was mobilized to provide supplemental power at a church in Burson. The church was housing evacuees and the electrical service inside the building could not handle the additional load. A generator was providing the additional power until it stopped functioning. An export power vehicle was quickly mobilized and the church was able to connect its freezers and refrigerators to the vehicle and keep critical supplies from going bad.

Although many of these projects are pilots and demonstrations, they have significant potential to enhance utility capabilities that will benefit PG&E's customers. Where proven, pilot technology can move into full deployment as part of future general rate cases and begin delivering benefits to customers as early as 2017.

PG&E's Smart Grid Benefits Summary

Last year, PG&E reported Smart Grid project benefits of $79.1 million, inclusive of key programs such as Cornerstone and SmartMeter™, across direct customer savings, avoided costs, environmental costs, lower energy usage, and customer reliability costs. Additionally, Smart Grid programs allowed customers to avoid nearly 33.3 million outage minutes and avoided 36.5 million pounds of CO_2 emissions over the past year.

This year, PG&E's Smart Grid benefits continue to grow, adding an estimated $19.6 million of incremental savings from July 2014 through June 2015. Another 40 million outage minutes and nearly 50 million pounds of CO_2 emissions were avoided as well.

Table 1-1: PG&E's Smart Grid Estimated Project Benefits – July 2014 to June 2015

	Annual Savings
Direct Customer Savings	$0.7 Million
Avoided Costs	$4.5 Million
Avoided Environmental Costs	$0.2 Million
Customer Energy Usage	$5.6 Million
Customer Reliability Costs	$8.5 Million
Total Cost Savings	$19.6 Million
Reliability	Avoided 40.0 million customer outage minutes
Greenhouse Gas Emissions	Avoided 49.9 million pounds of CO_2 emissions

Projects that contribute to PG&E's Smart Grid project benefits include:

- PG&E's SmartMeter™ outage information improvement
- PG&E's Home Energy Reports program, Energy Alerts

- PG&E’s Automated Demand Response program
- PG&E’s Fault Location and Service Restoration (FLISR) project
- PG&E’s Modular Protection and Automation Control (MPAC) project

Smart Grid and Supplier Diversity

Through its nationally-recognized Supplier Diversity Program, PG&E has worked for over 30 years to bring more women-, minority-, LGBT- and service-disabled veteran-owned business enterprises (collectively, Diverse Business Enterprises or “DBEs”) into its supply chain.

Again in 2014, PG&E spent over $2 billion with diverse businesses for a 40.9 percent total DBE spend. PG&E continues its demonstrated success in DBE outreach, development and partnership in all categories of procurement, including Smart Grid.

The first four approved Smart Grid pilot projects (from CPUC Decision 13-03-032) are well underway: Line Sensor, Volt/VAR Optimization, Short-Term Demand Forecasting, and Fault Location projects. PG&E is testing a range of hardware, software and systems integration, communication infrastructure, and voltage management software from selected suppliers, and utilizing a variety of direct and subcontract DBEs in these efforts.

The remainder of this report is organized as follows:

Chapter 2 provides an update of the progress on PG&E’s Smart Grid projects from July 1, 2014 through June 30, 2015.

Chapter 3 provides an update on the Smart Grid metrics approved by the Commission in Decision 12-04-025.

Chapter 4 provides PG&E’s concluding remarks on this Annual Report.

Chapter 5 provides an appendix of PG&E’s recorded project costs and closed projects.

CHAPTER 2

PG&E'S SMART GRID DEPLOYMENT PLAN AND PROJECT UPDATES

2. PG&E's Smart Grid Deployment Plan and Project Updates

Pursuant to Decision 10-06-047, Ordering Paragraph 15 and the Smart Grid Deployment Plan Decision 13-07-024, Ordering Paragraph 4, PG&E provides this Smart Grid Annual Report with the following information included:

a) A summary of PG&E's deployment of Smart Grid technologies during the past year (July 2014 through June 2015) and its progress on its Smart Grid Deployment Plan.[1]

b) The costs and benefits of Smart Grid deployment to PG&E's customers during the past year, including a monetary estimate, to the extent possible, of the health and environmental benefits that may arise from the Smart Grid.

c) Current PG&E initiatives for Smart Grid deployments and investments.

d) Updates to PG&E's security risk assessment and privacy threat assessment; and PG&E's compliance with North American Electric Reliability Corporation (NERC) security rules and other security guidelines and standards identified by the National Institute of Standards and Technology (NIST) and adopted by the Federal Energy Regulatory Commission (FERC).

Consistent with PG&E's Smart Grid Deployment Plan, PG&E's Smart Grid Annual Report provides information on the status of its PG&E's Smart Grid investments, including Smart Grid Baseline Projects, Smart Grid-Related Customer Programs, and proposed Smart Grid Roadmap Projects.[2] For convenience of review, PG&E's Smart Grid investments are combined in this Annual Report.

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[1] Unless otherwise specified, PG&E has provided cost and benefits for all projects for the period beginning July 1, 2014 through June 30, 2015. For the SmartMeter™ Program, PG&E has provided the costs and benefits since inception.

[2] PG&E's Smart Grid Deployment Plan, Application 11-06-029, Chapters 4, 5, and 6.

2.1. Summary of Updates to PG&E's Smart Grid Deployment Plan

The Smart Grid Deployment Plan filed with the Commission in June 2011 and approved in July 2013 forms the foundation for PG&E's approach to modernizing the grid to support new customer demands on the grid. Since its initial preparation and review by the Commission, PG&E is increasing its Smart Grid program focus on integrating increasing levels of distributed energy resources, energy storage, and electric vehicles into the grid. PG&E is leveraging the foundational investments in SmartMeters™, distribution automation, and other technologies identified in PG&E's original Smart Grid Deployment Plan. While the focus of the plan is shifting to some extent to account for new and emerging grid needs, the plan continues to describe PG&E's goals and objectives and reflects PG&E's plans to modernize its grid, consistent with the Commission's goals and Senate Bill (SB) 17. As summarized earlier and described in more detail later in this report, PG&E has made progress implementing approved Smart Grid projects and initiatives and is seeking approval in various proceedings to further advance the plan and provide benefits to its customers.

2.2. Smart Grid Project Updates

PG&E continues to invest in Smart Grid related projects and initiatives with the objective of enhancing its grid infrastructure to provide safe, reliable and affordable energy services to its customers. Over the past year, PG&E has continued the implementation of key Smart Grid related projects outlined in its Smart Grid Deployment Plan. The projects that PG&E has implemented, or plans to implement, focus on areas such as customer engagement and empowerment, transmission and distribution automation and reliability, safety and operational efficiency, cybersecurity, and integrated and cross-cutting systems. As a result of these efforts, PG&E has continued to gain additional information and knowledge, which enhances its understanding of the capability of its grid operations, the potential for deployment of new and innovative Smart Grid technologies, and customer expectations as they relate to the Smart Grid.

2.3. Customer Engagement and Empowerment Projects

Over the past year, PG&E has made steady progress on a number of projects to provide customers with tools necessary to manage their energy usage and costs. PG&E considers its customers to be the primary driver of its Smart Grid program. Therefore, without an engaged and empowered customer population, many benefits offered by a Smart Grid will be difficult to realize. PG&E believes that continuing to leverage SmartMeter™ technology and data access technologies to provide customers with greater benefits and demonstrate the importance of utilizing customer demand-side programs is vital to support PG&E's efforts to help customers understand their energy use and manage their energy bills.

In the 12 months ending on June 30, 2015, PG&E has implemented various projects and initiatives that manage, improve, and demonstrate the use of Demand-Side Management resources for operational efficiency. For example:

> PG&E continued to enhance the Home and Business Energy Checkup tools, also known as Universal Audit Tools, through My Energy. The objective of these tools is to make it easy for our customers to find targeted energy savings ideas for their home or business. The tools include information to help customers understand how they use energy, including comparisons to similar homes and businesses and a breakdown of their energy end uses. The audit tools are progressive in nature, continually leveraging the additional information that customers provide and includes recommendations for energy efficiency, demand response, distributed generation, and behavioral changes. Enhancements over the reporting period included a new end-use disaggregation graphic added to the Home Energy Checkup to help customers understand how their energy use breaks down into key areas. In the Business Energy Checkup, an Agricultural Teacher's portal was created to help bring the Business Energy Checkup into agriculture classroom discussions on Energy Efficiency. PG&E also released a new multifamily property owner tool into the Business Energy Checkup to help property owners use the tool to assess common areas.

PG&E increased residential customer enrollments in its SmartRate™ program. Through July 30, 2015, PG&E has enrolled 134,000 residential customers onto this rate plan. SmartRate™ continues to provide opportunities for customers to manage and reduce their energy usage.

In the coming years, PG&E will continue to pursue further assessments, demonstrations, and implementation of technologies and programs that will empower customers to manage their energy usage. The HAN-DR Integration project and CDA project are some of the technologies and programs that PG&E is working on to further provide customers with the tools necessary to manage their energy use. In addition, PG&E will also continue to evaluate the future development of DR technologies and platforms that would support integrating with PG&E operations.

PG&E expanded its Energy Alerts program, which provides notifications to residential customers when their energy consumption crosses or is forecasted to cross into higher usage tiers. As of August 2015, over 142,000 PG&E customers have enrolled to receive these energy alerts. These customers are continuously being notified and educated about their energy consumption patterns, which will increase customer awareness and spur behavioral modifications and may lead to lower energy usage and customer bills.

The following sections provide an update on completed, in-progress or planned projects during the July 1, 2014 through June 30, 2015 time period. Throughout Section 2, the dollar amounts associated with the specific projects refer to the total amount spent from July 1, 2014 through June 30, 2015, unless otherwise noted.

2.3.1. Demand Response Projects

Supply-side DR Pilot (Continuation of IRM Pilot Phase 2)	**$2.4 Million**
Description: The Supply-side DR Pilot (SSP) is a continuation of the IRM Pilot Phase 2 (IRM2) and was approved as part of the 2015 – 2016 DR Bridge Funding (Decision 14-05-025). The IRM2 was originally proposed in PG&E's 2012-2014 Demand Response application and approved by the Commission in Decision 12-04-045. The SSP will continue to explore the integration of DR resources into the CAISO market to help with renewable resource integration that was started in the IRM2 by expanding participation from large C&I to smaller commercial and residential participants and enabling real-time and non-spin ancillary	

services) for commercial participants.

Funding Source: Funding for this pilot was approved as part of the 2015 – 2016 DR Bridge Funding (Decision 14-05-025).

Status: Bidding into the CAISO Day Ahead (DA) wholesale energy market started in April 2015. As of June 2015, a handful of Proxy Demand Resources composed of multiple commercial customers are bidding into the CAISO DA energy market. The pilot will be expanded to allow residential aggregators in 2015. In addition, commercial customers will be able to bid into the CAISO Real-Time (RT) wholesale energy market over the next few months.

Benefits Description: If proved viable, the SSP will be the gateway for more DR resources to be integrated into the CAISO wholesale market. PG&E is structuring the SSP as a bridge between the retail and wholesale market and also to allow for third party DR providers' participation in the CAISO wholesale market. This step is vital in order to have a self-sustaining and fruitful third party DR market in California. The SSP may also assist PG&E in future grid planning and operations, especially as more connected intermittent generations appears on the grid, potentially improving overall system reliability.

Benefit Category: Smart Market – PG&E is continuing to evaluate the value streams of enabling DR resources in a changing operations environment and to provide services to facilitate the reliable and cost effective integration of renewable resources. PG&E is committed to discover the necessary program attributes that system operators will need in the future.

Demand Response Transmission & Distribution (T&D) System Integration	**$0.69 Million**

Description: In T&D System Integration, PG&E will evaluate areas where existing DR programs can support PG&E's T&D planning and operations. In addition, this project will evaluate how future DR programs can be designed and implemented to support the needs and objectives of PG&E's T&D operations.

Funding Source: Funding for this project is provided under PG&E's 2012 – 2014 Demand Response Proposal approved by the Commission in Decision 12-04-045. Funding was extended through 2015-2016 program cycle in Decision 14-05-025

Status: This project is currently in progress. The first phase of the pilot was concluded in Q1 2015. The first phase included a study of the required DR resource characteristics to meet distribution needs. The pilot expects to conduct field demonstration projects as part of 2015 – 2016 DR Bridge Funding Activities (Decision 14-05-025). Demonstration projects will include the deployment of local demand response resource zones that can be called by Distribution Operations to maintain local system reliability, development of behavioral demand response resources that can be locally called by Distribution Operations and testing the feasibility of automated calling of demand response resources linked to SCADA.

Benefits Description: In the long run, the benefits of this project would include the use of DR resources to improve grid reliability, especially as more intermittent resources are connected on the grid.

Benefit Category: Smart Utility – PG&E is continuing to evaluate the value streams of enabling DR resources and to provide new services to support T&D operations. PG&E is committed to determining the necessary program attributes that transmission and distribution operators will need now and in the future.

AC Cycling Next Generation Technology Assessment	$0.22 Million
Description: Under its direct installation program, PG&E has deployed over 200,000 one-way paging air conditioner direct load control receivers (LCR) since 2007. With technological advances in communication platforms and standards such as ZigBee and OpenADR and declining cellular transmission costs, PG&E has been testing two-way LCR's that could be deployed in 2018 to expand the AC cycling demand response program for the residential segment. In 2013, PG&E conducted a targeted technology assessment of a ZigBee based LCR that connected through a SmartMeter™. In 2014, PG&E conducted a Request for Quote (RFQ) and subsequent laboratory test of Zigbee, direct to grid (SSN) and cellular LCRs. PG&E has worked with manufacturers of these devices to offer features that may provide greater benefits, real time monitoring, than what was previously available. PG&E will assess whether the cost of this new technology will be cost effective in order to include the new technology in its application for 2018-20. Funding Source: Funding for this project is provided under PG&E's 2015-16 Bridge Funding Budget for Demand Response as approved by the Commission in Decision 14-05-025. Status: On July 1, 2014 PG&E issued an RFQ for two-way direct LCRs for central air conditioners. Eleven models were assessed in the laboratory in 2014. In total, five devices passed the 2013 and 2014 laboratory tests and are being assessed with the new feature set in 2015. PG&E intends to conduct a field test in 2016 of the devices that prove viable from the final laboratory test. Benefits Description: By installing two-way direct load control devices, PG&E will have near real-time visibility to an individual premise and the air conditioner's actual response to a load control event signal. This will facilitate early detection of device malfunction in either under- or over-performance. Additionally, costs can be avoided related to unnecessary truck rolls to retrieve internal programming and operational history. Currently, PG&E uses SmartMeter™ data to determine an estimate of the number of non-performing devices in its maintenance program. With a disconnect alarm on a two-way LCR, unnecessary truck rolls can be avoided to sites. Benefit Category: Smart Utility – The two-way technology will provide greater visibility into device behavior, which will be used in more accurate forecasting of load reduction during events and provide efficiencies in program management operations.	

2.3.2. Electric Vehicle Integration Projects

Demand Response Plug-In Electric Vehicle (DR PEV) Pilot	$1.5 Million
Description: In the DR PEV Pilot, PG&E intends to evaluate the feasibility of utilizing PEV batteries, when they are in the vehicle and after they are removed from the vehicle, to provide grid services to the utility. Funding Source: Funding for the project is provided under the 2012 – 2014 Demand Response Program. Status: On April 2, 2013, this project was approved, per Advice Letter 4077-E-B. Upon approval of the pilot, PG&E initiated work on the pilot, as detailed in Advice Letter 4077-E-B. On August 16, 2013, PG&E released a Request For Information (RFI) to	

automakers and received responses from various parties. Building off of the RFI, PG&E released a Request For Proposal (RFP) on April 30, 2014 to automakers for the purposes of entering into a contract to provide grid services through the use of managed charging and stationary storage applications. The RFP closed on August 8, 2014. PG&E selected BMW to administrate this project. This pilot requires BMW provide a minimum of 100 kilowatts (kW) of capacity at any given time, regardless of how many BMW electric vehicles are charging. Further, BMW is required to provide this capacity in the form of one of the existing grid services as defined by the California Independent System Operator. BMW has developed aggregation software that will determine how the 100 kW load drop will be met by either managed charging, stationary storage resources made of used EV batteries or a combination of both. Benefits Description: As part of this project, PG&E will be able to evaluate the capabilities and willingness of EV owners and automakers to participate and provide grid services to the utility. Benefit Category: Smart Market – PG&E will be able to assess the development of the DR - PEV market to provide grid services to the utility.

2.3.3. SmartMeter™ Enabled Tool Projects

Energy Diagnostics and Management (includes s, Home Energy Reports, Business Energy Reports, My Energy Portal)	**$9.75 Million**
Description: The Energy Diagnostics and Management Project (ED&M) is the implementation of a comprehensive strategy for customer self-service demand side management. The project is enhancing the online My Energy platform and launching new tools to help customers understand their energy bills, how they use and generate energy, rate options, and savings opportunities. In addition to launching new versions of existing online tools, the current Home Energy Report program is being scaled to 1.5 million residential customers, and a new Business Energy Report Emerging Technology project is being evaluated in a scaled field test. Funding Source: This project was funded through the Energy Efficiency and Demand Response Balancing Accounts and General Rate Case. Status: The project was launched in May 2015 and development will continue through December 2016. It replaces the existing contract to provide Home Energy Reports and existing My Energy portal functionality. Benefits Description: This project provides residential and small and medium non-residential customers with actionable information and personalized recommendations on how they can save energy, find the best rate for them and explore distributed generation and electric vehicle options. Benefit Category: Engaged Consumer – the project increases customer awareness and engagement in managing their energy usage in an environmentally sustainable and economically efficient manner.	

Energy Alerts	$0.1 Million
Description: The PG&E Energy Alerts program notifies customers when their energy consumption crosses into higher rate tiers or is forecasted to cross into higher rate tiers by the end of a billing period. This program is currently being offered to residential customers with electric SmartMeters™ who are on electric Rate Schedules E1, E6, E7, and E8. Funding Source: This project was funded under PG&E's SmartMeter™ Upgrade program. Status: This is an ongoing program that commenced in June 2010. As of August 2015, July 19, 2014, over 142,000 customers have signed up to receive Energy Alerts. Benefits Description: Energy Alerts provides enrolled customers with usage information and patterns that will help them adjust their consumption patterns to avoid paying higher energy bills. During calendar year 2014, the Energy Alerts resulted in a total cost savings of $215,000 for customers by helping them reduce their energy consumption by 6,163 MWh. This energy reduction has also led to the elimination of 7.0 million pounds of greenhouse gas emissions. Benefit Category: Engaged Consumer – the program increases customer awareness and engagement in managing their energy usage in an environmentally sustainable and economically efficient manner.	

Share My Data (Customer Data Access) Project	$6.2Million
Description: Under the Customer Data Access (CDA) project, now known as "Share My Data", PG&E developed a platform that provides authorized and secure data to customer-authorized third parties. Upon authorization, third parties have access to customer meter data, including electric internal energy usage data, in a standardized format. Phase 2 of the CDA project will focus on increasing the types of customer data that will be supported. Additional data include pricing information, customer information, billing information, and account information. Funding Source: This project is funded through the CDA Decision 13-09-025. Status: On September 19, 2013, the CPUC approved PG&E's CDA Application (D. 13-09-025). PG&E launched Phase 1 of the Share My Data project in March of 2015. PG&E expects to implement Phase 2 in Q4 2015. Benefits Description: This platform provides PG&E's customers and their selected third party service providers with a robust means of accessing their energy data in a standardized manner. It also supports the evolution of the energy services industry by providing the data necessary for third parties to develop applications that will help customers manage their energy usage and reduce their monthly energy bills. Benefit Category: Engaged Consumer – the program increases customer awareness and engagement in managing their energy usage in an environmentally sustainable and economically efficient manner.	

Energy Data Access	$0.4 Million

Description: In Decision 14-05-016, the Commission adopted rules to provide access to energy usage and usage-related data to local governments, researchers, and state and federal agencies while protecting the privacy of customers' personal data.

Funding Source: PG&E is tracking the incremental costs associated with implementing this decision in a memorandum account and is in the process of seeking authorized recovery of such costs through its general rate case proceeding.

Status: PG&E has implemented this decision, which includes the development of an Energy Data Request Program (EDRP) portal, creation of a Data Request and Release Process (DRRP), publishing of a data request log (referred to as data catalog in the decision), publishing of a public report for customer usage information by ZIP code quarterly, and the formation of a statewide Energy Data Access Committee (EDAC) that meets quarterly to discuss IOU's data sharing programs.

As required by D. 14-05-016, PG&E reports on the data request log, which includes the details of all data requests received from qualified third parties.

Benefits Description: This program will provide energy data to qualified educational institutions for research purposes, local governments for their climate action plans, to state and federal agencies to fulfill statutory obligations, including low income participation in energy efficiency programs. The data request log table below summarizes the requests received from third parties, starting on December 1, 2014 (when the program was launched) through June 30, 2015.

Benefit Category: Engaged Consumer – this program facilitates access to energy data for local governments, academic researchers, and state and federal government entities needing data to fulfill statutory requirements.

Energy Data Access - Data Request log:

Request ID	Complete Request Received	Requestor Name	Requestor Type	Request Description	Status	Date Closed
rn7476807709	01/07/2015	San Francisco Department of Public Health	Local Government	2013/14 San Francisco aggregated customer usage data by ZIP code (electric & gas)	Completed	04/03/2015
rn4108830455	N/A	City of San Jose	Local Government	Usage data by ZIP+4 for all SJ ZIP codes	Cancelled / Withdrawn	06/29/2015
rn2790968528	N/A	San Mateo County Energy Watch	Local Government	Usage data by ZIP+2 and ZIP+4, peak KW, project costs, incentives, copay for all projects SMCEW has completed	Cancelled / Withdrawn	06/24/2015
rn2152325681	02/18/2015	City of Fremont	Local Government	2013/14 residential usage by ZIP, plus quarterly recurring for additional two years (electric & gas)	Completed	Recurring Quarterly for two years (Q1 2015 – Q4 2016)
rn1835788791	N/A	City of Benicia	Local Government	Customer usage by ZIP	Cancelled / Withdrawn	03/27/2015
rn2093531064	N/A	County of Sonoma	Local Government	Usage data and GHG data	Cancelled / Withdrawn	04/06/2015
rn1702060876	04/14/2015	San Francisco Planning Department	Local Government	Monthly aggregated customer usage data for specific set of ZIP codes (by ZIP+2 or ZIP+4) in San Francisco (electric & gas)	Completed	06/18/2015
rn2869404331	04/27/2015	Santa Barbara County	Local Government	For 2014, by month, usage by ZIP+2 for Non-Residential customers (by Industry segmentation) in the unincorporated area of County (electric only)	Cancelled / Withdrawn	06/3/2015
rn3061260395	N/A	City of San Leandro	Local Government	Energy usage (electric and gas) for City facilities, Residential, and Commercial/Industrial.	Cancelled / Withdrawn	06/5/2015
rn8515424281	N/A	City of Morgan Hill	Local Government	Energy usage (electric and gas) for City facilities, Residential, and Commercial/Industrial.	Cancelled / Withdrawn	06/24/2015
rn1972290390	06/04/2015	County of Contra Costa	Local Government	Customer usage data, electric and gas, for the following NAICS codes: Warehousing (43-493000); Petroleum and coal manufacturing (32-324000); and Chemicals (32-325000), for the unincorporated area of Contra Costa County.	Denied	06/25/2015

Home and Business Area Network (HAN) Demand Response (DR) Integration Pilot Project	$3.47 Million

Description: PG&E's HAN DR Integration Project builds upon the HAN IT infrastructure by delivering price signals and load control messaging to expand the DR opportunities for residential and Small & Medium Business (SMB) customers. This pilot evaluation project involved approximately 1,700 residential and SmartRate™ and SMB Peak Day Pricing (PDP) customers, allowing PG&E to identify issues, obtain feedback, and learn from its customers. It included HAN devices that provided real-time energy prices and DR notifications of critical pricing events.

Funding Source: Funding for this project is under PG&E's 2012 – 2014 Demand Response Programs and Budgets authorized by Decision 12-04-045 and Advice Letter 4119-E.

Status: This project is completed and was declared used and useful in November 2014. PG&E completed the design and build phases of the necessary DR and rate engine IT systems in order to deliver price and DR signals to HAN devices. The pilot successfully tested the delivery of data and messages to devices including current price, current energy rate, bill-to-date, bill forecast and DR event messages. The HAN platform was renamed "Stream My Data" to be more customer-friendly, and the suite of functionality is available to all eligible customers

Benefits Description: Through this project, customers use validated HAN devices/technologies to receive price and DR signals via their SmartMeter™. This improves their energy awareness and helps them adapt their energy consumption or load shifting behaviors to lower their monthly energy bills, and makes it easier for customers to participate in DR programs.

Benefit Category: Engaged Consumer – HAN enablement allows customers with SmartMeter™ interoperable devices/technologies to synchronize with PG&E's SmartMeter™.

Time Varying Pricing Rates (TVP)	$12.5 Million

Description: Time varying pricing products, such as Peak Day Pricing (PDP) and Time-of-Use (TOU), take advantage of SmartMeter™ capabilities that are now largely available across PG&E's service territory. Charging customers different rates based on varying system conditions is intended to more closely align retail and wholesale electric prices for generation, as well as create economic incentives for customers to actively manage their energy costs by shifting electricity use from when it costs more to when it costs less. PDP provides between 30-45MW of load reduction on the hottest days of summer, equaling the load of almost 2 peaker power plants. There are a number of pricing programs implemented today and others envisioned for the future. The SmartMeter™ has enabled PG&E to cost-effectively offer all customers these types of rate programs which provide significant customer and societal benefits.

Funding Source: This project is funded as part of PG&E's Rate Design Window (D.10-02-032, D.11-05-018, and D.11-11-088 – $97.05 million), 2011 GRC (2011 Phase 1 – $12.61 million) and AMI Cases (D.06-07-027– $2.07 million).

Status: PG&E continues to administer and offer Time Varying Pricing (TVP) Rates to all PG&E bundled residential and nonresidential customer class. Beginning in November 2012, SMB customers with 12 months of SmartMeter™ data began a mandatory transition to TOU rates and two years later, in 2014, will be transitioned to opt out PDP. Small Agricultural customers will transition to mandatory TOU rates annually starting in March 2013. There is currently no decision that requires

the default of Residential customers to TVP, however, they may enroll in to the SmartRate™ program. Approximately 110,000 SMB customers defaulted to TOU in November 2013 and 200,000 SMB customers are forecasted to default to PDP in November 2014. Approximately 61,600 SMB customers defaulted to TOU in November 2014 and 43,000 SMB customers are forecasted to default to PDP TOU in November 2015. Approximately 169,000 SMB customers defaulted to PDP in November 2014 and 90,000 SMB customers are forecasted to default to PDP in November 2015. In 2015, PG&E also ran a pilot to increase load from existing PDP participants by providing them in season support emails and customized analytics based on their facilities' performance. Benefit Description: Time Varying Pricing enables customers to save money while still using the same amount of energy, and will reduce demand during peak summer time periods lowering system-wide costs. Benefit Category: Engaged Consumer and Smart Utility – the program increases customer awareness and engagement in managing their energy usage in an environmentally sustainable and economically efficient manner while at the same time allowing PG&E great control and flexibility over its transmission and distribution.

2.3.4. Emerging Customer Side Technology Projects

Automated Demand Response (AutoDR) Program	**$6 Million**
Description: PG&E's Automated Demand Response (AutoDR) program offers small, medium and large commercial, industrial and agricultural customers an incentive to install automated equipment that enhances their ability to reduce load during DR program events. Specifically, AutoDR is an automation-based communication infrastructure that links PG&E's designated third party hosted solution servers to customer-owned Energy Management Control Systems (EMCS). PG&E helps its customers to develop pre-programmed energy management and curtailment strategies to automate their facilities when PG&E calls a DR event day. Funding Source: Since its inception, PG&E's Auto DR program has been funded under PG&E's DR activities and budgets, which have been authorized by the Commission. Status: PG&E's AutoDR program is currently in progress. PG&E's AutoDR program currently provides incentives to large commercial and industrial customers. Benefits Description: PG&E's AutoDR program has recruited 579 customers who will provide PG&E with up to 106 MW of dispatchable load during the Demand Response seasons. During the past year, 1,656 MWh were shed reducing greenhouse gas emissions by 2,074,113 pounds. Benefit Category: Engaged Consumer – PG&E offers this program to enable customers with a way to automate their DR load strategies. This two-way communication and technology provides PG&E with operational status of the customer that is valuable in a smarter grid.	

Opower/Honeywell Smart Thermostat Assessment Pilot	$1.11 Million

Description: PG&E conducted a Smart Thermostat field assessment with Opower and Honeywell to evaluate the energy benefits that accrue to customers who utilize internet-enabled thermostats, when exposed to behavioral energy saving messaging. This effort was a component of the Energy Efficiency Portfolio's Emerging Technologies Program. PG&E successfully installed Honeywell Smart Thermostats in 505 residential homes in the San Francisco Bay Area and the Central Valley in February 2013. Opower and PG&E monitored usage differences between the test and control groups for a 12 month period.

Funding Source: PG&E funded this project using funds authorized under the 2010 – 2012 Energy Efficiency program as part of Emerging Technology.

Status: This project was completed and final report was issued in July of 2014. Report recommendations included future efforts to study and evaluate the next generation and iterations of this technology with a focus on improving the connectivity between the thermostat and the internet, and ensuring that customers understand the basic operating functions of the thermostat.

Benefits Description: PG&E leveraged key learnings from this effort to guide development of a Smart Thermostat Study currently in progress, with final report targeted for Q4 2015.

Benefit Category: Engaged Consumer – PG&E conducted a thermostat behavior assessment project that will assess if customers are more likely to take advantage of having enabling technology and what that translates to as far as energy savings.

Smart Thermostat Study	$1.3 Million

Description: PG&E is conducting an Emerging Technologies field assessment to evaluate gross energy savings and effectiveness of Energy Efficiency facilitating features in multiple smart thermostats – Nest, EcoBee3 and Radio Thermostat of America CT50 with EnergyHub service provider – with focus on learning/optimization software, occupancy sensing and geo-location. Smart thermostats will be professionally installed at no cost to up to 3,000 residential customers in in the North Valley, Stockton and Fresno areas. Behavioral messaging and DR are out of scope. Both billing data and manufacturer thermostat usage data will be collected over the 12 months period and used for analysis.

Funding Source: PG&E funded this project using funds authorized under the 2013 – 2015 Energy Efficiency program as part of Emerging Technology activities.

Status: This project is currently in progress and with a final report expected in Q4 of 2016. PG&E recruited approximately 14,000 customers who agreed to participate in the Study and is finalizing control and treatment assignment based on eligibility criteria. Installation is targeted for September of 2015.

Benefits Description: PG&E will be leveraging key learnings from this Study to add Smart Thermostats to Energy Efficiency portfolio in 2017.

Benefit Category: The latest generation of Smart Thermostat products offers customers easier and more convenient ways to manage their HVAC with improved functionality and integration to other connected devices.

2.4. Distribution Automation and Reliability Projects

Projects in the Distribution Automation and Reliability category provide capabilities and associated technology enablement to monitor and control the electric distribution system. PG&E continues to focus on technology capabilities to increase the visibility and control enabled by Substation Supervisory Control and Data Acquisition (SCADA) in the distribution system, continues to deploy Fault Location, Isolation, and Service Restoration (FLISR) technology projects first introduced by the Cornerstone project, implemented technologies to support the effective consolidation of Distribution Control Centers, and piloted and deployed Smart Grid technologies to improve distribution performance and outage response.

The following section provides an update on all completed, in-progress or planned projects through June 2015 unless otherwise noted.

Distribution Substation Supervisory Control and Data Acquisition (SCADA) Program	**$142.4 Million (since program inception)**
<u>Description</u>: The Distribution SCADA program focuses on increasing SCADA penetration to support future Distribution Control Center consolidation and improve reliability for PG&E customers. PG&E's goal is to achieve 100 percent visibility and control of all critical distribution substation breakers by 2019, adding or replacing SCADA for approximately 393 substations and approximately 1,107 breakers. <u>Funding Source</u>: This project is funded under PG&E's 2011 and 2014 GRC Budget. <u>Status</u>: This project is currently in progress. PG&E anticipates the conclusion of this project in December 2019. Implementation of this project began on March 2011. This project has upgraded or replaced SCADA in 125 substations and added SCADA on 502 breakers between 2011 through June 2015. <u>Benefits Description</u>: Increasing SCADA penetration enables improvements in reliability, grid planning, and operations. <u>Benefit Category</u>: Smart Utility – PG&E's goal of 100 percent visibility using SCADA is expected to reduce outage time, personnel travel and operations time managing the system and provide data to better operate and plan and design the distribution system.	

Distribution Management System (DMS) Project	**$1.0 Million**
<u>Description</u>: The DMS Project implements electronic wall maps to assist in distribution operations control center consolidation. This project is a key strategic system implementation for the electric distribution system to provide increased grid visibility and	

control capability.

Funding Source: This project is funded under both PG&E's 2011 and 2014 General Rate Cases.

Status: This project is currently in progress. PG&E commenced implementation activities in February 2012 and anticipates concluding implementation of activities under this project in November 2016. This project has two phases. The project has completed its first phase and went live in October 2013. Phase 2 is currently in the testing phase and is expected to be deployed in October 2014 prior to the start of the roll-out of transferring the first control center into the new facilities.

Benefit Description: This project will enable operational improvements that yield safety, reliability, and operational benefits.

Benefit Category: Smart Utility – The project installs electronic wall map capability in centralized distribution operations control centers. The electronic wall map is a new smart technology that assists operations personnel in managing and making operational decisions regarding the distribution system. The DMS will also be a foundational system for future Smart Grid projects.

Sodium Sulfur (NaS) Battery Energy Storage System (BESS) Demonstration Projects	**$0.2 Million**

Description: In these projects, PG&E will utilize sodium sulfur (NaS) battery technology to demonstrate grid-scale energy storage services on the T&D system. PG&E implemented two projects that seek to aggregate and quantify the battery system benefits by developing and evaluating operating profiles designed to improve service reliability, provide ancillary services, and enhance the value of renewable resource integration.

Project 1 – 2 megawatt (MW)/14 megawatt hour (MWh) NaS BESS: Located at a major PG&E substation, this unit is the first BESS to participate in CAISO energy and ancillary services markets.

Project 2 – 4 MW/28 MWh NaS BESS: Located at the end of a distribution feeder in San Jose, this system is used to enhance reliability and power quality for customers. The system will also participate in CAISO markets for energy and ancillary services, and in tests of its ability to improve the integration of intermittent renewable generation.

Funding Source: The project was originally forecasted for cost recovery in the 2011 GRC and was subsequently rolled into the 2014 GRC Budget.

Status: This project is currently in progress. PG&E commenced implementation of these projects in November 2009 and released the projects to operations in 2012 and 2013. Additional evaluation work will be conducted by PG&E's Applied Technology Services and EPRI via a grant from the California Energy Commission. Project 1, the unit at the substation site, began operational testing in January 2013 and testing with CAISO at the end of 2013. In 2015, the system was used primarily for performance evaluation of active participation in CAISO markets. Project 2, on Yerba Buena Road in San Jose began operational testing in 2013, and is being used to island downstream loads in the event of a utility disturbance. It is also planned that this resource will become commercial in CAISO markets in the fall of 2015.

Benefit Description: If proved viable, this project will improve PG&E energy storage capabilities resulting in improved system reliability and reduced procurement costs, as well as inform the discussion around the costs and benefits of battery energy storage systems.

Benefit Category: Smart Market and Smart Utility – PG&E is testing the operational and integration capabilities of grid-scale storage batteries to better understand the benefits to the utility of integrating renewables and usage in the overall supply market. PG&E is working with the CAISO on its integration and usage as part of a potential future supply market capability.

Smart Grid Fault Location, Isolation, and Service Restoration (FLISR)	**$11.3 Million (since 2014)**
Description: This project continues the installation of FLISR systems work that was funded in the Cornerstone Decision (D.10-06-048). Smart Grid FLISR will expand the implementation of the FLISR system to approximately 100 circuits per year across the PG&E system to improve customer service reliability. Funding Source: This project is proposed to be funded in PG&E's 2014 GRC. Status: This project has been approved. The Smart Grid FLISR project has begun in 2014 and is expected to continue through 2019. Benefit Description: When installed, FLISR can reduce the impact of outages by quickly opening and closing automated switches to reduce what may have been a one to two hour outage to less than five minutes. Benefit Category: Smart Utility – the Smart Grid FLISR project improves customer service reliability, provides real time load and voltage data which supports distribution operations and DER / distribution resource integration.	

Install Smart Grid Line Sensors Pilot	**$4.2 Million**
Description: This objective of the project is to pilot how line sensors can: (1) provide more accurate information about the fault location area, allow faster outage restoration by reducing outage response time, and improve customer satisfaction; (2) provide accurate current flow information to operators and engineers to plan and reconfigure the system without overloading equipment based on actual current measurements instead of models; and (3) provide more accurate current flow information to engineers to support better planning of the distribution system rather than relying exclusively on models. L Funding Source: This project is funded under Smart Grid Pilot Deployment Project Decision 13-03-032. Status: This project is in flight and as of mid-September 2015, has deployed over 200 sensors on the distribution primary system. Phase I of the project is complete. This project began in August 2013 and is anticipated to end by December 2016. The CPUC approved this project in March 2013 (D.13-03-032; A.11-11-017). The project is broken into two gated phases: Phase I - perform benchmarking, analysis, plan a measurement and evaluation plan to capture benefits, send out a request for information (RFI) and then design and pick potential pilot vendor solutions to be tested at the ATS facilities located in San Ramon. Phase II - pilot acceptable vendor solutions on approximately 30 PG&E distribution feeders and then complete a report on the project with a specific focus on costs and benefits to be used in requesting a system roll out. Deployments have	

started for one of two vendors. Deployment of both vendors will be completed this year.

Benefit Description: This pilot project may demonstrate safety, reliability, and operational benefits through reducing outage time and improving system operations and planning. This project is expected to deliver the following benefits:

- Customer Cost Savings: reduced O&M from more efficient outage response and restoration
- Reliability Benefits: improved CAIDI and SAIDI

A forecast of these potential benefits was submitted as part of A. 11-11-017.

Benefit Category: Smart Utility – The Smart Grid Line Sensor project improves reliability and increases the capability of the distribution system for operations and planning engineering personnel to operate and effectively run the distribution system.

Voltage and Reactive Power (Volt/Var) Optimization System Pilot	**$11.86 Million**

Description: This project is piloting a voltage and reactive power (Volt/Var) optimization technology to evaluate its ability to reduce customer energy usage and reduce utility system losses by managing the distribution voltage from the substation to the customer's service point (distribution primary, secondary and service systems). This project will also demonstrate the benefit of this technology in managing voltage with higher levels of DER penetration.

Funding Source: This project is funded under Smart Grid Pilot Deployment Project Decision 13-03-032.

Status: This project began in August 2013 and is anticipated to conclude by December 2016. The CPUC approved this project in March 2013 (D.13-03-032; A.11-11-017). The VVO pilot project team has completed the Analysis and Laboratory Testing phase (Phase 1), selecting 2 vendor software solutions to pilot on 14 PG&E distribution feeders. Both vendor solutions communicate with the substation Load Tap Changer and line voltage regulators and capacitors via SCADA, delivering improved voltage and reactive power control. The Field Trial phase (Phase 2) has begun and VVO technology has been successfully deployed on 12 feeders. Furthermore, the CPUC has granted PG&E permission to commission VVO on an additional 2 feeders in the Fresno division, for a total of 14 feeders operating VVO by October 2015. PG&E will evaluate how VVO can support increased penetration of distributed energy resources during the field trial phase. When the pilot ends in December 2016, PG&E will provide a report on the project with a specific focus on costs and benefits to request full system deployment.

Benefit Description: This pilot project may demonstrate the ability to enable more efficient procurement and supply of electricity, and potentially enable increased penetration of distributed renewable generation and reducing greenhouse gas emissions. This project is expected to deliver the following benefits:

- Grid Reliability: mitigate voltage issues caused by high penetration of Distributed Generation through better voltage regulation
- Customer Energy Savings: avoided cost savings from reduced energy consumption (MWh) and peak demand (MW)
- Environmental Savings: avoided greenhouse gas emissions

A forecast of these potential benefits was submitted as part of A. 11-11-017. The project will perform measurement & verification of actual benefits throughout the Field Trial (Phase 2)..

Benefit Category: Smart Utility – The Volt/Var Optimization project is a smart utility project that seeks to improve the operating efficiency of distribution circuits and customer equipment by managing the voltage and power factor devices improving the overall operating efficiency of the distribution circuit and voltage at the customer metering point. Additionally managing the distribution voltage and power factor reduces the need for generation which in turn reduces greenhouse gas emissions.

Detect and Locate Faulted Circuit Conditions Pilot	**$2.72 Million**

Description: This project will install and evaluate a fault-finding software system or systems that will assist in more precisely locating failed equipment that caused an outage and determine if there are additional benefits of providing a more accurate location to utility first responders to outages.

Funding Source: This project is funded under Smart Grid Pilot Deployment Project Decision 13-03-032.

Status: Phase I of the project is complete. Phase II has started and is assessing existing fault data recording capabilities and alternative sources for the most effective field implementation. This project began in August 2013 and is anticipated to end by December 2016. The CPUC approved this project in March 2013 (D.13-03-032; A.11-11-017). The project is broken into two gated phases:

> Phase I - perform benchmarking, analysis, plan a measurement and evaluation plan to capture benefits, send out a request for information (RFI) and then design and pick potential pilot vendor solutions to be tested at the ATS facilities located in San Ramon.
>
> Phase II - pilot acceptable vendor solutions on approximately 15 PG&E distribution feeders and then complete a report on the project with a specific focus on costs and benefits to be used in requesting a system roll out.

Benefit Description: This pilot project may demonstrate safety, reliability, and operational benefits through reducing outage time and improving system operations and planning. This project is expected to deliver the following benefits:

- Customer Cost Savings: reduced O&M from more efficient outage response and restoration
- Reliability Benefits: improved CAIDI and SAIDI

A forecast of these potential benefits was submitted as part of A. 11-11-017.

Benefit Category: Smart Utility – The Smart Grid Detect and Locate Faults project improves reliability by improving information to find the likely location of the damaged equipment that caused the distribution outage. The distribution operations personnel will be better equipped to operate and efficiently run the distribution system. Additionally, this project will explore enhancing the utilities ability to locate and mitigate high impedance faults.

2.5. Transmission Automation and Reliability Projects

Projects included in the Transmission Automation and Reliability category provide capabilities and associated technology enablement to monitor and control the electric transmission system. Over the past year, PG&E has focused on technology capabilities to improve wide-area monitoring, protection, and control enabled by SCADA in the transmission system, equip operators with the tools necessary to enhance bulk system reliability in coordination with the CAISO and neighboring utilities, and pilot and deploy digital substation technology and other Smart Grid technologies.

The following section provides an update on all completed, in-progress or planned projects through June 2015 unless otherwise noted

Compressed Air Energy Storage (CAES) Demonstration Project	**$19.6 Million**
Description: The purpose of this demonstration project is to determine the technical and economic feasibility of an approximately 300 MW CAES plant using a porous rock structure for up to 10 hours of air storage at a location within California. CAES technology will compress air into an underground porous rock formation during periods of excess generation and then will release the stored air to generate electricity during periods of peak demand. Funding Source: The project is funded under the Department of Energy/American Recovery and Reinvestment Act (DOE/ARRA) grant of $25 million and matching funds approved by the CPUC and CEC of $24 million and $1 million, respectively. Status: This project is currently in progress. The project started January 2012 and is expected to be completed in December 2016. PG&E selected two reservoirs for core extraction and analysis. Preliminary core analysis showed that both sites have the permeability and porosity suitable for a CAES project. One of the sites was chosen as the preferred site for the air injection/withdrawal test. The DOE drafted an Environmental Assessment for the preferred site as part of its National Environmental Policy Act (NEPA) review; the DOE issued a Finding of No Significant Impact (FONSI) in May of 2014 which allowed the project to move forward with ground disturbance activities associated with the air injection test. PG&E also prepared and submitted an Underground Injection Control permit application to the EPA; this permit, which is required prior to construction of the injection/withdrawal well as part of the air injection test, was issued to PG&E on August 20, 2014. PG&E drilled and completed the injection/withdrawal well and completed the construction of the air compression test facility in Q4 of 2014 and Q1 of 2015. The test commenced on February 14, 2015, with the injection of approximately 550MM SCF of depleted air and ambient air and series of withdrawal tests to replicate the operation of a full scale CAES facility. The test results are currently being evaluated. The site was substantially decommissioned by June 30, 2015. A Request for Offers (RFO) for third party bids to build, own, and operate a CAES facility is currently scheduled for release in the 4th Quarter of 2015. Benefit Description: If demonstrated to be economically and technologically viable, CAES technology may facilitate the integration of renewable generators and help attain clean energy policy goals.	

Benefit Category: Smart Market – This project seeks to evaluate the feasibility of a large energy storage facility that can be used to manage renewables and other generation.

Transmission Substation SCADA Program	**$108 Million (Since Program Inception)**
Description: Under the Transmission Substation SCADA program, PG&E is in the process of installing new SCADA on the transmission system to provide PG&E's Electric Operations and the CAISO with full visibility into the transmission system, significantly improving efficiency and operational flexibility. PG&E's current goal is to achieve 100 percent visibility and control of all transmission substations by 2019, adding or replacing SCADA for approximately 230 substations and approximately 673 breakers. Funding Source: This project is funded under PG&E's Transmission Owner cases. Status: This project is currently in progress. The project started in July 2010 and is expected to be completed in December 2019. PG&E has added or replaced SCADA at 127 substations and 478 breakers from 2010 through June 2015. Benefit Description: Increasing SCADA penetration enables improvements in reliability, grid planning, and operations. Benefit Category: Smart Utility – PG&E's goal of 100 percent visibility using SCADA is expected to reduce outage time, personnel travel and operations time managing the system and provide data to better operate and plan the transmission system.	

Modular Protection Automation and Control (MPAC) Installation Program	**$312 Million (Since Program Inception)**
Description: The multi-year MPAC program aims to deploy pre-engineered, fabricated, and standardized control buildings in transmission substations. These activities are performed in an integrated manner with other PG&E projects such as capacity expansion projects, bus conversions, deficiency and aging asset replacement, control room condition improvements, reliability, and control center consolidation efforts. Funding Source: This project is funded under PG&E's Transmission Owner cases. Status: This project is currently in progress. This is an ongoing program, and doesn't have a defined end date, the project began in 2005. PG&E has installed and completed 96 MPAC buildings. Benefits Description: The program will help improve reliability of the transmission system by replacing aging infrastructure and modernizing facilities. Over the past year, the MPAC Installation Program has avoided \$3.9 million in capital costs over traditional upgrade methods and has avoided a cumulative total of \$54.2 million. Benefit Category: The program is a Smart Utility project designed to improve reliability of the transmission system by replacing	

aging infrastructure and modernizing facilities.

Synchrophasor Project Realization	$2.31 Million

Description: Synchrophasor technology realization will build on the foundation of the original PG&E Synchrophasor Investment project, to provide additional functionality to the Energy Management System and integration into real-time operations. The initial Synchrophasor Project allowed PG&E (and others within WECC) to install the technology. Process and steps have been established to enable use of some of the measurement features for day-to-day use in 2015. Data flow into control centers (Disaster Recovery Infrastructure) has been validated and several components of the project have transitioned into stages that transmission system operation will activate for PG&E business use. Examples include, Post Event Analysis, selected Angle Pairs, and Phasor based Dispatch Training simulator.

Funding Source: PG&E Electric Transmission Operation / Transmission System Operations.

Status: Active. Training planned for 2015. Some of the realization components planned for use later in 2015. Other functions activated by TSO on case-by-case basis.

Benefit Description: Synchrophasor technology provides high resolution grid measurement and more accurate and synchronized measurements in real-time. Benefits include:

- Improvements in PG&E' system models (the basis for the EMS used by Operators) - Accurate model allows identifying true system constraints (voltage, system instability, thermal), improved transmission system performance, evaluating true limits due to better results for on-line EMS applications supporting state estimation and dynamic line rating.
- More accurate Control Center understanding of the state of the Grid (Situational Awareness)
- Faster operator alerts and improved visibility of the fast, dynamic grid conditions
- Prompt identification of un-damped grid oscillations to prevent outages
- Quick identification of the location of a grid disturbance for faster response
- More cohesive system restoration amongst transmission owners and reliability coordinators
- PG&E dispatchers will be able to compare view of grid for with neighboring systems

Benefit Category: System Reliability and Operational Efficiency

2.6. Asset Management and Operational Efficiency Projects

Projects included in the Asset Management and Operational Efficiency category provide capabilities and associated technology enablement to track and manage asset information (e.g., location, maintenance history, specifications/characteristics), as well as assess and plan asset maintenance, replacement, and capacity enhancements. Over the past year, PG&E has focused on technology capabilities to leverage industry-standard technologies (e.g., integrated GIS/SAP system) to capture and provide access to accurate, traceable, and verifiable asset information for all stakeholders to support the Electric Operations business.

The following section provides an update on all completed, in-progress or planned projects through June 2015 unless otherwise noted.

Condition-Based Maintenance (CBM) – Distribution Network Project	**$1.7 Million**
Description: The distribution network CBM project will deploy an application to accurately monitor underground equipment in the downtown San Francisco and Oakland secondary network systems. This application guides replacement and maintenance activities based on real time operating conditions. The CBM technology solution for electric distribution network provides automated capabilities for field personnel to capture maintenance process and data electronically via rugged computers and to upload data to SAP. When ultimately coupled with the SCADA system, it will be used to trigger real time maintenance and replacement work on the networks. Funding Source: This project is funded through PG&E’s 2014 GRC. Status: This project is in progress. The CBM system is operational and PG&E completed the conversion of the available SCADA information to the PI Historian system. The next phase of the project is the integration of the PI Historian and the CBM system into a single system which will provide a comprehensive assessment of the condition of all of PG&E’s network transformers and network protectors. The new integrated system will include a module to allow engineers to assess and manipulate data from the systems directly rather than require the need for using programmers to modify the systems. PG&E has eliminated the time based replacement of equipment on the networks in favor of a condition based replacement system. The new CBM and PI Historian systems are what make the condition assessment feasible. It is expected that the integration project will begin in late 2015 and run through early 2017. Benefit Description: This project is expected to deliver safety, reliability, and operational benefits through improving the understanding of the condition of key assets in the SF and Oakland network system. Benefit Category: Smart Utility — this project provides PG&E personnel with information regarding existing assets to make informed maintenance and upgrade decisions.	

SmartMeter™ Outage Management Integration Project	$0.15 Million

<u>Description</u>: The SmartMeter™ Outage Management Integration project integrates the SmartMeter™ "Last Gasp" and Restoration messages into PG&E's Outage Management System for outage notification to operators and dispatchers and improved outage restoration. Phase I project will deliver: (1) the capability to create trouble reports from AMI alarms when an associated customer call has been received; (2) the capability to ping a transformer to determine if an outage is larger than it was inferred to be; (3) the capability to ping individual meters to determine whether they have been restored. Phase 2 of the project will identify and isolate downstream outages that have occurred prior to a larger upstream outage. Additionally, it will enhance the capability introduced in Ph. 1 by removing the requirement for an associated customer call and automatically creating trouble reports using AMI only reports.

<u>Funding Source</u>: This project is funded within PG&E's SmartMeter™ Project, Decision 06-07-027. Future work planned to be funded by PG&E's Proposed 2014 GRC.

<u>Status</u>: Phase 1 of this project was started in May 2008 and completed in September 2011. The functionality of Phase 2 has been deployed to two control centers for monitoring and evaluation. System wide deployment is anticipated in Q4 for 2015.

<u>Benefits Description</u>: This project is expected to deliver reliability and operational benefits through leveraging SmartMeter™ data to better understand and resolve customer outages. The program this past year saved more than 6,500 "truck rolls" eliminated approximately 61,000 pounds of greenhouse gas emissions and saving the utility more than $733,000.

<u>Benefit Category</u>: Smart Utility – this project integrates SmartMeter™ outage last gasps into PG&E's outage management system and allows for pinging customers to make sure they are back in power after the outage restoration work was completed.

Electric Distribution Geographic Information System and Asset Management (ED GIS/AM) Project	$122.4 Million

<u>Description</u>: The ED GIS/AM project is a continuation of and enhanced approach to the Automated Mapping and Facilities Management (AM/FM) Project, where PG&E upgraded hardware and software components from 2008 to 2010 and completed alignment of electric and gas maps to a common coordinate scheme or "land base", to prepare the maps for migration and conversion into a new enterprise Geographic Information System (GIS) solution.

While the purpose and scope of the ED GIS/AM project is consistent with and leverages work completed as part of the predecessor AM/FM project, key enhancements are being made to drive increased business value with the integrated GIS and enterprise asset management system (SAP) data. A significantly more rigorous approach to assure data quality and implement data governance processes is included as part of the new ED GIS/AM project. In addition, the scope of the ED GIS/AM project has been expanded to include web based analytics for multiple ED functions. These and other capabilities are more fully detailed and scoped in the GIS/AM project as compared to the 2011 GRC AM/FM forecast, resulting in a more comprehensive and longer duration project.

<u>Funding Source</u>: This project is funded from PG&E's 2011 and 2014 GRCs.

Status: This project is currently in progress. The development of the enterprise-wide data repository commenced in October 2011 and is expected to be completed by December 2015.

Benefits Description: PG&E has quantified expected cost savings including $0.6 million in 2015, $3.4 million in 2016 and $4.1 million in 2017 based on efficiencies gained from implementing the ED GIS/AM solution. These savings will result from back office efficiencies as well as improved productivity by applying ED GIS/AM technology in conjunction with other initiatives to streamline processes that are currently manual or less efficient.

Benefit Category: Smart Utility – this project is expected to deliver safety, reliability, and operational benefits through enhanced visualization of PG&E's electric distribution system.

Network Supervisory Control and Data Acquisition (SCADA) Monitoring Project	**$8.4 Million in 2014**

Description: The project is installing new monitoring and control systems on the downtown San Francisco and Oakland secondary network systems including full remote control on network protectors (including remote setting of relays), and primary switches. The monitoring itself includes voltages, currents, temperature, oil level, and chamber pressures. For vaults, the monitoring system includes SCADA battery, water detection and may include others such as distributed generation monitoring depending on future needs and feasibility. Real time data collected from the equipment is used for triggering of alarms, and for equipment condition assessment as part of the Condition Based Maintenance system for operation and maintenance activities. The data is also used for asset management decisions on maintenance and replacement of network equipment. The new SCADA system has remote operating capabilities that include network protector open/close and station transfer trip of the network protectors for feeder clearances.

Funding Source: This project is funded by PG&E's 2014 GRC.

Status: This project is currently in progress. PG&E has a total of twelve network groups. Three network groups are complete (Z-34-1, Z-34-2 and Y-3), and the fourth network group (Z-1) will be completed by December 2015 with a fifth group (Y-4) currently under construction. These completed network groups have been added to the PI Historian system which is the data accumulator for all of the SCADA information. This data in turn is coupled with the Condition Based Maintenance (CBM) system described above which allows PG&E to transition from time based to condition based replacement and maintenance. This results in a safer system while at the same time generating savings through deferring work until the condition of the equipment warrants.

Benefit Description: The new control features included as part of this project will improve personnel safety and overall system operability.

Benefit Category: Smart Utility – this project provides information for PG&E to better manage its assets and make informed maintenance, repair and upgrade decisions.

Smart Grid Short-Term Demand Forecasting Pilot Project	**$2.09 Million**

Description: The objective of the proposed Project is to evaluate if more granular sources of data can be acquired and used to improve the accuracy of PG&E's short-term electricity demand forecasts for retail load. The Project will follow a three phase approach to analyze, build, and pilot the systems that incorporate more granular sources of data for local pilot areas within PG&E's service territory.

Funding Source: This project is funded under Smart Grid Pilot Deployment Project Decision 13-03-032.

Status: The CPUC approved this project in March 2013 (D.13-03-032; A.11-11-017). Phase 1 was completed with the selection of the pilot areas to test the new forecasting methodology. In July 2014 the CPUC granted PG&E authority to proceed to Phase 2 of this pilot project (Advice Letter 4429-E). In Phase 2, PG&E has been developing the infrastructure and systems to process the new granular data sources into a central repository for input into the demand forecasting model for the local pilot areas.

Benefit Description: This pilot project seeks to demonstrate if more granular sources of data can improve the accuracy of PG&E's demand forecast within the selected areas and if the implementation to PG&E's entire service area would be cost-effective.

Benefit Category: Smart Market and Smart Utility – this project uses SCADA data and SmartMeter™ usage data to determine if there is an improvement to the accuracy of PG&E's short-term electric demand forecasts to meet PG&E's retail load obligations.

2.7. Security (Physical and Cyber) Projects

Since the publication of the Smart Grid Deployment Plan, PG&E has completed the Advanced Detection and Analysis of Persistent Threats (ADAPT) cybersecurity project that was primarily focused on increasing the utility's capability to effectively anticipate, prevent, and respond to a new and emerging class of cyber and physical threats. Following the conclusion of the ADAPT project, PG&E has undertaken the implementation of a second project, the Identity and Access Management (IAM) project. This is a multi-year investment focused on improving PG&E's core access control capabilities. Additional detail on these two projects has been provided in the following section, and discussion of PG&E's overall Cybersecurity Risk Management Program is provided in Section 2.12 to 2.16 of this report.

The cybersecurity projects have multiple goals and provide regulatory compliance benefits (SOX, NERC CIP, and other standards and regulations) significant risk reduction benefits, and alignment to PG&E's Risk Management Framework as described later in this document.

The following section provides an update on all completed, in-progress, or planned projects through June 2014 unless otherwise noted.

Identity and Access Management (IAM) Project	$7.27 Million
Description: The IAM project is a multi-year, enterprise level investment that will strengthen authorized PG&E system access controls and reduce the risk of unauthorized access. The project will improve centralized control over access to PG&E's key systems, provide role based access control to those systems, provide a central authoritative source for identity attributes of authorized individuals, and provide enhanced auditing capabilities to achieve enterprise wide visibility and control of employee access to systems. Through the IAM Project, PG&E will implement key technologies and services in the areas of identity management, credential administration, provisioning, entitlements, access management, and audit and compliance. Funding Source: This project is funded in PG&E's 2011 and 2014 GRCs. Status: This project started in March 2012. This is a multi-year project expect to complete in 2016. This project is in progress. Benefit Description: As of July 2015, PG&E has decreased the risk of unauthorized physical and logical access through: automated creation of network login credentials for approved and authorized users; automated removal of access from up to 231 separate facility access control systems for decommissioned users; centralized server access provisioning/de-provisioning, monitoring and reporting; improved governance processes for enterprise user access functions contributing to a reduction in Segregation of Duties violations by 91%; deployment of controls to restrict and better monitor privileged accounts; deployment of a centralized logical and physical access management portal called My Access; and retirement of the legacy provisioning system for SOX systems. Benefit Category: Engaged Consumer, Smart Market, and Smart Utility – The IAM project, enhances controls across the entire PG&E infrastructure and is not limited to the Smart Grid. Each of the Engaged Consumer, Smart Market, and Smart Utility areas benefit from these improved controls that protect key processes and systems across the enterprise. For example, the infrastructure that allows customers to log in to PG&E's My Energy will be enhanced with increased security and control mechanisms to validate that only customers and their approved designees can access customer energy information online.	

2.8. Integrated and Cross-Cutting Systems Projects

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 this type of projects will ensure that investments are managed efficiently while creating the platform to deliver a stream of benefits across the IOU operations and to 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 would enable information exchange with the IOU, service partners and customers using secure networks. Data management and analytics projects will improve the IOU's ability to utilize vast new streams of data from T&D automation and SmartMeters™ for improved operations, planning, asset management, and enhanced services for customers.

Advanced technology testing and standards certification are a foundational capability for the IOUs 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 the IOUs maximize technology performance and interoperability prior to deployment.

Workforce development and advanced technology training enables the successful deployment of new technologies, ensuring that the IOUs' workforces are prepared to make use of new technologies.

The integrated and cross-cutting systems group is driven by several state and federal laws and regulatory orders including SB17, Energy Independence and Security Act (EISA), CPUC Decision 10-06-047, Assembly Bill (AB) 32 and Executive Order S-305 , SB 078 and SB X1-2.

The following section provides an update on all completed, in-progress or planned projects through June 2015 unless otherwise noted.

Telecommunications Architecture	**$ 10.5 Million**
<u>Description</u>: Telecommunications Architecture allows PG&E to meet near term and long term telecommunications needs by developing and implementing a multi-tier, multi service telecommunications infrastructure architecture, consisting of a core and an edge network. Smart Grid projects require an exponential increase in the ability for customers, markets and utilities to securely and reliably communicate on a near real time basis. New communication models include customer to utility, customer to market, and smart "equipment to equipment." PG&E's telecommunication infrastructure must be enhanced to facilitate this increased communications and also developed in a systematic, economic manner that allows for re use of communications infrastructure. A blend of technologies will be needed to address the diverse performance needs and geography of the PG&E service territory. Increased SCADA density, Phasor Measurement Units, cyber security, and network management requirements will drive capacity, latency, and quality of service requirements that must be built into future networks.	

Funding Source: This project is being funded in PG&E's 2011 and 2014 GRCs.

Status: This project is currently in progress and is expected to be completed in 2017. PG&E has completed implementation of the core of the Multi-Protocol Label Switching (MPLS) network and has begun the network consolidation. Multiple Virtual Routing and Forwarding Domains have been constructed enhancing security and availability of critical applications. Pilot installations of wireless edge technologies have begun to verify cost models associated with the technology and ensure system meets desired increases in capacity and coverage, and reductions in latency.

Benefits Description: Benefits are estimated at $10 million in lifecycle asset replacement avoidance.

Benefit Category: Engaged Consumer, Smart Markets and Smart Utility – Cross-cutting initiatives apply across all three segments.

Information Management Architecture	**$3.3 Million**

Description: PG&E intends to invest in a core set of Information Management and processing capabilities to allow participants in the Smart Grid to have timely access to the best available data to drive their energy related decisions. The Information Architecture foundation includes enhanced decision support tools to more accurately analyze, predict, and respond to energy impacting events based on data processed from a multitude of systems and stakeholders. The high level areas of foundational information architecture investments include the following:

- Master Data Management across business processes and systems.
- Enhancement of PG&E's current operational data store capabilities.
- Common services including Service Oriented Architecture and framework to support Smart Grid systems and data interoperability.
- Enhanced business intelligence and analytic capabilities to support storing and processing of disparate sources of data.
- Data governance program and standards to support the enhanced information architecture and management foundation.

Funding Source: This program is being funded in PG&E's 2011 GRC and future related applications.

Status: PG&E is continuing work on the Interval Data Analytics (IDA) project which began in August 2012. This project enables the company to enhance its operational data storage capabilities and business intelligence and analytic capabilities. To date, we have included SmartMeter Usage, Customer, and some Billing data. SmartMeter Alert, Voltage, and extended Billing data will be added in future phases. Customer Data Access (CDA) has been implemented to provide SmartMeter Usage data to customers and authorized third parties.

Benefit Description: Improved access to SmartMeter™ data and integration with customer data is supporting advancements in consumption analysis, distribution loading analysis, transmission loading analysis, EE/DR analysis, and rate analysis and design.

Benefit Category: Engaged Consumer, Smart Markets and Smart Utility – Cross-cutting initiatives apply across all three

segments.

California Energy Systems for the 21st Century (CES-21) Program	$0.6 Million

Description: The CES-21 Program is a public-private collaborative research and development project between PG&E, Southern California Edison Company (SCE), San Diego Gas & Electric Company (SDG&E), and Lawrence Livermore National Laboratory (LLNL). The objective of the CES-21 Program is to address challenges of cyber security and grid integration of the 21st century energy system for California. The CES-21 Program will utilize a team of technical experts from the Joint Utilities and LLNL, who will leverage and extend ongoing research in grid cyber security. LLNL will combine data integration with advanced modeling, simulation, and analytical tools to provide problem solving and planning necessary for the challenges of grid integration.

In Decision 14-03-029, which modified D.12-12-031 to comply with Senate Bill 96, the Commission authorized the three utilities to recover up to $35 million over five years for the CES-21 Program and limited research areas to cyber security and grid integration. On April 25, 2014, the three utilities filed a joint Advice Letter (PG&E AL 4402-E) requesting approval for two research projects and the Cooperative Research and Development Agreement (CRADA), which was approved in October 2014.

Funding Source: In Decision 14-03-029, the Commission authorized the three utilities to recover up to $35 million over five years for the CES-21 Program.

Status: The CPUC approved the Advice Letter (PG&E AL 4402-E) and CRADA in October 2014 allowing the IOUs and LLNL to kick-off the cyber security and grid integration projects at the beginning of 2015. The cyber security project is in the planning phase while the grid integration project in the design / engineering phase.

Benefit Description: The CES-21 Program has the potential to deliver significant benefits to California's electric customers. California customers will benefit greatly from avoided or shortened outages due to cyber-attacks. Automated response capabilities may reduce the number of outages, minimize their impact, and improve recovery times. The grid integration project may reduce operating and capital costs and improve reliability by reducing the uncertainty about the adequacy of planned resource to integrate greater amounts of intermittent renewables.

Benefit Category: Engaged Consumer, Smart Markets and Smart Utility – Cross-cutting initiatives apply across all three segments.

Electric Program Investment Charge (EPIC) Program	$13.2 Million

Description: As a result of the CPUC's Phase 2 EPIC Decision 12-05-037, PG&E, the other California IOUs, and the CEC are executing on the approved 2012-2014 Triennial Investment Plan and program framework to provide ongoing support for the development and deployment of next generation clean energy technologies. After approval of the EPIC 2 Final Decision 15-04-020, the California IOUs, and the CEC are also executing on the approved 2015-2017 Triennial Investment Plan. The EPIC program demonstrates promising new Smart Grid technologies focused on four key areas: Renewables and DER Integration; Grid Modernization and Optimization, Customer Service and Enablement; and Cross-Cutting and Foundation Strategies. Project specific information about EPIC 1 can be found in PG&E's EPIC 2014 Annual Report, which was filed on February 27, 2015.

Funding Source: This EPIC 1 program is funded in Decision 12-05-037. The Commission authorized the three IOUs to collect funding for the EPIC program in the total amount of $162M annually beginning January 1, 2013 and continuing through December 31, 2020. The total collection amount shall be adjusted on January 1, 2015 and January 1, 2018 to commensurate with the average change in the Consumer Price Index. PG&E's share is 50.1%. The EPIC 2 program is funded in Decision 15-04-020, and follows the increase to annual funding amount of $162M as previously stated. The EPIC 2 program is funded in Decision 15-04-020, which adjusted EPIC 1 funding amounts by the Consumer Price Index, which came out to 1.6%.

Status: In November 2013, the CPUC approved PG&E's 2012-2014 Triennial Investment Plan filed on November 1, 2012. 17 projects have been kicked off and are in various phases, with 4 projects in the planning phase, 6 projects in the design / engineering phase, 1 project in the staging phase, and 6 projects in the build / test phase. Additionally, CPUC approved 30 projects for PG&E's 2015-2017 Triennial Investment Plan on April 9, 2015. 12 projects have been internally approved, and the remainder will be going through PG&E's prioritization process in August 2015 to assign the remaining EPIC 2 funding.

Benefit Description: EPIC projects are expected to improve the safety, reliability and affordability of the electric system in California while supporting state energy policy goals.

Benefit Category: Engaged Consumer, Smart Markets and Smart Utility – Cross-cutting initiatives apply across all three segments.

Workforce Development and Technology Training	**N/A**

Description: PG&E is committed to developing a Smart Grid workforce. Enhanced workforce skills and knowledge are required for successful support of smarter grid design, deployment, operation, maintenance, safety, and customer care. PG&E develops internal training programs through experience, including with demonstration pilot projects, and scales them for broader deployment.

Funding Source: This work is funded through PG&E's GRCs.

Status: PG&E is continuing to enhance workforce skills to support a smarter, more integrated grid.

Benefit Description: Improved access to a skilled workforce necessary to implement the Smart Grid deployment to benefit grid reliability, increasing grid complexity, and technology integration that will help PG&E meet its energy goals in the state of California.

Benefit Category: Engaged Consumer, Smart Markets and Smart Utility – Cross-cutting initiatives apply across all three segments.

Supplier Diversity	**N/A**

Description: Throughout the process of identifying qualified suppliers to participate in the initial testing and limited pilots, PG&E emphasized the criticality of diverse supplier inclusion. PG&E continues to highlight the importance of education, mentoring and careful planning for the full participation of DBEs as business solution partners and subcontractors over the life of this program. In the initial and current phases of the Smart Grid evaluation, PG&E has hired over a dozen DBE firms providing technical consulting, legal services, computer systems, staff augmentation, and office and electrical supplies. As a result, at mid-year 2015, as in 2014, PG&E Smart Grid supplier spending is in-line with the company's year-to-date supplier diversity goals.

As part of the advance planning and education effort, PG&E provided specific Smart Grid and general business opportunities to DBEs, including:

- PG&E's sponsorship of DBE firms in the University of California Advanced Technology Management Institute (ATMI) executive management training for companies poised for growth in emerging technologies like Smart Grid.
- PG&E's sponsorship of DBE firms in the UCLA Anderson School of Business, Management Development for Entrepreneurs (MDE) executive business management training.
- DBE supplier development opportunities through PG&E's Technical Assistance Program (TAP), which include ISO 9001 and ISO 14001 certification training scholarships, DBE sponsorships to select industry trade shows, invitations to matchmaking events and other educational workshops.

2.9. Customer Roadmap

In its March 2012 Smart Grid Workshop Report, CPUC Staff requested the following information to be included in the IOUs' Smart Grid Annual Reports:

1. Timeline that connects specific projects with specific marketing and outreach efforts,
2. Specific steps to overcome roadblocks, as identified in the workshops and included in this report.[3]

As requested by CPUC Staff, PG&E is providing marketing and outreach information using the sample template in Appendix 1 to the Smart Grid Workshop Report as follows:

Timeline: PG&E has adapted the CPUC Staff's template (Appendix 1) to reflect the existing and planned work that is related to the Smart Grid, including approved initiatives in place that meet the customer objectives outlined in SB 17 and Decision 10-06-047. Since the Marketing, Education, and Outreach proposal in the Smart Grid pilot deployment Application 11-11-017

3 See Smart Grid Workshop Report: Staff Comments and Recommendations, March 1, 2012, page 10.

was denied, the only outreach that provides support to the Smart Grid initiative is conducted through funding approvals of individual program and their initiatives as listed in Table 2-1.

Initiative Detail: For each of the project areas identified in the Customer Engagement timeline, PG&E has provided detail on existing or proposed outreach in accordance with the proposed template from the Commission's Smart Grid Workshop Report.

Table 2-1 below provides an annual illustration of PG&E's customer engagement timeline.

	2013	2014	2015	2016*	2017*
Energy Management Enablement Tools:					
PG&E online account web tools (including rate comparisons)	X	X	X	X	X
Universal audit tools	X	X	X	X	X
Energy usage alerts	X	X	X	X	X
Business & home energy reports	X	X	X	X	X
Third-party customer data access tools (e.g. green button connect, customer data access)	X	X	X	X	X
SmartMeter™	X	X			
Behind the meter (customer premise) devices:					
SmartAC™	X	X	X	X	X
Distributed Generation (Solar Water Heating, Solar PV, etc.)	X	X	X	X	X
Business and Home Area Network (HAN); Local Area Network (LAN); Smart Thermostat, etc.	X	X	X	X	X
Public Electric vehicle charging stations infrastructure				X	X
Rates Options:					
SmartRate™ and related residential time varying rates	X	X	X	X	X
Time-of-Use (TOU)	X	X	X	X	X
Peak Day Pricing	X	X	X	X	X
Electric Vehicle rates	X	X	X	X	X
Note: *The activities for 2016 and 2017 are dependent on receiving authorization from the Commission for initial funding and/or to continue funding for these programs in each of the appropriate programs proceedings.					

2.10. Overview of Customer Engagement Plan

PG&E's had sought approval for a plan to more broadly educate customers on longer-term benefits of Smart Grid technology beyond these immediate offerings, to provide context for future technologies and customer-facing benefits that will be available in the coming years in PG&E's Customer Outreach and Education Pilot. However, since the Outreach proposal in Application 11-11-017 was denied, the outreach that supports the Smart Grid initiative can only be conducted through marketing of individual programs if they are approved in new cycles with outreach funds allocated. PG&E's outreach efforts over the reporting period have been focused on meeting goals of each program.

PG&E's effort to ensure that customers have the tools and knowledge to benefit from the Smart Grid have included customer education on:

- Available tools designed to help customers understand their energy use
- Choices for rate options and new technology that will help customers manage their energy bills
- Communicating with customers through communication methods they prefer, including online and by mail.

2.11. Smart Grid Engagement by Initiative Area

In the following section PG&E describes the customer engagement elements for each initiative area identified in Table 2-1 above, as requested by CPUC Staff in its March 1, 2012 Smart Grid Workshop Report.

Enablement Tool: Energy Management	
Project Description	Marketing, Education & Outreach (ME&O) to educate customers about the various tools available to evaluate and manage their energy use and to develop a more interactive and engaged relationship with PG&E services
Target Audience	Focused on Residential and SMB Customers
Sample Message	"PG&E offers a number of ways to help you evaluate your energy use and learn about ways to save energy"
Source of Message	Utility
Current Customer Engagement Road Block(s)	• Low engagement category • There is a low baseline incentive for customers to be interested in incremental savings on their power bill given the low engagement level of the utility category • While customers are increasingly interested in digital communications, not all customers prefer communications through online channels
Strategy to	• Continue to offer residential customers a variety of outreach methods to ensure highest

Overcome Roadblocks	penetration possible of relevant and targeted information • Continue to market energy enablement tools • Demonstrate available energy savings by highlighting customer case studies • Conduct frequent customer communication, including through the Small Business and residential e-newsletters

Enablement Tool: Behind the Meter (Customer Premises) Devices	
Project Description	ME&O to educate customers about available home or businesses devices that: 1) Provide interval energy usage data like SmartMeter™, Home Area Networks (HAN) Local Area Networks (LAN) 2) Allow customers to participate directly in grid operations with tools like SmartAC 3) Facilitate distributed generation
Target Audience	Residential and SMB customers
Sample Message	"PG&E offers devices that provide information to help customers manage energy use and costs"
Source of Message	Utility
Current Customer Engagement Road Block(s)	• Concerns about ceding control of customer premises to utility through installed devices • Immediate economic impact (i.e. cost savings) is not always easily seen • Long payback periods on technology investments can make the Investment unfeasible

Strategy to Overcome Roadblocks	• Provide customers with factual information about devices, focusing on:
	  o The benefits and energy management tools it serves
	  o The potential to positively impact the customer's economic bottom line with cost savings
	  o Positive impact on grid stability and reliability
	• Continue to market customer premise device rebates available

Rate Options	
Project Description	ME&O to educate customers about rate options. Includes opt-in for residential customers and default rates for SMB customers
Target Audience	Residential and SMB customers
Sample Message	"Rate options offer customers new ways to conserve energy and to choose the rate that is best for them"
Source of Message	Utility
Current Customer Engagement Road Block(s)	• Lack of customer understanding about how they can benefit financially from various rate options available • TOU and critical peak pricing requires action from the customer on event days • Changes to rate structures for residential and businesses
Strategy to Overcome Roadblocks	• Sustained, ongoing outreach about default rates for SMB (prior to and after default) and how to participate in opt-in residential rates • Provide customers examples of how to benefit from rate options on peak event days and how to prepare for a an event day, including developing an action plan • Cross promotion of enablement tools so that customers gain understanding of how various options available to them work together to save them money (SmartAC and SmartRate) • Promote SmartRate program that offers bill protection for the first year after signup for and highlight a maximum of 15 "Smart Days" will be called each year; Once enrolled continuous communication to keep customers engaged by highlighting ways they can continue to save on SmartRate and remind them that their regular day (non-Smart Day) rates are lower when on the SmartRate program.

2.12. Key Risks

As part of the continuous review of its key risks, PG&E has concluded that there has been no appreciable change to those risks over the past year.

PG&E initially laid out its strategy for measuring, managing and mitigating both cybersecurity technology risks and physical security risks in its June 2011 Smart Grid Deployment Plan filing. The strategy described in June 2011 highlighted PG&E's fundamental cybersecurity approach at that time. The Utility business continues to evolve. New operational models depend more and more on converged Information and Operations Technologies to perform advanced business functions such as those proposed for the Smart Grid. Many of these functions are automated and will be implemented through information-rich applications or grid automation with "smart" devices. New technologies change the risk and threat landscape. New threats continue to put pressure on and change the risk posture of the Utility requiring more protective measures and safeguards to prevent, detect, respond, and recover in a resilient manner that does not jeopardize the safe, reliable, and cost-effective delivery of energy to customers. Since June 2011, PG&E's cybersecurity strategy has evolved, with the implementation of a more quantitative approach to risk management through the newly developed and deployed Risk Management Framework (RMF) that blends current efforts for managing compliance with this new method for proactively managing risk. This approach is emphasized in the CPUC September 19, 2012 Policy Paper: *Cybersecurity and the Evolving Role of State Regulation: How it Impacts the California Public Utilities Commission.* As recognized by the CPUC, "Compliance is an important component of addressing cybersecurity, but it is not enough to ensure that the rapidly evolving risks are adequately considered and acted upon effectively. … A broader risk management-based approach is needed to move beyond minimal compliance and mitigate cybersecurity risks as they arise." PG&E recognizes that focusing solely on compliance management without a holistic risk management framework will not achieve the desired optimal outcome to adequately protect the Utility and the Smart Grid. This philosophy also extends to PG&E's physical security strategy, which is driven by the Corporate Security department and plays an important role in protecting PG&E's Smart Grid assets. Physical security continues to remain focused on four layers of physical security that work to complement each other to provide the necessary level of security for the Smart Grid. From a cybersecurity perspective, physical security is leveraged as part of the overall defense-in-depth strategy; a critical protection layer for the widely distributed systems and devices planned for the evolving Smart Grid.

2.13. Key Risks and Actions Taken to Address Them

PG&E established the RMF as part of its ongoing focus on continuous improvement—from cybersecurity risk assessment to technology risk management. PG&E's June 2011 Smart Grid Deployment Plan described its holistic approach to cybersecurity which was based on the concept of risk assessment. It described how security would be achieved for the Smart Grid through principle-based concepts such as “defense-in-depth” and “least privilege” that are enabled through multiple security “service layers”. PG&E’s Smart Grid Pilot Deployment Project (A. 11-11-017) extends this concept by tying together how each detailed security “service” would be specifically woven into each of the proposed pilot projects to assess and mitigate the cybersecurity risks.

PG&E has taken additional steps to further enhance its cybersecurity risk management procedures and has implemented processes to consistently measure, manage, and mitigate technology risks. PG&E’s Risk Management Framework quantifies system-specific risk via a “cybersecurity risk index” to give a relative cybersecurity measure on a system by system basis. Processes are also applied to evaluate and rank the likelihood of, and impact from, potential information security risks for each of PG&E’s lines of business. Risk evaluation activities may include augmenting security controls through mitigation, transferring some of the risk to a third party (such as in the case of cyber insurance), or accepting an appropriate level of “residual” risk. As the CPUC staff notes, “Regulators must also be able to adapt their assessments of cost-effectiveness to a dynamic assessment of risk. Using risk assessment can greatly enhance the ability of regulators to determine appropriate level of funding for cybersecurity measures, recognizing that a 100 percent secure system cannot be achieved."[4] Through these efforts PG&E is able to establish that appropriate level of investment while reducing residual risk just below the target threshold with the right amount of controls in place to ensure safe and reliable operations. PG&E has adopted a continuous approach to managing and controlling IT risk by regularly and repeatedly measuring and mitigating risk to acceptable threshold levels. This methodology enables PG&E to prioritize security specific investments by identifying opportunities for improvement in the cybersecurity control framework. PG&E has most recently prioritized three security related investment areas—Disaster Recovery, Telecommunications Network Enhancements and Identity and Access Management—to bring about operational risk reduction benefits and further improve the controls across PG&E.

While the next sections primarily focus on managing cybersecurity, physical security remains critical for controlling risk within the Smart Grid. PG&E's Corporate Security department remains abreast of changes in the regulatory landscape and continues to closely follow all Critical Cyber Assets outlined in the NERC Cyber Security Standards, CIP 006 as well as industry standards from NIST, such as those outlined in the industry guideline NISTIR 7628, Guidelines for Smart Grid Cyber Security. From a design perspective, physical security focuses on four key complementary layers. These layers consist of environmental design, mechanical and electronic access control, intrusion detection, and video monitoring. PG&E is pursuing automation technology in each of these areas to reduce the physical risk profile, enhance alarming and alerting, and improve PG&E's speed of detection and response capabilities when alarms and alerts are activated.

2.13.1. Managing Cyber Security Risk through Control Baseline

PG&E's risk assessment and evaluation processes are designed to run systems through multiple scenarios (such as unauthorized access to a system, and inability of the system to process security events) and test the strength of PG&E's baseline security controls. Controls are the

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[4] CPUC September 19, 2012 Policy Paper: Cybersecurity and the Evolving Role of State Regulation: How it Impacts the California Public Utilities Commission.

system safeguards that mitigate various types of risk, and PG&E has developed a set of standardized, baseline controls that align to multiple best practice governing bodies and regulations.

PG&E has established the following thirteen control families as part of its baseline controls:

Security Leadership

This control includes strategy development and industry leadership in security. This includes continual analysis of the target state to the current state to identify potential security gaps through both internal and external benchmarking initiatives.

Audit and Risk Management

This control layer drives the risk management function. The risk management and governance functions provide the overarching risk management structure that guides the cyber security risk process.

Privacy Protection

PG&E's privacy controls protect customer privacy and have multiple standards, policies, and procedures which ensure compliance with federal and state laws as well as CPUC orders aimed at protecting private customer information.

Records Management

This control governs how PG&E handles the lifecycle of records from document creation to disposition.

Configuration Management

Configuration and change management controls are a cornerstone for ensuring cybersecurity effectiveness across PG&E. The ability to provide assurance that Smart Grid hardware and software are configured as expected and changes to that configuration are managed is critical for managing cybersecurity risk.

Operational Management

This layer provides the real-time security and risk operations control through "situational awareness" by providing an overview and measure of the current threats and vulnerabilities facing the Enterprise. This is also where PG&E engages heavily in public-private information sharing across private sector and public sector entities for securely acquiring and submitting threat information to assess risk.

Human Resource Management

The objective of this control layer is to ensure that the security controls are well understood, evenly applied, well trained, and enforced throughout the Enterprise. This layer emphasizes the fact securing the Utility is a shared responsibility across PG&E. This layer also incorporates areas such as personnel screening and background checks.

Monitoring and Measurement

The control layer provides critical security testing for new and existing systems across the Enterprise. The measurement focuses on assuring that the controls are effective and are meeting the system design requirements, the acceptable risk thresholds, and the compliance requirements. Developing metrics in alignment with industry is a way in which PG&E is benchmarking itself to measure relative effectiveness of the control framework. PG&E is actively leading the development of cybersecurity metrics with NERC.

System Design, Build, and Implementation

The control ensures that security and risk management is built into the early stages of technology projects and technology infrastructure so that potential security risks can be managed and mitigated. The control design process starts with a principle-based approach that integrates the security controls into conceptual, logical, and physical system architectural designs.

Physical Security

The physical control layer is vital for controlling cybersecurity risk within a Smart Grid. PG&E's Corporate Security department remains abreast of changes in the regulatory landscape and continues to closely follow industry standards.

System Continuity

This layer assumes that critical systems will and do fail and provides the necessary controls to ensure that the recovery of the business process meets the recovery time objectives for that process. Systems are tested, gaps identified, and corrective action is implemented to mitigate the risk of a critical business process being inoperable for an undesirable amount of time.

Acquisition of Facilities, Technologies, and Services

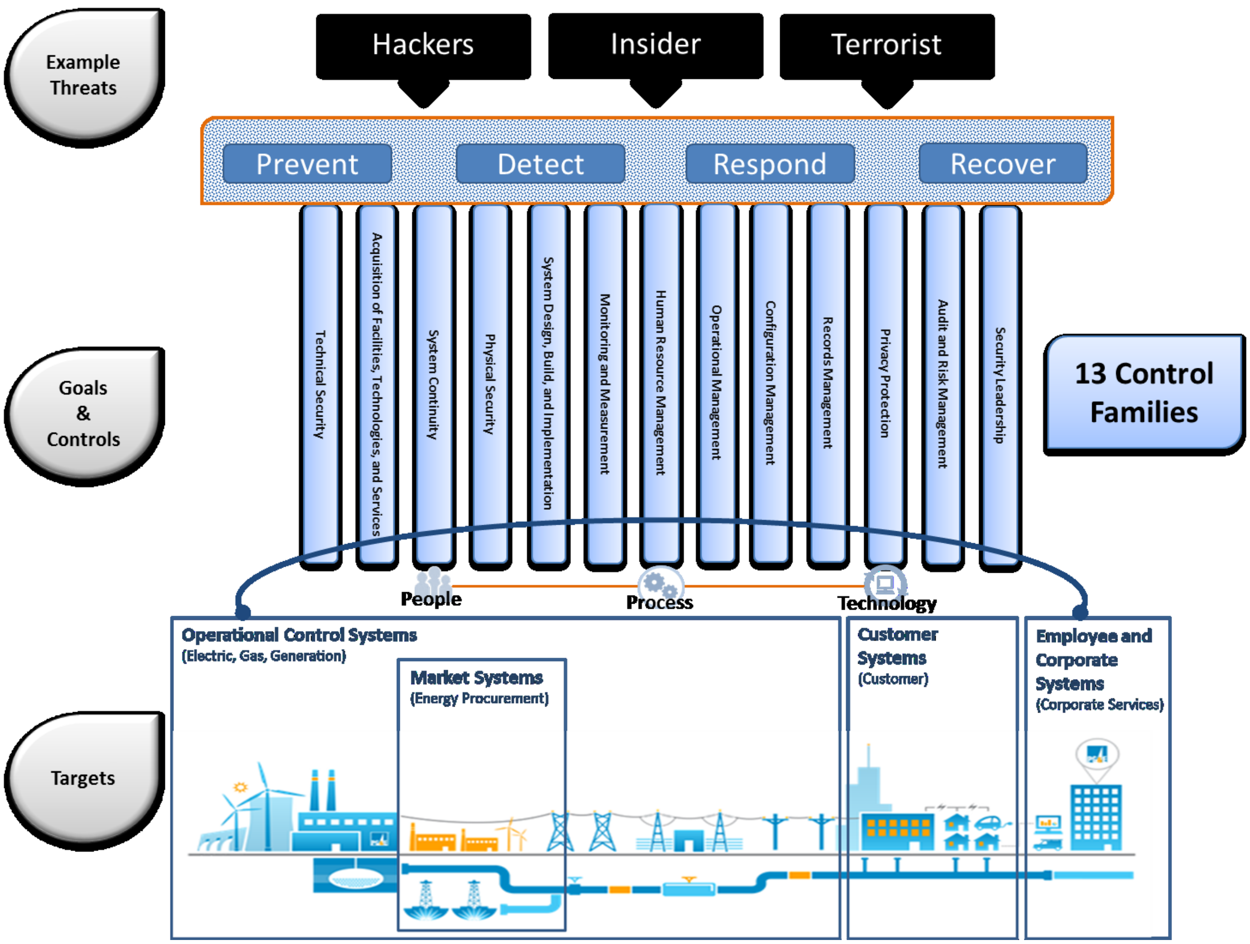
This control layer provides assurance around protecting the supply chain for investments in areas such as cloud services or new and emerging Smart Grid end point devices. PG&E has developed common procurement language based off of industry best practices that is being used for new contracts and contract renewals. The language ensures that third party vendors and suppliers are following a best practices approach in alignment with the PG&E baseline controls. In addition PG&E has established a third party vendor assessment program to sure that vendor security reviews are conducted to verify that PG&E controls are being adhered to and any gaps mitigated accordingly.

Technical Security

This control layer represents the entire technology foundation for security and risk management. It includes investments in existing security technologies that are aging and in need of lifecycle replacement as well as proposed investments in new security-based initiatives. Extending the Identity and Access Management framework to include control of Smart Grid devices is an example of the how PG&E is evolving technology control strategies.

These control families provide a baseline for risk measurement and inform controls implementation across people, process, and technology. The figure below provides an overview of the control families that drive risk mitigation within PG&E across the four utility defined "risk areas": Operational Control Systems, Market Systems, Customer Systems, and Employee and Corporate Systems.

Figure 2-1: PG&E's Cybersecurity Controls - Overview



2.13.2. Key Risks and Major Mitigation Focus Areas

The Smart Grid Deployment Plan outlined investments in various service areas and highlighted the need for investment in cross-cutting cybersecurity architecture to support the Smart Grid. PG&E has executed and continues to plan targeted improvements across the cybersecurity infrastructure to improve PG&E's risk posture. In Section 2.7, *Security (Physical and Cyber)*

Projects, of this report, PG&E provided an update on the ADAPT project and the IAM Initiatives, two important cybersecurity cross-cutting initiatives that enhance PG&E's control foundation.

PG&E is also pursuing ongoing security related improvements to both its IT network and its disaster recovery program. Through these investments, PG&E is increasing security in its IT network through improved network segmentation and visibility. Segmentation is an architectural approach that ensures different types of systems are logically or physically isolated from each other by applying technology control techniques in the network. The isolation reduces risk by minimizing the impact of an event to other systems should an adverse event occur. PG&E has also initiated several enhancements to its IT Disaster Recovery program to identify mission critical processes, infrastructure, business applications and Data Center services and to strengthen the operational resiliency and disaster response in these areas.

2.14. Updates to PG&E's Security Risk Assessment and Privacy Threat Assessment

PG&E is committed to protecting customer privacy by implementing policies, standards, and procedures in compliance with federal and state laws. A key privacy decision adopted by the CPUC in July, 2011, Decision 11 07 056, requires each California electric utility to conduct an independent audit of its data privacy and security practices in connection with its GRC proceedings. The ruling focuses on privacy and security protections for energy usage data and the Smart Grid in alignment with the Fair Information Practices Principles developed by the Federal Trade Commission and adopted by the Department of Homeland Security. The decision also aligns to the more general privacy provisions that the California Legislature promulgated in SB 1476.

In the first half of 2015, PG&E completed an assessment covering Customer Energy Usage Data (CEUD) that is accessed, collected, stored, used, and disclosed in accordance with the decision. KPMG LLP (KPMG) was engaged to conduct the independent assessment of PG&E's CEUD privacy and security controls. The assessment covered a review of the management control framework in place to achieve compliance with the CPUC's decision.

In its June 15, 2015 report, KPMG recognized that PG&E "is supported by a mature Customer Privacy Program that has executive and management support, oversight, and visibility."

Specifically, KPMG found that (1) "PG&E has documented policies and procedures outlining the acceptable purposes for which Covered Information may be collected, stored, used, and shared," (2) "PG&E provides customers with multiple methods of accessing their Covered Information," (3) "PG&E has implemented the Data Minimization principle as a foundational component to its overall privacy framework," (4) "PG&E has internal third party management policies and informs third parties about data privacy requirements," and (5) "PG&E has established an Information Security Program and organization which is responsible for the design and implementation of both physical and logical information security controls to protect Covered Information."

KPMG's assessment made six "Observations" reflecting potential improvements that PG&E could make to its existing security and privacy practices. None of these are "High-Risk," i.e., KPMG did not find any "[i]ssue [that] poses a significant risk of data breach of Covered Information and/or a significant deviation from the CPUC Privacy Decisions." Consistent with PG&E's continuous improvement efforts regarding the protection of CEUD, PG&E has initiated a work plan to address KPMG's observations, and remains committed to continuing to work with the CPUC, vendors, and most importantly, customers, to protect CEUD.

2.15. PG&E's Compliance with NERC Security Rules and Other Security Guidelines and Standards as Identified by NIST and Adopted by FERC

PG&E has developed and established formal standards that form the foundation for controls implementation and adherence. Examples of those standards include password management, user access management, information classification, information security, training, and privacy. PG&E's standards leverage industry best practice standards such as NIST. PG&E also participates in industry peer groups to understand changes in technology and regularly updates applicable standards. PG&E has implemented a user-friendly Guidance Document Management initiative in order to make standards more intuitive and easy to understand. This helps improve compliance with both the spirit and intent of the guidance.

PG&E's RMF described previously enables compliance with multiple state and federal regulations and is aligned to leading industry practices and standards including the following:

- NERC Critical Infrastructure Protection (NERC CIP)
    - PG&E has developed nine standards that align with the CIP standards for protection of our critical infrastructure. In addition, PG&E participates on committees with industry peers to monitor changes to the CIP standards and implements the changes required.
- Industry Guidelines
    - The NISTIR 7628 is a set of documents detailing guidelines and controls for Smart Grid cybersecurity. PG&E has taken a leadership role in developing the "NISTIR 7628 User's Guide", and the Guide was used to help inform PG&E's Smart Grid Pilot Deployment Application filing last year.
- Privacy
    - CPUC Privacy Decision 11-07-056
    - California SB 1476
    - California SB 1386
- SCADA System Security
    - International Electro Technical Commission 62351
- Others
    - International Organization for Standardization/IEC 27000 Series
    - Federal Communication Commission Regulations
    - Sarbanes Oxley
    - Health Insurance Portability and Accountability Act

PG&E participates in multiple forums to ensure that its control design is current, comprehensive and remains in alignment with the standards and industry groups mentioned above. A listing of the industry-related security forums that PG&E participates in is included in Figure 2-2 below.

Figure 2-2: PG&E's Security Industry Leadership and Engagement

#	Acronym	Organization	Function	Capacity / Role
1	AGA	American Gas Association	Cybersecurity Working Group	Member
2	BPC	Bipartisan Policy Center	Cybersecurity Task Force	Member
3	DHS	Department of Homeland Security	Dam Sector Coordinating Council	Member
4	DOE / NIST	Department of Energy	Electric Sector Risk Management Process	Advisor
5	DOE / White House	Department of Energy	Cybersecurity Capability Maturity Model	Advisor
6	DOE CEDS / Labs	Department of Energy Cybersecurity of Energy Delivery Systems	Supply Chain Integration For Integrity	Advisor
7	EEI	Edison Electric Institute	Cybersecurity Working Group	Member
8	EEI	Edison Electric Institute	Threat Scenario Project	Member
9	EEI	Edison Electric Institute	Business Continuity Working Group	Member
10	FBI	Federal Bureau of Investigations	Infraguard	Member
11	INGAA	Interstate Natural Gas Association of America	Cybersecurity Working Group	Member
12	JTTF	Joint Terrorism Task Force	Information Sharing and Industry Collaboration	Member
13	NASPI	North American SynchroPhasor Initiative	Initiative Working Group	Member
14	NBISE	National Board of Information Security Examiners	Smart Grid Cybersecurity Panel	Advisor
15	NCRIC	Northern California Regional Intelligence Center	Steering Committee	Member
16	NEI	Nuclear Energy Institute	Cybersecurity Task Force	Member
17	NERC	North American Reliability Corporation	Bulk Electric System Security Metric Working Group	Chair
18	NERC	North American Reliability Corporation	Critical Infrastructure Protection Committee (CIPC)	Voting Member
19	NESCO	National Electric Sector Cybersecurity Organization	Information Sharing and Industry Collaboration	Member
20	NIST	National Institute of Standards and Technology	Cybersecurity Working Group	Task Lead and Voting Member
21	OpenSG	Open Smart Grid	Security Working Group	Member
22	PSERC	Power Systems Engineering Research Center	Cyber Risk Modeling and Mitigation & Attack-Resilient Control Algorithms	Advisor
23	SunGard	SunGard	Resiliency Advisory Committee	Vice-Chair
24	Trans Forum	North American Transmission Forum	Security Practices Working Group	Member
25	UNITE	Investor Owned Utility Consortium	Security Directors Council	Member
26	WECC	Western Electricity Coordinating Council	Critical Infrastructure and Information Management Subcommittee	Member

2.16. Key Risks Conclusion

PG&E continues to improve upon its ability to measure, manage, communicate, and mitigate potential cybersecurity, privacy, and technology risks that could impact the systems that PG&E depends on to deliver safe and reliable electric and gas services to its customers. PG&E’s RMF enhances PG&E’s technology-focused capabilities and creates more holistic risk management and compliance practices. Risk measurement procedures and risk controls enable PG&E to establish an objective risk baseline, develop target risk thresholds, and chart a clearly prioritized and efficient investment plan for mitigating risks.

PG&E’s risk management approach is focused on ensuring that risks are well understood at all levels of the Company and that there is executive support for mitigating and managing operational risks, physical security risks as well as cyber security risk. PG&E's IT risk management efforts are focused on continuous improvement to effectively predict and proactively manage risk by integrating risk management strategies, plans and practices into everyday business activities.

CHAPTER 3

SMART GRID METRICS

3. Smart Grid Metrics and Goals

In this section, PG&E provides an update on the nineteen consensus Smart Grid metrics approved by the Commission in Decision 12-04-025. PG&E continues to support the Commission's position that these consensus metrics will provide parties and the Commission with information that will allow for better understanding of PG&E's Smart Grid investments and provide the foundation for moving forward with Smart Grid investments.

3.1. Customer/Advanced Metering Infrastructure Metrics

Metric 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.

Number of PG&E Advanced Meter Malfunctions Where Customer Electric Service is Disrupted; Percentage of Total Installed Advanced Meters	
Metric	Value
Number of Meter Malfunctions	220 meters
Percentage of Total Meters	0.00422%
Note: Reporting date: July 1, 2014 through June 30, 2015.	

Metric 2: Load impact in MW of peak load reduction from the summer peak and from winter peak due to smart grid-enabled, utility administered DR programs (in total and by customer class).

Load Impact in MW of Peak Load Reduction from the Summer Peak and from Winter Peak Due to Smart Grid-enabled, Utility Administered Demand Response (DR) Programs	
Metric	Value
From the Summer Peak (May – October 2014:	
Residential	0 MW
Non-Residential < 200 kW	0 MW
Non-Residential ≥ 200 kW	32 MW
Other (Agricultural)	9 MW
Total	41 MW
From the Winter Peak (November 2014 – April 2015):	
Residential	0 MW
Non-Residential < 200 kW	0 MW

Non-Residential ≥ 200 kW	0 MW
Other (Agricultural)	0 MW
Total	0 MW
Note: Includes load reduction from demand response programs and time-varying rates that is enabled by automated technologies.	

Metric 3: Percentage of DR enabled by AutoDR in each individual DR impact program.

Percentage of PG&E Demand Response Enabled by AutoDR in Each Individual DR Impact Program (2014	
Metric	Value
Percentage of DR enabled by AutoDR – Demand Bidding Program (DBP)	7%
Percentage of DR enabled by AutoDR – Peak Day Pricing (PDP) program	1%
Percentage of DR enabled by AutoDR – Capacity Bidding Program (CBP)	1%
Percentage of DR enabled by AutoDR – Aggregator Managed Portfolio (AMP)	4%
Note: Percentage represents the Verified kW load reductions (engineering analysis) available for Demand Response programs in 2014, divided by total Demand Response portfolio kW, with the resulting number multiplied by 100.	

Metric 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, California Alternate Rates for Energy (CARE) status, and climate zone).

Number and Percentage of PG&E Owned Advanced Meters with Consumer Devices with HAN or Comparable Consumer Energy Monitoring or Measurement Devices Registered with PG&E		
Metric	Number	Percentage
Residential	3011	<1%
Non-Residential < 200 kW	51	<1%
Non-Residential ≥ 200 kW	0	0%
Other	0	0%
Total	3066	<1%
CARE	0	0%
Non-CARE	3066	<1%
Total (CARE and Non-CARE)	3066	<1%
Climate Zone P	52	<1%

Climate Zone Q	16	<1%
Climate Zone R	70	<1%
Climate Zone S	201	<1%
Climate Zone T	793	<1%
Climate Zone V	17	<1%
Climate Zone W	25	<1%
Climate Zone X	1882	<1%
Climate Zone Y	7	<1%
Climate Zone Z	3	0%
Total by Climate Zone	3066	<1%
Note: Percentage is defined as the number of advanced meters with consumer devices with HAN or comparable consumer energy devices registered with the utility divided by the number of advanced meters installed for the group of concern, with the resulting number multiplied by 100.		

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

Number and Percentage of Customers on a Time-Variant or Dynamic Pricing Tariff		
Metric	Number	Percentage
Residential	281,236	6%
Non-Residential < 200 kW	472,204	78%
Non-Residential ≥ 200 kW	7,890	1%
Other	0	0%
Total	761,330	14%
CARE	34,154	1%
Non-CARE	727,176	14%
Total (CARE and Non-CARE)	761,330	14%
Climate Zone P	23,541	13%
Climate Zone Q	679	18%
Climate Zone R	89,148	15%
Climate Zone S	115,531	13%
Climate Zone T	114,582	9%
Climate Zone V	7,536	13%
Climate Zone W	42,029	15%
Climate Zone X	203,823	10%
Climate Zone Y	6,936	11%

Climate Zone Z	468	7%
Total by Climate Zone	604,273	11%
Note: Percentage is defined as the number of customers that are on a time-variant or dynamic pricing tariff divided by the number of customers in the group of concern, with the resulting number multiplied by 100.		

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

Number and Percentage of Escalated PG&E Customer Complaints Related to (a) Accuracy, Functioning or Installation of Advanced Meters, or (b) Functioning of a PG&E-administered Home Area Network with Registered Consumer Devices		
Metric	Number	Percentage
Escalated customer complaints related to the accuracy, functioning or installation of advanced meters	7	.6%
Escalated customer complaints related to the functioning of a PG&E-administered HAN with registered consumer devices	0	0%
Note: Percentage is defined as the number of escalated complaints related to (1) the accuracy, functioning, or installation of advanced meters or (2) the functioning of a utility-administered Home Area Network with registered consumer devices divided by the number of escalated complaints in total, with the resulting number multiplied by 100.		

Metric 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.

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	Number	Percentage
Advanced meters replaced	17,703	0.34%
Explanation for the replacements: These advanced electric meters were replaced due to a malfunction before the end of their expected useful life (e.g., damaged meter, etc.).		
Note: Percentage is defined as the number of advanced meters replaced before the end of their expected useful life during the course of one year, reported annually, divided by the number of advanced meters installed, with that resulting number multiplied by 100.		

Metric 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 the Commission-mandated accuracy bands.

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 Advance Meters Tested Measuring Usage Outside the Commission-mandated Accuracy Bands		
Metric	Number	Percentage
Advanced meters field tested at the request of customers	2,975	0.06%
Advance meters tested measuring usage outside the Commission-mandated accuracy bands	25	0.84%
Note: Percentage is defined as the number of advanced meters field tested divided by the number of advanced meters installed, with that resulting number multiplied by 100.		

Metric 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.

Number and Percentage of Customers Using a PG&E Web-based Portal to Access Energy Usage Information or to Enroll in PG&E Energy Information Programs or Who Have Authorized PG&E to Provide a Third-Party with Energy Usage Data		
Metric	Number	Percentage
Customers using a PG&E web-based portal to access energy usage information [A]	2,334,402	44%
Customers using a PG&E web-based portal to enroll in PG&E energy information programs	129,908	2%
Customers who have authorized PG&E to provide a third-party with energy usage data	70,448	1%
[A] This number represents the unique number of customers who have clicked on the "My Usage" tab within My Energy at least one time during the reporting period (July 1, 2014 through June 30, 2015).		

3.2. Plug-in Electric Vehicle Metric

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

Number of PG&E Customers Enrolled in a Time-Variant Electric Vehicle Tariffs	
Metric	Value
Number of E-9A Customers	3,424 customers
Number of E-9B Customers	210 customers
Number of EV-A Customers	16,899 customers
Number of EV-B Customers	104 customers
Note: Utilities currently have limited ability to determine which customers have electric vehicles. As methods for acquiring this information are determined in that proceeding, this metric should be updated. Metrics related to metering arrangements should be deferred until after PEV metering policy is set in Alternative Fueled Vehicles OIR (R.09-08-009).	

3.3. Energy Storage Metric

Metric 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. The measure is for January 1, 2014 through December 31, 2014. Data is unavailable for any other time frame.

MW and MWh of PG&E-Owned or Operated Energy Storage Interconnected at the Transmission or Distribution System Level	
Metric	Value
Energy Storage interconnected at the transmission system level	1,212 MW
	599,072 MWh
Energy Storage interconnected at the distribution system level	6 MW
	42 MWh
Note: As highlighted in this Smart Grid Project Update, a 2 MW / 14 MWh battery storage system was commissioned at a PG&E substation near Vacaville in August 2012 and a 4 MW / 28 MWh battery storage system on a distribution circuit in San Jose California in May 2013.	

3.4. Grid Operations Metrics

Metric 1: The system-wide total number of minutes per year of sustained outage per customer served as reflected by the System Average Interruption Duration Index (SAIDI) Major Events Included and Excluded for each year starting on July 1, 2014 through June 30, 2015. There were no major events in this time period.

PG&E's System Average Interruption Duration Index (SAIDI), Major Events Included and Excluded	
Metric	Value
SAIDI – Major Events Included	177.5
SAIDI – Major Events Excluded	102

Metric 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, 2014 through June 30, 2015. There were no major events in this time period.

PG&E's System Average Interruption Frequency Index (SAIFI) Major Events Included and Excluded	
Metric	Value
SAIFI – Major Events Included	1.164
SAIFI – Major Events Excluded	0.889

Metric 3: The number of momentary outages per customer system-wide per year as reflected by the Momentary Average Interruption Frequency Index (MAIFI), Major Events Included and Excluded for each year starting on July 1, 2014 through June 30, 2015. There were no major events in this time period.

PG&E's Momentary Average Interruption Frequency Index (MAIFI) Major Events Included/Major Events Excluded	
Metric	Value
MAIFI – Major Events Included	1.710
MAIFI – Major Events Excluded	1.404

Metric 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, 2014 through June 30, 2015.

Metric 4: Number and Percentage of PG&E's Customers per Year and Circuits per Year Experiencing Greater Than 12 Sustained Outages per Year		
Metric	Number	Percentage
Customers experiencing greater than 12 sustained outages per year	799	0.0148%
Circuits experiencing greater than 12 sustained outages per year	10	0.333%
Note: (Percentage of customers experiencing greater than 12 sustained outages per year equals [(the number of customers experiencing greater than 12 sustained outages in a year) divided by (the total number of customers)] with the resulting number multiplied by 100. Percentage of circuits experiencing greater than 12 sustained outages per year equals (the number of circuits experiencing greater than 12 sustained outages in a year)		

Metric 5: System load factor and load factor by customer class for each year starting on January 1, 2014 through December 31, 2014. Data is unavailable for any other time frame.

PG&E's Load Factors	
Metric	Value
System Load Factor	61.31%
Residential Load Factor	40.94%
Non-Residential < 200 kW Load Factor	Small L&P: 53.71% Medium L&P: 51.52%
Non-Residential ≥ 200 kW Load Factor	Large L&P: 60.45%
Other (agriculture) Load Factor	55.35%
Note: Until advanced meters are fully deployed for residential, small commercial and industrial, and small agriculture customers, load factors will be calculated using estimates, rather than measured directly.	

Metric 6: Number of and total nameplate capacity of customer-owned or operated, grid-connected distributed generation facilities. The data are cumulative through June 30, 2015.

Number and Total Nameplate Capacity of PG&E's Customer-owned or operated Grid connected Distributed Generation Facilities		
Metric	Number of facilities	Capacity (MW)
Distributed generation facilities (solar PV)	181,497	1,592
Distributed generation facilities (non-solar)	915	748
Distributed generation facilities (solar PV and non-solar)	182,412	2,340
Note: Information and estimates about production of distributed generation facilities that serve on-site customer load is produced annually by the CEC in their California Energy Demand Forecast. D.12-04-025 defines Distributed Generation as "Customer-owned or operated generating systems that are enrolled with a utility in the Self Generation Incentive Program (SGIP) or the California Solar Initiative (CSI) or otherwise operating under a Feed In Tariff (FIT)". Significant customer-side Distributed Generation capacity has been interconnected outside of the CSI and SGIP programs. Therefore, data includes all NEM and non-export Rule 21 interconnected facilities. For Rule 21 facilities, capacity for solar generating facilities is reported as the PV CEC-AC rating, while for non-solar facilities, capacity is reported as the maximum inverter capacity. Please note that in last year's annual report, PV capacity was reported as the maximum inverter capacity of the system.		

Metric 7: Total electricity deliveries from customer-owned or operated, grid-connected distributed generation facilities, reported by month and by ISO sub-Load Aggregation Point. This information is for July 1, 2014 through June 30, 2015.

Total Electricity Deliveries from PG&E's Customer-owned or Operated Grid-connected Distributed Generation Facilities		
Metric	Deliveries from Feed in Tariff (FIT) Projects (GWh)	Excess Generation from Net Surplus Compensation (NSC) Customers* (GWh)
July-2014	11.5	-0.2
August-2014	11.4	-0.8
September-2014	10.2	-0.5
October-2014	8.5	-2.6
November-2014	6.2	-1.9
December-2014	7.5	-7.1
January-2015	7.3	-2.1
February-2015	8.8	-2.0

March-2015	10.4	-3.3
April-2015	12.0	-2.8
May-2015	14.2	-5.2
June-2015	15.3	-8.2
Total July 1, 2014 to June 30, 2015	123.2	**-36.8**
By Sub-LAP		
CAISO Sub-LAP_PGCC-APND	6.2	-0.9
CAISO Sub-LAP_PGEB-APND	2.6	-4.1
CAISO Sub-LAP_PGF1-APND	19.4	-4.3
CAISO Sub-LAP_PGFG-APND	4.0	-1.5
CAISO Sub-LAP_PGHB-APND	2.5	-0.1
CAISO Sub-LAP_PGLP-APND	29.5	-2.3
CAISO Sub-LAP_PGNB-APND	0.2	-0.9
CAISO Sub-LAP_PGNC-APND	2.9	-3.6
CAISO Sub-LAP_PGNV-APND	25.6	-1.5
CAISO Sub-LAP_PGP2-APND	0.1	-0.8
CAISO Sub-LAP_PGSA-APND	8.2	-9.3
CAISO Sub-LAP_PGSB-APND	0.0	-3.9
CAISO Sub-LAP_PGSF-APND	0.0	-0.6
CAISO Sub-LAP_PGSI-APND	10.1	-1.2
CAISO Sub-LAP_PGSN-APND	0.0	-0.1
CAISO Sub-LAP_PGST-APND	11.9	-1.4
Total	123.2	**-36.5**

Note: Information and estimates about production of distributed generation facilities that serve on-site customer load is produced annually by the CEC in their California Energy Demand Forecast.

*Excess generation from Net Surplus Compensation (NSC) customers is based on the annual true-up date on which the customer is compensated.

Metric 8: Number and percentage of distribution circuits equipped with automation or remote control equipment, including SCADA systems. The measure is for July 1, 2014 through June 30, 2015.

Number and Percentage of PG&E's Distribution Circuits Equipped with Automation or Remote Control Equipment, Including SCADA		
Metric	Number	Percentage
PG&E distribution circuits equipped with automation or remote control equipment, including SCADA	2,188	67.1%
Note: Percentage of distribution circuits equipped with automation or remote control equipment equals the number of distribution circuits equipped with automation or remote control equipment) divided by the total number of distribution circuits with the resulting number multiplied by 100.		

CHAPTER 4

CONCLUSION

4. Conclusion

As growth in DERs continues, PG&E is confident that continued focus on Smart Grid investments and piloting new technologies will build the platform for a new energy landscape, one filled with customer choice and more clean, renewable, and distributed energy.

In the last year, PG&E continued its commitment to reliability by continuing to invest in intelligent switch technology. Additionally, PG&E introduced its Grid of Things™ Vision, which envisions integrating new energy devices and technologies to the grid and allows their owners to achieve greater value from their energy technology investments. Through various programs, such as the Smart Grid Pilot Program and EPIC, PG&E is making progress in integrating distributed energy resources, enhancing decision making, automating complex tasks, and enhancing customer interactions. These capabilities will enable the Grid of Things™ vision while PG&E continues maintaining a safe and reliable grid.

Customers continue seeing benefits from previous investments as well as from incremental benefits each year. Last year, customers enjoyed an estimated $79.1 million in benefits, inclusive of several key programs such as Cornerstone and the Smart Meter deployment. This year, PG&E accrued an additional $19.6 million in benefits associated with its smart grid projects.

Lastly, PG&E maintains a strong commitment to supplier diversity and continues to focus on exceeding the Commission's supplier diversity goals set forth in General Order 156. PG&E intends to continue its successful track record and will review strategies related to its Smart Grid Pilot Projects, which were approved by the Commission in Decision 13-03-032.

CHAPTER 5

APPENDIX

PACIFIC GAS AND ELECTRIC COMPANY

2015 Annual Smart Grid Report

Recorded Smart Grid Project Costs from July 1, 2014 through June 30, 2015

Project Name	Recorded Amount
Customer Engagement and Empowerment Projects	
Supply-side DR Pilot (Continuation of IRM Pilot Phase 2)	$2.4 Million
Demand Response Transmission & Distribution (T&D) System Integration	$0.69 Million
AC Cycling Next Generation Technology Assessment	$0.22 Million
Demand Response Plug-In Electric Vehicle (DR PEV) Pilot	$1.5Million
Energy Diagnostics and Management	$9.75 Million
Energy Alerts	$0.1 Million
Share My Data (Customer Data Access) Project	$6.2 Million
Energy Data Access	$0.4 Million
Home Area Network (HAN) Demand Response (DR) Integration Pilot Project	$3.47 Million
Time Varying Rates (TVR)	$12.5 Million
Automated Demand Response (AUTO-DR) Program	$6 Million
Opower/Honeywell Smart Thermostat Assessment Pilot	$1.11 Million
Smart Thermostat Study	$1.3 Million
Distribution Automation and Reliability Projects	
Distribution Substation Supervisory Control and Data Acquisition (SCADA) Program	$142.4 Million[5]
Distribution Management System (DMS) Project	$1.0 Million
Sodium Sulfur (NaS) Battery Energy Storage System (BESS) Demonstration Projects	$0.2 Million
Smart Grid Fault Location, Isolation, and Service Restoration (FLISR)	$11.3 Million
Install Smart Grid Line Sensors Pilot	$4.2 Million
Voltage and Reactive Power (Volt/Var) Optimization System Pilot	$11.86 Million
Detect and Locate Faulted Circuit Conditions Pilot	$2.72 Million
Transmission Automation and Reliability Projects	
Compressed Air Energy Storage (CAES) Demonstration Project	$19.6 Million
Transmission Substation SCADA Program	$108 Million[6]
Modular Protection Automation and Control (MPAC) Installation Program	$312 Million[7]
Synchrophasor Project Realization	$2.31 Million
Asset Management and Operational Efficiency Projects	
Condition-Based Maintenance (CBM) – Distribution Network Project Release	$1.7 Million

5 Cost since project inception.

6 Cost since project inception.

7 Cost since project inception.

SmartMeter™ Outage Management Integration Project	$0.15 Million
Electric Distribution Geographic Information System and Asset Management Project	$122.4 Million
Network Supervisory Control and Data Acquisition (SCADA) Monitoring Project	$8.4 Million[8]
Smart Grid Short Term Demand Forecasting Pilot Project	$2.09 Million
Security (Physical and Cyber) Projects	
Identity and Access Management Project	$7.27 Million
Integrated and Cross-cutting Systems Projects	
Telecommunications Architecture	$10.5 Million
Information Management Architecture	$3.3 Million
California Energy Systems for the 21st Century (CES-21) Program	$0.6 Million
Electric Program Investment Charge (EPIC) Program	$13.2 Million

[8] Cost recorded in 2014.

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Closed Smart Grid Projects

Project Name	Completion Date
Customer Engagement and Empowerment Projects	
Intermittent Renewable Resource Management (IRRM) Pilot Phase 1 In the IRRM Pilot Phase 1, PG&E leveraged work performed under the Commercial and Industrial (C&I) DR Participating Load Pilot to provide regulation services to the CAISO. The objective of the IRRM Pilot Phase 1 was to demonstrate whether customers can provide second by second frequency-regulation service needs to the CAISO.	2011
Proxy Demand Resources (PDR) Program Phase 1 As part of the Commission's vision of integrating retail-wholesale DR programs, in the PDR Program Phase 1, PG&E is in the process of enabling its retail DR programs to directly participate in the CAISO's wholesale market – PDR product. Phase 1 of this project was focused on assembling the proper tools (i.e., telemetry, forecasting) and integrating interfaces (procurement back-end systems to schedule, notify and settle) that PG&E needs to operate when bidding available DR resources in the CAISO market.	2013
Plug-in Hybrid Electric Vehicle/Electric Vehicle (PHEV/EV) Smart Charging Pilot In the PHEV/EV Smart Charging Pilot, PG&E and the Electric Power Research Institute (EPRI) tested baseline functionalities of PEV charging hardware by conducting an end-to-end system connectivity to evaluate potential residential smart charging capabilities utilizing the load management software over the SmartMeter™ network.	December 2011
SmartMeter™ Program PG&E's SmartMeter™ Program launched the deployment of foundational technology to help PG&E's customers understand how and when they use energy, including through automated home energy management. The SmartMeter™ system improved infrastructure integrity, helped PG&E manage energy demand, and also enabled PG&E to provide more reliable service. Through these broad system-wide enhancements, the SmartMeter™ Program has served the vital foundational step to enable creation of the Smart Grid, which in turn fosters a clean energy economy and sustainable economic expansion.	December 2013
The Green Button Initiative In PG&E's Green Button Initiative, the Green Button tool provides customers with a means of easily accessing and downloading their energy use online in a standardized format that can be shared with energy service providers.	October 2012
Green Button Connect (GBC) Beta Green Button Connect is a software interface that allows PG&E customers to easily share their SmartMeter™ enabled energy usage data with other energy service providers. These developers can then "mash up" the data in unique ways to provide valuable insights to customers. Green Button Connect was retired when PG&E launched its Share My Data platform.	March 2015
Energy and Carbon Management System (ECMS) In the ECMS, PG&E has developed tools specifically for PG&E's large Commercial and Industrial (C&I) customer account representatives to identify opportunity customers and enable a consultative energy discussion with those customers using advanced usage analytics and financial metrics for proposed energy efficiency projects.	December 2013
My Energy Web Tools PG&E's customer website – My Energy – allows residential, small and medium business, and small agricultural customers to view usage, price and cost, and take advantage of various rate analysis tools. The usage information is displayed in a variety of formats including year to year comparison, peak/off peak, hourly and 15 minute interval data (depending on the granularity of the SmartMeter™ data), bill to date and monthly bill forecast. The "My Energy" website will	November 2012

also include a rate calculator which will calculate the customer bill under a variety of available rate plans.	
Universal Audit Tools (UAT) PG&E provides the Home Energy Checkup and Business Energy Checkup (also known as Universal Audit Tools) for residential and small and medium business customers through My Energy. These tools utilize SmartMeter™ data along with other customer insights to make it easy for our customers to find energy savings ideas that are particular to how they use energy. The tools are progressive in nature, continually learning based on the information the customer provides, and include recommendations across energy efficiency, demand response, distributed generation, and behavioral changes.	September 2012
HAN Enablement Program – Phase 1 & Phase 2 PG&E's HAN Enablement program is an infrastructure that allows customers to register and commission a standards compliant device with PG&E's AMI network to receive near real-time data from their SmartMeter™. In HAN Phase 1 (Initial Deployment), which ran from March 1, 2012 through April 30, 2013, PG&E installed and supported 430 in home displays (IHDs) with residential customers. Starting in January 2013, PG&E launched HAN as a platform, making the capability to register a device and received near real time usage information from a customer's electric SmartMeter™ available to all eligible customers across its service territory.	April 2013 and February 2014
Distribution Automation and Reliability Projects	
Cornerstone Improvement Project – Feeder Automation The Cornerstone Improvement Project includes the installation of distribution feeder fault locating, isolation and service restoration (FLISR) systems on select urban and suburban circuits. The project is expected to result in reliability improvements for PG&E customers. The Feeder Automation component of Cornerstone Improvement Project involves implementing feeder automation on approximately 400 distribution circuits. The project scope includes automating mainline protection equipment utilizing FLISR schemes to restore unaffected customers within five minutes.	December 2013
Transmission Automation and Reliability Projects	
Regional Synchrophasor Investment Project As part of this project, PG&E installed or upgraded Synchrophasor technology, also known as Phasor Measurement Units (PMU), throughout its service territory, has networked them together, and provided the data in a secured interface to PG&E's electric transmission operators, WECC, neighboring utilities, and the CAISO. The data exchange portion of the project includes positioning PG&E to share data with WECC. Nine other partner entities can coordinate and exchange data amongst partner entities, including PG&E.	May 2014
Asset Management and Operational Efficiency Projects	
Transformer Load Management Project The SmartMeter™ Transformer Loading Management project enables T&D electric planning engineers and estimators to access actual customer usage data from SmartMeter™ for analysis in equipment sizing and voltage analysis. The solution will enable PG&E to report transformer (or multiple transformers) load based on interval usage data and the ability to drill down to month, week, day, and Service Point level to see the peak usage. The solution will also identify transformer (or multiple transformers) by load category (over loaded, under loaded) over the entire SmartMeter™ population.	June 2012
Condition-Based Maintenance (CBM) – Substation Project The Condition Based Maintenance (CBM) Substation Project was a PG&E initiative to convert substation inspections collected on paper to a centralized electronic form. Centralizing the data aids in identifying problematic substation assets based on inspected condition trends in a predictive manner. The CBM technology solution for substation provides the platform for equipment inspection readings, temperature, and other data points to provide equipment predictive maintenance. The solution will automate many of the manual processes that are used today including: (1) review of station inspection and test data to identify abnormal conditions; (2) update maintenance trigger plans from oil condition assessment results, counter readings, etc.; and (3) equipment ranking for replacement decisions. The tool is also designed to provide easy access to inspection and test data to asset strategy and engineering personnel that do not have it readily available today. The data will be used to adjust maintenance triggers	February 2013

and for capital investment strategy.	
Load Forecasting Automation Program The Load Forecasting Automation program will automate existing manual electric distribution system load forecasting to increase accuracy of the process and improve forecast documentation. Current and future SCADA data will be gathered and stored within the existing data historian system and will become an input to the new forecasting tool. Circuits with SCADA will provide hourly load data into the historian system and non SCADA circuits will provide a single monthly peak load from monthly substation inspections. Additionally, this project will replace analog bank demand meters with electronic recording meters.	October 2012
Security (Physical and Cyber) Projects	
Advanced Detection and Analysis of Persistent Threats (ADAPT) Cyber Security Project The ADAPT project is focused on increasing PG&E's ability to effectively anticipate, prevent, and respond to current and shifting cyber and physical threats by enhancing the following three control areas: a) Intelligence and threat management controls: Build specific "early-warning" controls that electronically collect, analyze, and correlate information on Utility targeting threats before they "approach" the Utility's logical perimeter. b) Advanced detective and preventative controls: Develop controls that "harden" the Utility's cyber security infrastructure with multiple layers of technology to filter, quarantine, and send alarms on questionable data. c) Adaptive response controls: Enhance incident monitoring, response, and investigation capabilities to quickly respond to potential security incidents.	May 2012
Integrated and Cross-Cutting Systems Projects	
Applied Technology Services (ATS) Distribution Test Yard (DTY) The DTY will serve as an electrical laboratory that includes simulated distribution capabilities for monitoring and evaluating various new distribution tools, equipment, and applications. It will include the necessary primary line equipment with isolated communications networks to allow safe and thorough testing without risking network security issues. This DTY is part of the overall ATS end to end test capability for distribution systems of the future.	September 2012
SmartMeter™ Operations Center (SMOC) The SMOC project implements telecommunication network operations management capabilities to support PG&E's SmartMeter™ network to handle growth in the number of deployed meters, effectively monitor the increased amount of data communications from the meters, bring new SmartMeter™-related customer services on-line efficiently, and enable timely customer response as well as proactive reliability and availability management. This scope includes designing and implementing a new SMOC for the day to day operations of the existing installed systems and ensure vendor production and operational commitments.	July 2012
Data Historian Foundation Project This project will implement enhanced data historian software for managing and analyzing operational data with select user groups in electric transmission, gas operations, power generation, and energy procurement. When deployed and integrated with other electric systems such as EMS and SCADA, the new data historian will serve as the central data archiving and analysis system for all-time series operational data. This solution enables PG&E operators, engineers, managers and executives to analyze, visualize, and share operational and business data in a manner that not only makes the most sense to them, but also informs intelligent decision-making throughout the utility value chain. The benefits of this capability include productivity improvements, situational awareness, reliability improvements, and regulatory compliance. A separate project is required to enable these capabilities for electric distribution.	July 2014