BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

In the Matter of the Application of San Diego Gas & Electric Company (U 902 E) for Adoption of its Smart Grid Deployment Plan	Application 11-06-____ (Filed June 6, 2011)

SMART GRID DEPLOYMENT PLAN APPLICATION OF SAN DIEGO GAS & ELECTRIC COMPANY (U 902 E)

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June 06, 2011

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I. INTRODUCTION

Pursuant to Decision ("D.") 10-06-047[1/] and in accordance with the California Public Utilities Commission ("Commission") Rules of Practice and Procedure and Senate Bill (SB) 17 (Padilla),[2/] Chapter 327, Statutes of 2009, San Diego Gas & Electric Company ("SDG&E") hereby files this application ("Application") to submit its Smart Grid Deployment Plan ("SGDP") to the Commission.

II. BACKGROUND AND GENERAL DESCRIPTION

A. Background

In 2007, the federal government passed the Energy Independence and Security Act of 2007 (H.R. 6, 110th Congress, "EISA" or "Act), authorizing two programs aimed at modernizing the nation's electric grid through the application of Smart Grid technologies: the Smart Grid Investment Grant Program;[3/] and the Smart Grid Demonstration Program.[4/] In 2009, the federal

[1/] D.10-06-047, "*Decision Adopting Requirements for Smart Grid Deployment Plans Pursuant to Senate Bill 17 (Padilla), Chapter 327, Statutes of 2009*" (issued June 28, 2010). Available at: http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/119902.htm

[2/] The bill was sponsored by Senator Alex Padilla (D-Pacoima).

[3/] EISA, Title XIII, § 1306 as amended by American Recovery and Reinvestment Act of 2009 ("ARRA").

[4/] EISA, Title XIII, § 1304 as amended by ARRA.

government passed the American Recovery and Reinvestment Act of 2009 (ARRA), appropriating $4.5 billion to fund projects qualifying for the two Smart Grid Programs ffb modernize the electric grid.┘[5] ARRA also amended several EISA provisions pertaining to the Smart Grid.[6]

By the time of Barack Obama|s inauguration in January 2009, the goal of an 80 percent emissions reduction by 2050 quickly became the basis for landmark carbon policy as America stepped out of the shadows to take a world leadership role on climate change. America|s present carbon policy has started to fundamentally change the country|s relationship with energy, and in the process it will also reshape the geopolitical energy map. The missing link to enable these changes is the evolution from an antiquated electricity system to a smart grid. The century-old power grid system design increasingly struggles to meet the demands of the modern-day electricity market. The added scale of vehicle electrification and the advanced metering functions it requires, such as dynamic pricing, cannot be addressed by the legacy infrastructure alone. Nor can the influx of renewable energy from state and national renewable portfolio standards be accommodated. A contemporary smart grid infrastructure is being pioneered as a reinvestment strategy that will be more flexible, while accommodating distributed energy sources such as rooftop photovoltaic panels, plug-in hybrid vehicles and backup generators. The smart grid will allow grid managers to shift power provided in one place to power needed in another place, while effectively managing demand and capacity.

This Commission has already recognized that incorporating new communication and information technologies into the electric grid can reduce greenhouse gas emissions, increase energy efficiency and demand response, expand the use of renewable energy, and improve

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[5] The American Recovery and Reinvestment Act of 2009, Pub. L. 111-5 (H.R. 1), 123 Stat. 115 at Division A, Title IV, Sec. 408 redesignated PURPA § 111(d)(16) as § 111(d)(18).
[6] *Id.* at Division A, Title IV.

reliability, all important state energy goals pursuant to the “Loading Order.”[7] The overall purpose of federal Smart Grid planning and investment programs is to accelerate the modernization of the nation's electric transmission and distribution systems and promote investments in smart grid technologies, tools, and techniques which increase flexibility, functionality, interoperability, cyber-security, situational awareness, and operational efficiency. The ARRA also provides funds to states in order to strengthen and expand government energy assurance planning for new energy portfolios and Smart Grid applications and to build in-house state and local government energy assurance expertise. The federal purpose focuses on building regional energy assurance capability to help states to better coordinate and communicate with one another on energy security, reliability, and emergency response issues. These ARRA Smart Grid Investment Programs create a unique opportunity for California to expand and accelerate its activities to modernize the state's electric infrastructure, using some federal dollars.

A key piece of smart grid infrastructure is smart or advanced technology which could take on grid balancing functions, while minimizing distribution losses, allowing each electrical corporation to manage the electric grid more efficiently, reliably and securely while reducing greenhouse gas emissions. Smart grid technology also empowers consumers with real-time information so they can better conserve energy and save money.

On October 11, 2009, SB 17 was signed into law by former California Governor Arnold Schwarzenegger.[8] The bill states that it is the policy of California to “modernize the state's electrical transmission and distribution system to maintain safe, reliable, efficient, and secure electrical service, with infrastructure that can meet future growth in demand.” The bill advances

[7] The “Loading Order” is a concept developed in the 2003 Energy Action Plan adopted by the Commission and the California Energy Commission (CEC) and sets an order for the use of energy resources that consists of (1) energy efficiency, (2) demand response, (3) renewable energy, and, if necessary, (4) clean traditional power generation.
[8] Chapter 327, Statutes of 2009.

California's clean energy policies by improving reliability and efficiency in power distribution through the deployment of smart grid technology. SB 17 establishes deployment of smart grid technology as the policy of the state. It calls on the California Public Utilities Commission, by July 1, 2010, and in consultation with the State Energy Resources Conservation and Development Commission (Energy Commission), the Independent System Operator (ISO), and other key stakeholders, to determine the requirements for a smart grid deployment plan consistent with the policies set forth in the bill and federal law. The bill also requires investor-owned utilities, by July 1, 2011, to develop smart grid deployment plans.

This Commission initiated Order Instituting Rulemaking ("Rulemaking") 08-12-009 to consider setting policies, standards and protocols to guide the development of a smart grid system and authorizing certain expenditures pertaining to the Smart Grid. On June 28, 2010, the Commission further issued D.10-06-047, dated June 24, 2010, in Rulemaking 08-12-009, which ordered that "Pacific Gas and Electric Company, Southern California Edison Company and SDG&E each shall file an application no later than July 1, 2011 submitting its Smart Grid Deployment Plan, consistent with Senate Bill 17 (Padilla), Chapter 327, Statutes of 2009, and the requirements in this decision."[9/]

B. General Description

Pursuant to SB 17, D.10-06-047 requires that IOUs follow a common outline in preparing their Smart Grid Deployment Plans.[10/] The outline consists of eight topics as follows:

1. Smart Grid Vision Statement;
2. Deployment Baseline;
3. Smart Grid Strategy;

[9/] D.10-06-047, at p. 138, Order 1.

[10/] This description provides a general outline of the topics included in the SGDP. A more detailed summary of the SGDP topic areas is provided in Attachment A of this Application.

4. Grid Security and Cyber Security Strategy;
5. Smart Grid Roadmap;
6. Cost Estimates;
7. Benefits Estimates; and
8. Metrics.

In addition, the decision sets requirements for each of these sections concerning the topics that the SGDPs must address, the information that the deployment plans must provide, and how the deployment plans must link each section and topic back to the policies set forth in SB 17 and in relevant federal law.

III.
SUMMARY OF APPLICATION AND REQUEST

The deployment plan presented in this Application arose from D.10-06-047, dated June 24, 2010, adopting certain requirements for Smart Grid Deployment Plans, which orders, among other things, that SDG&E shall file an Application to submit its deployment plan addressing how the grid can achieve the policies contained in SB 17. These policies include: Be self-healing and resilient; Empower consumers to actively participate in the operations of the grid; Resist attack; Provide higher quality of power and avoid outages; Accommodate all generation and energy storage options; Enable electricity markets to flourish; Run the grid more efficiently; Enable penetration of intermittent power generation sources; Create a platform for deployment of a wide range of energy technologies and management services; Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources; and Significantly reduce the total environmental footprint of the current electric generation and delivery system in

California.[11] The utility|s Application submitting its deployment plan must be filed with the CPUC no later than July 1, 2011.

As described in more detail in Attachment A to this Application, the SGDP represented in this Application is fully consistent with and responsive to the requirements outlined in D.10-06-047 and the policies contained in SB 17. The Commission|s directives as well as SDG&E|s demonstrated smart grid vision and strategy warrant the Commission|s approval of the proposed deployment plan that comprise this Application. The SDG&E SGDP advances the utility|s vision for a smart energy future while delivering new value to its customers, meeting its public policy requirements and delivering societal and economic benefits that exceed project costs.

SDG&E views the SGDP as an end-to-end transformation of its electric delivery system that applies advances in technology to deliver a range of new benefits to all stakeholders. The Smart Grid empowers customers, increases renewable generation, integrates Plug-in Electric Vehicles (PEVs) and reduces greenhouse gas (GHG) emissions while maintaining and improving system reliability, operational efficiency and ensuring security while protecting customer privacy. SDG&E anticipates that investments in Smart Grid infrastructure will yield additional benefits as the transformation progresses and its customers, policy makers and the industry are able to leverage lessons learned and achieve the Smart Grid|s full potential.

The SDG&E SGDP is not a static document. Consistent with its Smart Grid vision, SDG&E intends to continue engaging with stakeholders in order to align its Smart Grid strategy to their priorities. The utility also plans to update its roadmap as its customers, stakeholders, available technologies, and services evolve; adopt new security strategies as new threats or best practices emerge; and adjust its cost and benefit estimates as its pilot and deployment

[11] D.10-06-047, at p. 139, Order 3; *see also* SB 17, Chapter 327, Statutes of 2009.

experiences and new information bring greater certainty to anticipated inputs, timelines and outcomes.

IV.
RELIEF REQUESTED

SDG&E respectfully requests that the Commission issue a decision:

1. Finding SDG&E in compliance with SB 17, Chapter 327, Statutes of 2009, and the requirements of D.10-06-047;
2. Accepting this Smart Grid Deployment Plan as a policy guide for future investments;
3. Rendering such other Findings of Fact, Conclusions of Law, and issuing orders consistent with the foregoing request; and
4. Such other relief as is necessary and proper.

V.
STATUTORY AND PROCEDURAL REQUIREMENTS

A. Rule 2.1 (a) ff(c)

In accordance with Rule 2.1 (a) ff(c) of the Commission|s Rules of Practice and Procedure, SDG&E provides the following information.

1. Rule 2.1 (a) - Legal Name

SDG&E is a corporation organized and existing under the laws of the State of California. SDG&E is engaged in the business of providing electric service in a portion of Orange County and electric and gas service in San Diego County. SDG&E|s principal place of business is 8330 Century Park Court, San Diego, California 92123.

2. Rule 2.1 (b) - Correspondence

Correspondence or communications regarding this Application should be addressed to:

Hannon J. Rasool
Regulatory Case Administrator
San Diego Gas & Electric Company
8330 Century Park Court, CP32D
San Diego, California 92123
Telephone: (858) 654-1590
Facsimile: (858) 654-1788
HRasool@semprautilities.com

with a copy to:

Allen K. Trial
Attorney for:
San Diego Gas & Electric Company
101 Ash Street, HQ-12
San Diego, CA 92101-3017
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3. Rule 2.1 (c)

a. Proposed Category of Proceeding

In accordance with Rule 7.1, SDG&E requests that this Application be categorized as quasi-legislative. Because this proceeding is intended for adopting SDG&E|s SGDP pursuant to SB 17 and D.10-06-047 issued June 28, 2010 in proceeding number R.08-12-009, SDG&E proposes this proceeding be conducted under the rules applicable to the quasi-legislative category unless and until the Commission determines that the rules applicable to one of the other categories, or some hybrid of the rules, are best suited to the proceeding. As the Commission stated in D.10-06-047, ff[t]his decision is a result of Governor Arnold Schwarzenegger signing into law Senate Bill (SB) 17 (Padilla),[12] which became effective January 1, 2010. SB 17 directs the Commission ffb determine the requirements for a Smart Grid Deployment Plan consistent with the policies set forth in the bill and federal law┘ by July 1, 2010.┘[13] The Commission in D.10-06-047 further

[12] Chapter 327, Statutes of 2009.
[13] D.10-06-047, at p. 6.

“reject separate review of each utility’s deployment plan,” providing instead that “[w]hile each utility is required to file a separate application submitting its Smart Grid Deployment Plan, we expect to review the plans in a consolidated proceeding.”[14]

b. Need for Hearings

SDG&E does not believe that approval of this Application will require hearings. SDG&E has provided ample supporting information, analysis and documentation that provide the Commission with a sufficient record upon which to grant the relief requested on an *ex parte* basis. SDG&E, nevertheless, sets forth below a schedule that includes hearings, in the event hearings are deemed to be necessary.

c. Issues to be Considered

The issues to be considered are described in this Application and the accompanying exhibits.

d. Proposed Schedule

As noted above, SDG&E does not believe hearings will be necessary, but proposes alternate schedules to address either scenario:

PROPOSED SCHEDULE - NO HEARINGS	
ACTION	**DATE**
Application filed	June 6, 2011
Responses/Protests	July 6, 2011
Reply to Responses/Protests	July 18, 2011
Prehearing Conference (if necessary)	August 1, 2011

[14] D.10-06-047, at p. 89.

Scoping Memo Issued	August 15, 2011
Intervenor Testimony	September 15, 2011
Rebuttal Testimony	October 17, 2011
Concurrent Opening Briefs	November 15, 2011
Concurrent Reply Briefs	December 15, 2011
Proposed Decision	February 15, 2012
Comments on Proposed Decision	March 6, 2012
Reply Comments on Proposed Decision	March 13, 2012
Commission Decision Adopted	March 16, 2012 (or first meeting scheduled after February 9)

PROPOSED SCHEDULE ffiHEARINGS REQUIRED	
ACTION	**DATE**
Application filed	June 6, 2011
Responses/Protests	July 6, 2011
Reply to Responses/Protests	July 18, 2011
Prehearing Conference (if necessary)	August 1, 2011
Scoping Memo Issued	August 15, 2011
Intervenor Testimony	September 15, 2011
Rebuttal Testimony	October 17, 2011
Evidentiary Hearings	October 27-28, 2011
Concurrent Opening Briefs	November 23, 2011
Concurrent Reply Briefs	December 27, 2011
Proposed Decision	February 27, 2012

Comments on Proposed Decision	March 16, 2012
Reply Comments on Proposed Decision	March 21, 2012
Commission Decision Adopted	March 27, 2012 (or first meeting scheduled after February 9)

B. Rule 2.2 ffiArticles of Incorporation

A copy of SDG&E|s Restated Articles of Incorporation as last amended, presently in effect and certified by the California Secretary of State, was filed with the Commission on August 31, 2009 in connection with SDG&E's Application No. 09-08-019, and is incorporated herein by reference.

VI.
SERVICE

This is a new application. No service list has been established. Accordingly, SDG&E will serve this Application and related exhibits on parties to the service list for R.08-12-009 (Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission|s own Motion to Actively Guide Policy in California|s Development of a Smart Grid System), R.10-05-006 (Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans), and A.10-12-005 (General Rate Case Application of SDG&E). Hard copies will be sent by overnight mail to the Assigned Commissioner and Assigned Administrative Law Judge (ffiALJ┘) in R.08-12-009 and Chief ALJ Karen Clopton.

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///
///

VII.
CONCLUSION

WHEREFORE, SDG&E requests that the Commission grant SDG&E|s Application as described herein.

Respectfully submitted this 6th day of June 2011.

By: */s/ Allen K. Trial*
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By: */s/ Lee Schavrein*
Lee Schavrien
Senior Vice President - Financial, Regulatory and Legislative Affairs
SAN DIEGO GAS & ELECTRIC COMPANY

OFFICER VERIFICATION

I, Lee Schavrien, declare the following:

I am an officer of San Diego Gas & Electric Company and am authorized to make this verification on its behalf. I am informed and believe that the matters stated in the foregoing **SMART GRID DEPLOYMENT PLAN APPLICATION OF SAN DIEGO GAS & ELECTRIC COMPANY (U 902-E)** are true to my own knowledge, except as to matters which are therein stated on information and belief, and as to those matters, I believe them to be true.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed this 6th day of June 2011, at San Diego, California.

Lee Schavrien
San Diego Gas & Electric Company
Senior Vice President – Financial, Regulatory and Legislative Affairs

ATTACHMENT A

SDG&E Smart Grid Deployment Plan: 2011-2020

SDGE

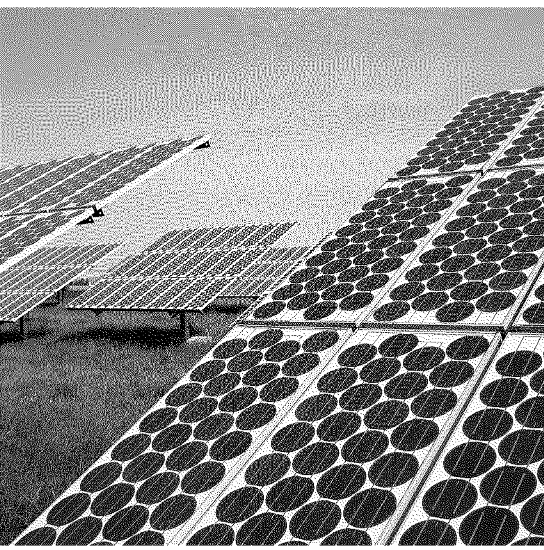
A Sempra Energy utility®

Proponent's Smart Grid Deployment Plan

for the

Smart Grid Deployment Plan Application Of

San Diego Gas & Electric Company (U 902 E)



A Sempra Energy utility®

Smart Grid Deployment Plan 2011-2020

June 6, 2011

Smart Grid OIR R.08-12-009

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mniggli@semprautilitiescom

June 6, 2011

Commissioner Michael R. Peevey, President
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

Dear President Peevey:

At SDG&E, we define the Smart Grid as an end to end transformation of our electric system that applies advances in technology to deliver a range of new benefits to all stakeholders. Our Smart Grid empowers customers, increases renewable generation, integrates plug in electric vehicles (PEVs) and reduces greenhouse gas emissions. We expect to do this while maintaining or improving system reliability and operational efficiency, and ensuring security while protecting customer privacy. We anticipate that investments in a smarter grid will yield substantive and as yet unidentified benefits as the transformation progresses and our customers, employees, policy makers and the industry are able to leverage lessons learned and achieve the Smart Grid's full potential.

There is one observation that is crystal clear: Our customers are driving our deployment plan.

- Over 13,000 of our customers have installed a total of over 100 megawatts of photovoltaics.
- Our customers are adopting PEVs at rates that are among the highest in the nation – 300 vehicles purchased and increasing by over 100 per month.
- Our customers are already leveraging real time information about their energy usage from third party software applications in order to make more informed decisions about how and when they use electricity.

- Our customers and SDG&E support environment friendly policies from the *California Global Warming Solutions Act* (AB 32) to a 33 percent renewable portfolio standard, to which we committed over two years prior to it being signed into law.

Our vision is to work collaboratively with key stakeholders to create the foundation for an innovative, connected and sustainable energy future. We have engaged the input of representative stakeholders from across our service territory and around the globe, including environmental, academic, business, municipal/regional government, ratepayer advocacy, consumer, large customer, and workforce development organizations. Their valuable insights have shaped our approach to the Smart Grid Deployment Plan. And we will continue to seek and incorporate their input as our plan develops.

Our connected grid will leverage technology advancements so that customers can manage their energy bills with minimal complexity and invested time. Products for the home such as appliances, air conditioners, plug in electric vehicles, electric generation, and products yet to be developed or not widely available, such as home energy storage, will automatically work in concert with a grid enabled by advanced technology to improve reliability, while integrating the increasing variability produced by an ever growing level of intermittent renewable generation.

The Smart Grid Deployment Plan was developed by SDG&E employees across the whole company, driving broad internal alignment around the exciting changes associated with the energy industry evolution. We are working with employees internally and partnering externally to ensure a Smart Grid ready workforce. Outreach to Diverse Business Enterprises is another key element in our Smart Grid supplier selection process to ensure SDG&E continues to exceed state targets for supplier diversity.

SDG&E's Smart Grid activities over the past two decades have developed a baseline that is the foundation for the utility of the future. From automation and control technologies, to re engineering operational processes, micro grids, our nearly complete Smart Meter program, advanced sensing technologies and many others; our investments are already benefiting our customers by improving safety, reliability, and efficiency. SDG&E's choice of open standards, where cost effective, available, and applicable allows the flexibility to incorporate new technologies, respond to evolving and new policy requirements and capture new benefits as opportunities arise.

Reliable electric service to customers is a key driver for SDG&E as evidenced by having been named "most reliable utility in the west" for the last five years and the honor of best reliability excellence in the nation for 2009. Our Smart Grid investments are intended to maintain or improve reliability as the grid is challenged by the two way energy flow from distributed generation; the intermittent power generation of solar and wind generators; and the large, mobile and growing load imposed by electric vehicle charging. Ultimately, the Smart Grid will also enable a significant reduction in the environmental footprint of electricity generation and delivery in the region; reduce energy dependence on foreign sources; enhance the grid's resilience to natural and manmade threats; and most importantly meet our customers' needs and provide them with greater choice, convenience and value.

To ensure our customers trust an electric grid that relies on significantly more technology, privacy and security must be a foundational element of Smart Grid systems and solutions. Customer data must be protected by "designing in" privacy from the beginning and leveraging the security of our systems. We have partnered with global leaders in this area to develop a smarter approach to privacy and security.

SDG&E's roadmap for Smart Grid projects from 2011 – 2020 as well as associated cost and benefit estimates are structured around nine program areas: Customer Empowerment; Renewable Growth; Electric Vehicle Growth; Reliability and Safety; Security; Operational Efficiency; Smart Grid Research, Development and Demonstration; Integrated and Cross cutting Systems; and Workforce Development.

While we have presented a detailed roadmap with specified estimated costs and benefits for our Smart Grid Deployment Plan, we plan to take an adaptive management approach on an ongoing basis. We will continually evolve our roadmap to leverage and respond to future technology breakthroughs, changing state and federal policies, shifting stakeholder priorities and other unanticipated events that the utility considers as a given over the coming 10 year period.

Our plan today estimates the preliminary and conceptual costs of SDG&E's Smart Grid deployments for the years 2006–2020 at approximately $3.5 to $3.6 billion with the majority of the estimated costs attributable to previously authorized investments and active applications. These previously authorized programs include SDG&E's Smart Meter and Operational Excellence 20/20 programs. Active applications include our Test Year 2012 General Rate Case (GRC) as well as other programs such as SDG&E's proposed Demand Response and Dynamic Pricing projects. The estimated investments for projects incremental to these previously authorized and active applications are approximately 25 percent of the overall estimated costs.

The total benefits associated with the Smart Grid deployments discussed in this plan are estimated to be between $3.8 and $7.1 billion. This calculation includes estimated economic and reliability benefits as well as estimated societal and environmental benefits such as avoided emissions through the integration of renewable energy and PEVs as well as the estimated avoided fuel costs PEV owners realize by their successful integration.

The majority of benefits derive from societal and "soft" benefits such as maintaining or improving reliability in the face of a more complex grid, avoided costs, reduction of commodity cost, environmental and others, and so they minimally reduce operating costs and are not projected to significantly impact rates, although customers who leverage Smart Grid technologies and data will have the capabilities they need to manage and reduce their bills. Smart Grid technologies and applications will enable the future — and the exciting achievement of benefits to society.

SDG&E's Smart Grid Deployment Plan is not a request for funding. While many of the costs have been previously authorized or submitted as part of the 2012 GRC, we will not pursue funding requests for incremental projects in this plan until we can accurately project associated costs and benefits for a project.

We are pleased to submit this foundational industry plan and share our vision for the next decade of Smart Grid transformation in our region and beyond. While this document is already based on broad stakeholder input, we anticipate that its publication will attract additional input and help SDG&E continue to enhance and improve its Smart Grid plans and thought leadership, as evidenced by President Obama's recognition of SDG&E in the *U.S Russia Bilateral Presidential Commission's Energy Working Group Joint Action Plan* and *Intelligent Utility Magazine's* most intelligent utility in the U.S. designation for the last two years. SDG&E is excited about the better customer service, reliability, efficiency and environmental benefits enabled by Smart Grid investments. We are proud to do our part to deliver these benefits to customers, to California and to society as a whole.

Sincerely,

SAN DIEGO GAS & ELECTRIC CO.

Michael R. Niggli

Michael R. Niggli, President and COO

A Sempra Energy utility®

Section 1 – EXECUTIVE SUMMARY

1 EXECUTIVE SUMMARY

The San Diego Gas & Electric Company (SDG&E) Smart Grid Deployment Plan advances the utility's vision for a smart energy future while delivering new value to its customers, meeting its public policy requirements and delivering societal and economic benefits that exceed project costs.

SDG&E views the Smart Grid as an end to end transformation of its electric delivery system that applies advances in technology to deliver a range of new benefits to all stakeholders. The Smart Grid empowers customers, increases renewable generation, integrates plug in electric vehicles (PEVs) and reduces greenhouse gas (GHG) emissions while maintaining and improving system reliability, operational efficiency, security and customer privacy. SDG&E anticipates that investments in Smart Grid infrastructure will yield additional benefits as the transformation progresses and its customers, policy makers and the industry are able to leverage lessons learned and achieve the Smart Grid's full potential.

Customer choice is a potent driver of SDG&E's deployment plan for the Smart Grid. SDG&E customers are adopting rooftop solar and PEVs at rates that are among the highest in the nation. They are seeking real time information about their energy usage and rates in order to make more informed decisions. Some are looking for opportunities to participate in energy markets through demand response, time of use rates, distributed generation (DG) and storage. Lastly, SDG&E customers have consistently shown their support for more electricity from renewable resources and other important environmental initiatives resulting in government and regulatory policies that are the other major drivers of SDG&E's Smart Grid Deployment Plan.

The state and federal policies accelerating planned Smart Grid investments include Senate Bill (SB) 17, Assembly Bill (AB) 32, California's 33 percent renewable portfolio standard (RPS), the state's distributed generation goals, demand response mandate, improved building and appliance efficiency standards, implementation of the electric procurement loading order and national security standards such as the North American Electric Reliability Corporation's Critical Infrastructure Protection (NERC-CIP) program.

SDG&E's vision for its Smart Grid transformation is to work in collaboration with key stakeholders to create the foundation for an innovative, connected and sustainable energy future. Consistent with this vision, SDG&E has engaged the input of representative stakeholders from across its service territory in the development of this Smart Grid Deployment Plan. These include environmental, academic, business, municipal/regional government, ratepayer advocacy, consumer, large customer and workforce development organizations. In addition to engaging these external groups, internal stakeholders at SDG&E have aligned behind the utility's Smart Grid vision and strategy which now further integrates Smart Grid across all utility planning efforts and operations.

SDG&E's deployment baseline is bolstered by the utility's nearly-complete, customer-empowering smart meter rollout, which is already supporting new customer behaviors, such as the use of third-party applications to see energy interval usage data. Its prior Smart Grid investments either already deployed or in the process of deployment, stretch back 20 years and have laid the foundation for the utility of the future through improved efficiency and reliability and maximized customer value. These include early investments in automation and control technologies; the development of the Sustainable Communities program; its "OpEx 20/20" program to reengineer operational processes and associated software for Smart Grid support; installation of a microgrid in Borrego Springs; and full-scale Supervisory Control and Data Acquisition (SCADA) deployments which now control 95 percent of the SDG&E transmission system.

SDG&E's Smart Grid investments to date have been carefully chosen and deployed to allow the flexibility to leverage future innovations, address evolving or new policy requirements and to capture more benefits as new opportunities and challenges arise. Some of these challenges include addressing issues associated with the two-way energy flow that results from distributed generation, the intermittent power of solar and wind generation and the unknown and potentially unpredictable load imposed by electric vehicle charging. SDG&E's Smart Grid investments are intended to manage such changes and transform the grid of the past into the smarter grid of the future that is increasingly needed today. Where technology innovations or energy markets are not mature enough to support a full deployment of a new or potentially promising Smart Grid investment, SDG&E's strategy is to leverage pilot and demonstration projects to improve the utility's understanding of likely costs and benefits before a full deployment decision is proposed.

SDG&E's Smart Grid strategy is guided by this vision, consistent with the goals of SB 17 and follows a decision-making framework that includes a five-pronged approach to ensure compatibility with SB 17's goals: a) identify applicable regulations; b) identify investment options that help meet policy requirements; c) determine if investment options aid SDG&E in meeting policy requirements; d) determine if investment options enhance customer value; and e) choose investments based on standard economic criteria, necessity for meeting policy requirements, and equity.

SDG&E's Smart Grid deployment strategy also prioritizes projects according to customer value, policy drivers or the need to pilot. Investments driven by customer value are those where the projected benefits outweigh costs or where the investment is necessary to effectively communicate with customers. For investments driven by state or federal policies, SDG&E still calculates the potential customer and societal benefits to pursue a least-cost and best-fit approach. By following this strategy, SDG&E's Smart Grid deployment efforts will significantly reduce the environmental footprint of electricity generation and delivery in the region; reduce energy dependence on foreign sources; enhance the grid's resilience to natural or manmade threats; provide customers with greater choice, convenience and value; mitigate risk; and ensure the provision of safe, reliable and secure electricity for its stakeholders.

In addition, SDG&E's strategy includes continued industry leadership in supporting General Order 156 with respect to including Diverse Business Enterprises (DBEs) in its supplier selection process. SDG&E has incorporated supplier diversity throughout all of its policies and procurement processes and has exceeded state targets for DBE spending and procurement, a trend it expects to continue with its Smart Grid Deployment Plan procurement practices.

Security is a priority impacting every component in SDG&E's Smart Grid Deployment Plan. Preventing or reducing physical and cyber security threats becomes more vital and complex in a Smart Grid; however, it also presents opportunities. With the new communications and control technologies for physical and cyber security, SDG&E anticipates the ability to integrate and correlate physical and cyber security monitoring and data to better protect grid assets and systems. SDG&E's Smart Grid security approach will begin at the earliest stages of system decision making and design. It will also seek to prevent or isolate the impacts of any physical or cyber threats to one or multiple portions of the Smart Grid to maintain system reliability in the event of a threat.

Just as security is designed into Smart Grid systems and solutions, so too is privacy. SDG&E will ensure a robust approach to enterprise architecture and information modeling, leveraging the National Institute of Standards and Technology's (NIST) four dimensions of privacy as well as the seven "privacy by design" foundational principles as guidance for its privacy program.

SDG&E's deployment plan will also leverage open standards where possible to ensure interoperability and avoid stranded costs.

To build the capabilities required to realize Smart Grid benefits for customers and to meet the state's ambitious energy policy goals, SDG&E's portfolio of Smart Grid projects is structured around nine specific program areas:

1. **Customer Empowerment** – SDG&E is investing to ensure customers have the knowledge and necessary information to make informed energy management decisions to maximize their energy value and to support their access to third party value added services and offerings while protecting their privacy.

2. **Renewable Growth** – SDG&E is making Smart Grid investments that will mitigate the impact of distributed and other intermittent energy sources by increasing measurement, control, and management capabilities.

3. **Electric Vehicle Growth** – SDG&E is deploying new Smart Grid technologies in conjunction with traditional infrastructure upgrades to ensure the safe, reliable, and efficient integration of PEVs.

4. **Reliability and Safety** – SDG&E is maintaining and/or improving reliability by mitigating the challenges that intermittent resources and electric vehicles present to an aging electric infrastructure through implementation of advanced sensors and associated systems, and other capabilities that will improve employee and public safety.

5. **Security** – SDG&E is investing to address the increased physical and cyber security risks and threats associated with Smart Grid system design, development, implementation, and operations.

6. **Operational Efficiency** – SDG&E is leveraging existing and developing new capabilities to improve the efficiency of planning processes and system operations through remote monitoring and real time responsiveness enabled by the deployment of advanced sensors and management systems.

7. **Smart Grid Research, Development and Demonstration (RD&D)** – SDG&E is improving its capabilities by researching new technologies, integrating emerging technology solutions, testing for interoperability and providing proof of concept demonstrations.

8. **Integrated and Cross-cutting Systems** – SDG&E is deploying systems in areas such as application platform development, data management and analytics and communications that support Smart Grid functionalities across multiple business units.

9. **Workforce Development** – SDG&E is investing to develop its current workforce and to transition to a future workforce that will meet the unique requirements of Smart Grid through implementation of effective organizational change management and workforce planning.

By applying an adaptive management strategy to the projects listed under each of these program areas, SDG&E expects to continually evolve its roadmap to leverage or respond to future technology breakthroughs, changing state and federal policies, shifting stakeholder priorities and other unanticipated events that the utility considers as a given over the coming 10-year period.

SDG&E has defined and included consensus metrics for its Smart Grid Deployment Plan, which permit the utility to benchmark and assess the progress achieved through its Smart Grid deployments. SDG&E plans to continue working with the California Public Utilities Commission, the Environmental Defense Fund, the other California Investor Owned Utilities (IOUs), interested parties and key stakeholders in the development and adoption of additional Smart Grid-related metrics.

SDG&E has identified, quantified, and monetized associated cost and benefit estimates for all of the projects in its nine Smart Grid program areas, including in-flight and planned roadmap projects. SDG&E will not request authorization for funding of projects that are not necessary to comply with policy unless the estimated benefits exceed the associated costs or where they are required to effectively communicate with the utility's customers.

SDG&E's analysis of the costs and benefits is intended to be as accurate as possible, given currently available information. However, due to the nascent state of much Smart Grid technology and the fact that actual deployment will be based on future events, lessons learned and pilots, these estimates are subject to change and are presented as conceptual for 2011–2015 and preliminary for 2016–2020. In addition, a range is provided to allow for more conservative cost and benefit scenarios. SDG&E will file supporting applications only when sufficiently precise estimates are available.

SDG&E's estimated cost of Smart Grid deployments for the years 2006 – 2020 described in this plan are approximately $3.5 to $3.6 billion and include previously authorized investments such as SDG&E's Smart Meter and OpEx 20/20 programs, Smart Grid projects included in its Test Year 2012 (TY2012) General Rate Case (GRC), other active applications such as SDG&E's proposed Demand Response and Dynamic Pricing projects, and estimated incremental investments, which are approximately 25 percent of the overall estimated costs.

The total benefits associated with the Smart Grid deployments discussed in this plan are estimated to be between $3.8 and $7.1 billion. This calculation includes estimated societal and environmental benefits of $760 million – $1.9 billion based on avoided emissions through the integration of renewable energy and PEVs as well as the estimated avoided fuel costs PEV owners realize by the successful integration of PEVs. They also include economic and reliability benefits of $3.0 – $5.1 billion resulting from previously authorized investments such as Smart Meter, TY2012 GRC and other active applications as well as incremental investments.

Because the majority of benefits derive from maintaining and/or improving reliability in the face of a more complex grid, avoided costs, reduction of commodity cost, environmental and other societal and "soft" benefits, they minimally reduce operating costs and so are not projected to significantly impact rates, although customers who leverage Smart Grid technologies and data will have the capabilities they need to manage and reduce their bills.

As with its cost estimations, SDG&E's economic and reliability benefits calculations extend back to 2006 to include the historical benefits realized from previously authorized Smart Grid projects. Because benefits will also accrue after 2020, SDG&E has included forecasted benefits based on the associated terminal value of its Smart Grid projects.

The SDG&E Smart Grid Deployment Plan is not a static document. Consistent with its Smart Grid vision, SDG&E intends to continue engaging with stakeholders in order to align its Smart Grid strategy to their priorities. The utility also plans to update its roadmap as its customers, stakeholders, available technologies, and services evolve; adopt new security strategies as new threats or best practices emerge; and adjust its cost and benefit estimates as its pilot and deployment experiences and new information bring greater certainty to anticipated inputs, timelines and outcomes.

Section 2 VISION

2 VISION

2.1 A SMART ENERGY FUTURE

SDG&E's vision for a smart energy future is driven both by public policies and by its customers who are currently adopting technologies such as rooftop solar and electric vehicles at rates higher than anywhere else in the nation. SDG&E's customers have also consistently shown support for more renewable generation projects, technologies and legislation. As a result, "Smart Utility," investments are already underway at SDG&E to ensure that it is meeting the unique demands that renewable energy, electric vehicles and rooftop solar are placing on the grid. Additionally, SDG&E envisions a smart energy future in which the rising cost of electricity is managed through new operational and customer enabling technologies, while consumer privacy and grid security are protected to the greatest degree possible. SDG&E envisions building on its current Smart Grid platform to maintain the utility's high service reliability while supporting more sustainable energy utilization and a cost effective Smart Grid roll out.

To date, SDG&E has invested in new technologies and redesigned its business processes to maximize efficiency, reduce emissions, empower customers and maximize customer value. Examples of its efforts include a full scale advanced metering infrastructure (AMI) deployment and its OpEx 20/20 program, which includes Smart Grid foundational projects such as a state of the art outage management/distribution management system (OMS/DMS), geographic information system (GIS), condition based maintenance (CBM) and transmission and distribution automation. Helping its customers to save on their energy usage and reduce the amount of electric and gas infrastructure needed through energy efficiency (EE) and demand response (DR) have also been key objectives of SDG&E.

This Smart Grid Deployment Plan builds on these initiatives to maximize its value and benefits as well as create new value and benefits through additional, targeted investments. SDG&E's Smart Grid vision is to work in collaboration with key stakeholders to create the foundation for an innovative, connected and sustainable energy future in its service territory. One of the key objectives of SDG&E's current Smart Grid programs and vision going forward is to help customers maximize the value of their energy usage and generation.

SDG&E's customers are adopting environmentally friendly technologies such as photovoltaic (PV) and wind generation as well as PEVs and are beginning to leverage customer empowering smart meter technology such as Google PowerMeter in greater numbers every day. These exciting technologies bring the promise of extensive benefits to customers and society including reducing the impact of energy usage on the environment, reducing energy dependence on foreign sources, and further developing the ability to better understand and control energy usage and resiliency in the face of a natural or intentional attack on the grid. They also bring new challenges, such as maintaining power quality and avoiding outages as issues associated with the two way energy flow that results from distributed generation, the intermittent power from solar and wind generation; and the unknown and potentially unpredictable load required by electric vehicle charging are addressed. These and other changes have triggered the start of a major transformation in the electric utility business transforming the grid of the past into a smarter grid of the future increasingly needed today.

The state of California is also focused on Smart Grid investments that will help reduce emissions. Senate Bill (SB) 17 establishes the overall intent that Smart Grid deployments help achieve the following: the goals of Assembly Bill (AB) 32, the state's 33 percent renewable portfolio standard (RPS); as well as achieving California's distributed generation goals and demand response mandate; improved building and appliance efficiency standards; and implementation of the electric procurement loading order. SDG&E's vision is that utilities will provide the foundation that facilitates the achievement of many of the state's emission reduction goals. The specific means by which this Deployment Plan complies with SB 17 are set forth in detail in Section 2.6 of this Smart Grid Deployment Plan Vision.

SDG&E's vision is to work in collaboration with key stakeholders to create the foundation for an innovative, connected and sustainable energy future. In fact, a broad cross section of stakeholders from across the service territory provided input to this filing, offering suggestions and recommendations to enhance this vision. SDG&E believes that the focus of its Smart Grid investments should be on maximizing benefits to customers. By leveraging digital and advanced technologies to create a smarter grid, customers will benefit from cost effective solutions to these new challenges and gain synergies while reducing energy consumption and related emissions from these evolving technologies while also having confidence their privacy is protected. For example:

- Through automation technologies integrated with the Smart Grid, customers will be able to manage discretionary loads, such as home air conditioning and PEV charging in a manner that is the most compatible with local electric distribution needs. By 2020, the use of stationary and PEV batteries can be networked at home, at work, and at shopping malls to help the utility stabilize the grid during partially cloudy days or erratic wind conditions, potentially lowering the cost of PEV ownership, while increasing the amount of renewable energy integrated reliably into the grid;
- Customers will have tools that will help them manage their energy use and costs and make it easy for them to do so;
- Customers will have price sensitive appliances and devices that can be programmed to react to the changing cost of energy and modify behavior to lower energy bills according to customer preferences, such as delaying the refrigerator's defrost cycle to midnight when air conditioner use is low, as well as charging a PEV earlier or later in the in the evening to early morning hours when the wind is blowing more than expected, and even discharging energy from storage when the price is extremely high;

- Customers will be able to ride through electric outages by leveraging microgrid technologies to manage a combination of community energy storage, electric vehicle batteries, load following fuel cells, and distributed solar and wind generation. Eventually PEV batteries will supply energy, and home energy management systems and smart appliances and devices will be utilized to better match energy use to the supply available.

- Customers will be able to look to the Smart Grid for provision of real time prices, energy use information and to enable an array of billing options to enable them to manage energy use and costs.

- SDG&E will be able to provide higher levels of power quality, reduce outages, and reduce restoration time by implementing new technologies. SDG&E will implement Smart Grid capabilities that can provide customers differentiated levels of reliability and power quality that are tailored to meet their specific needs.

Smart Grid investments will provide a utility platform that creates a network of many different market participants throughout the grid, allowing electricity to be generated, stored, delivered and consumed in the most cost efficient and ecologically sound manner possible. This will empower power producers, foster innovation in equipment suppliers, and enable new trading partner relationships and new product markets (which may include things such as allowing customers with distributed generation and storage to participate in balancing, storage and/or ancillary service markets at the distribution service level), all of which will serve to increase efficiency and minimize cost and emissions associated with electricity consumption.

Many utilities across the nation are waiting to see what happens elsewhere before responding to these industry changes. For the San Diego region and SDG&E, however, waiting is not an option. SDG&E cannot wait because:

- Its customers and many stakeholders have shown consistent support for new renewable legislation, generation technologies, and projects – with some already being developed and more being planned in the San Diego region to meet the 33 percent renewable portfolio standard by 2020;

- Its customers have installed more megawatts of rooftop solar in San Diego than utility customers in any other U.S. city. By the end of 2011, over 13,000 – more than 1 percent – of SDG&E customers will have installed photovoltaic systems totaling over 100 MW of capacity;

- Its customers are already taking delivery of Nissan Leaf and Chevrolet Volt electric vehicles, with more Leafs being sold in San Diego than anywhere else in the country (and Ford, Mitsubishi, and BMW have also targeted the San Diego region for their PEV release in late 2011 – early 2012); and,

- Its customers already have access to interval usage data, with thousands signing up for Google PowerMeter. They are poised to leverage new energy management technology.

SDG&E can't wait for others to move forward, because its customers are already moving forward. Consistent with the views expressed by many of the utility's stakeholders, SDG&E envisions a future in which customers are empowered – with accurate price signals, advanced enabling technologies, a well-designed market structure, and a Smart Grid that allows them to choose how they want to consume and generate their electricity and maximize their energy value based on their own preferences and priorities. Customers will be able to safely add increasing levels of intermittent distributed renewable generation and may even provide grid reliability services to the utility. The electricity grid will be able to accommodate increasing demand from PEVs. Accurate price signals may also encourage more economic decisions regarding charging such vehicles during off-peak and super off-peak hours when prices are low and there is sufficient system capacity and resources. SDG&E will achieve greater efficiencies by moving to condition based maintenance and implementing other efficiency improvements through the use of new technologies.

The grid itself will become more resistant and resilient to an ever increasing number of threats, from cyber attack to terrorism, and customers and providers alike will be confident that the infrastructure and information they depend on are secure. The Smart Grid will also empower electricity producers and other market participants by creating a network that allows for efficient coordination among many different market participants from central station generation, capacity and ancillary service resources to distributed generation and demand response resources and allows electricity to be generated, stored, delivered and consumed in the most cost efficient and ecologically sound manner possible.

SDG&E's vision for its Smart Grid Deployment Plan is intended to create a secure utility platform for the "Smart Customer" that empowers them with reliability, choice, control and convenience. This utility platform of the future is enabled by SDG&E's vision of a "Smart Utility" that is capable of coordinating energy resource operation across the grid, from central station generation and capacity resources sited on the transmission grid, to distributed energy and demand resources sited on the distribution system. Through its utilization and expansion of information delivery channels, SDG&E will provide customers with more timely and relevant information on their energy usage, market prices and system conditions and make them active participants in the Smart Grid of the future. Lastly, by creating a utility platform that ensures reliability and allows resources to respond to accurate and timely price signals and system event conditions, SDG&E will strengthen the efficiency, transparency and security of the grid to support its vision of a "Smart Market" for its customers and all grid stakeholders.

"SDG&E can't wait for others to move forward, because its customers are already moving forward."

SDG&E looks forward to working closely with its customers, stakeholders, the Commission, the California Independent System Operator (CAISO), and Federal Energy Regulatory Commission (FERC) to help achieve its Smart Grid Deployment Plan Vision.

2.2 SDG&E'S SMART GRID VISION

The electricity industry is facing unprecedented changes. Customers, increasingly concerned with their carbon footprint and rising energy costs, are installing distributed renewable generation resources in greater numbers every year. PEVs are being introduced early in the San Diego market to respond to a growing focus on what an individual can do to have less impact on the environment while reducing their monthly transportation fuel expenses. New technologies are allowing customers to become increasingly empowered to manage their energy usage to minimize electricity costs and air emissions (both greenhouse gases and criteria pollutants) associated with their electricity use.

In order to successfully navigate these changes in a way that maximizes the value of the services, SDG&E has adopted a vision on the basis of input from customers, key stakeholders, and employees. Its vision is set forth below:

> *"San Diego Gas & Electric, in collaboration with key stakeholders, will create the foundation for an innovative, connected and sustainable energy future."*

This is also SDG&E's vision for Smart Grid deployment. SDG&E will work with key stakeholders to deploy Smart Grid technologies that create an innovative, connected and sustainable energy future that provides value to its customers. It will do this by making Smart Grid investments to ensure safe and reliable electricity service as customers invest in renewable DG and PEVs, and allow SDG&E to effectively communicate with customers and their agents regarding their energy use. This "core technical platform" will increase the value of services SDG&E provides and empower customers to consider distributed energy resources (DER) alternatives, after meter services, and/or a PEV, thereby creating a new innovative and improved customer experience. SDG&E's vision aligns with the vision set forth in the Electric Power Research Institute (EPRI) Public Interest Energy Research (PIER) program final project report entitled *California Utility Vision and Roadmap for the Smart Grid of Year 2020.*

In developing this Deployment Plan, SDG&E solicited input from its customers and stakeholders.[1] Three areas of interest stood out as the highest priorities in these discussions: customer behavior/education, demand response and rate design. These key themes and other areas of stakeholder interest are summarized in greater detail below and incorporated throughout this deployment plan:

1. **Educate Customers on Energy Opportunities and Choices.** Education of customers and all stakeholders is paramount, and significant investment in customer communications and research on customer behavior should be high priorities. Customer behavior and preferences vary, thus the education and product and service offerings need to vary also. "One size does not fit all." Utilizing peer to peer education is an important strategy. Significant education will also be needed for SDG&E's workforce who will be integral in offering this education to customers. Educated customers make better choices and are more empowered to make value decisions on energy.

[1] SDG&E solicited input from the following organizations as it developed this deployment plan:

- Environmental: Environmental Health Coalition; San Diego Audubon Society; San Diego Coastkeeper
- Academia: San Diego State University (SDSU) Center for Energy Studies; University of California, San Diego (UCSD) Division of Calit2; UCSD Office of Strategic Energy Initiatives
- Business Organizations: San Diego Regional Chamber of Commerce; San Diego, North County, East County economic development organizations
- Municipal Utilities/Governmental Organizations: City of San Diego; County of San Diego; City of Chula Vista; SANDAG Energy Working Group
- Ratepayer Advocates: Utility Consumers' Action Network (UCAN)
- Energy NGOs: University of San Diego (USD) School of Law Energy Policy Initiatives Center (EPIC); California Center for Sustainable Energy
- Large Customer/Corporate Interests: Sony; *Additional Large Communications Technology Company*
- Collaborative Organizations: UCSD Connect; Clean Tech San Diego
- Workforce Interests: San Diego Workforce Partnership

2. **Facilitate Energy Efficiency and Demand Response.** Customer access to energy information, energy prices and emissions by time of day with enabling technologies that allow customers to control and maximize their energy value are critical. This is similar to the importance of communicating with customers in their chosen language; utilities have an obligation to provide and communicate customer specific usage and price information with the customer's chosen communication channel(s).

3. **Offer Rate Options and Cost Choice.** Cost based and time differentiated rates in some form are critical and must be linked by customers to cost savings to be effective.

4. **Enable Plug in Electric Vehicles (PEVs).** SDG&E's goal is to ensure the safe, reliable and efficient integration of PEV charging loads with the utility grid. Community planning is important in addressing the potential future "ramp up" of home and public/commercial PEV charging facilities. Cost based time differentiated PEV rates can be an effective way to encourage PEV charging during off peak hours, and yield other system benefits that could result from a more efficient use of the grid today, and in the future potentially enable longer term PEV charging and electricity storage.

5. **Enable and Integrate Energy Storage.** There is a consensus in the industry that electricity storage is a critical component in mitigating intermittency and integrating increased penetration of renewable distributed generation. Large scale storage should be part of the strategy, as should vehicle to grid storage.

6. **Expand Collaboration.** SDG&E, its vendors and suppliers, businesses, partners, community organizations, key stakeholders and academia should all work together to incorporate projects/concepts into Smart Grid deployment. Smart Grid functionality could have significant potential as a local economic driver.

7. **Support Workforce Readiness.** A Smart Grid will demand a new workforce with specific skills at all levels. SDG&E, academia, business, and labor should work together to create and/or invest in the creation of a new, local "reservoir" of talent with these skills. In addition, there needs to be a proactive approach to working with unions in order to develop agreements that are forward thinking and collaborative and support a flexible workforce that is able to meet the future needs of the Smart Grid. Current employees will need to develop new skills to adapt to technological and business process changes while HR systems will need to be aligned so that the workforce is flexible and consistent with Smart Grid needs.

8. **Integrate Distributed Energy Resources (DER).** The Smart Grid must be able to integrate DER resources without adverse impacts on reliability. The Deployment Plan should address how Smart Grid technologies can facilitate development of combined heat and power (CHP) facilities.

9. **Expand Technology Development.** Investment and collaboration, integration of new technologies to interface with the Smart Grid, as well as business and technology transition strategies are needed to ensure existing technologies are optimized.

SDG&E has developed this Deployment Plan on the basis of its vision and stakeholder input and consistent with the requirements of D.10 06 047. Pursuant to that decision, SDG&E's Smart Grid Deployment plan describes SDG&E's Smart Grid vision in the context of three high level concepts – "Smart Customer," "Smart Market," and "Smart Utility" below. SDG&E's Deployment Plan will also continue to evolve as the priorities and expectations of its customers and stakeholders change.

2.3 "SMART CUSTOMER"

SDG&E's vision of the "Smart Customer" is one who is empowered and able to make informed decisions about their energy usage and generation as a result of Smart Grid investments, allowing them to maximize their energy value.

Specifically, Smart Grid investments will create opportunities for the "Smart Customer" of the future to reduce energy cost and use, to reduce their carbon footprint, and to install and effectively utilize DG and after-meter technologies. Under SDG&E's Smart Grid Deployment Plan Vision, the utility will collaborate with customers and energy service providers to provide customers with more choice on how and when they use energy based on improved information (including accurate price signals) and access to enabling technology.

SDG&E will create a utility foundation for an innovative, connected and sustainable energy future and work with customers and service providers to increase customer engagement with and adoption of new energy management technologies. From a "Smart Customer" perspective, this will give consumers the opportunity to capture the benefits of a wide range of existing and emerging energy technologies and associated energy management products and services that may, or may not, be provided by the utility. These energy products and technologies will empower customers to reduce energy use when energy prices and associated emissions are at their highest, and reduce their overall energy demand, all of which will reduce energy costs and related emissions.

Customers will be aware, informed and knowledgeable about their energy choices, and have the tools to act upon those choices. Customers will use, store, produce, and/or manage energy to meet their individual needs as well as the needs of the grid and energy markets with a clear understanding of its value. Technology, energy-related services, and energy markets will evolve as market participants/actors: (1) they will adopt new technologies that integrate readily accessible information with automated systems that manage appliances and equipment; (2) they will install competitive distributed generation systems and networked and integrated PEV charging equipment; and, (3) they will optimize energy storage capabilities. In order to achieve these objectives, it will be necessary to ensure the availability of accurate and transparent cost based rates and pricing and standardized/reliable information. This will enable utility and non utility service providers to offer competitive products and services that will be valued by customers and 3rd party service providers. SDG&E will create a standardized platform for the transfer of customer usage information to third parties (with customer approval), thereby enabling customers to access third party services and reduce overall market transactions costs.

SDG&E recognizes that engaging with and proactively reaching out to customers is critical to the success of its smart meter deployment and Smart Grid utilization efficiency. Both demand side (customers) and supply side decisions (including self provided supply) are more efficient if valued added market information is available to market participants. The Commission and the State have clearly embarked on the path of deploying advanced metering technology (e.g., smart meters). Advanced metering technology is not only achieving operating efficiencies in meter reading, i.e., automating the meter reading process, but as recognized by many of SDG&E's stakeholders, including consumer advocacy groups, business interests, academia, non governmental organizations, and corporate interests, the availability of more timely and granular (interval) energy usage information can and will change customer behavior.

The change in customer energy usage resulting from smart meters can be categorized into four impacts:

- Information feedback
- Demand response from short run price elasticity
- Energy efficiency or equipment investments including PEVs
- Distributed generation and storage investments

To achieve customer and environmental benefits associated with these impacts, investments are necessary to ensure the availability of energy usage data at the granular level. Customer specific interval usage information must be presented in a timely, understandable and useful form. Customers must understand their rate structure and the impacts that may result from various dynamic rate options. Time differentiated rates, in some form, are a critical component in the success of demand response and adoption of new energy management technologies.

Customer Education, Outreach and Information

Unless customers understand the benefits that Smart Grid provides, believe those benefits are meaningful, and believe there is an easy and feasible way for them to participate, they will likely not engage. SDG&E's customer education, outreach and communications strategy will recognize and effectively respond to this challenge. SDG&E must continue to tailor specific customer messages and content to specific customer groups based on how they use energy, how they access information about energy, and how they make energy decisions. In addition, SDG&E will need to work with each segment to ensure two way feedback/communication so customers have the information to make informed energy choices on demand response, energy efficiency investment measures and self generation. Customer education and communications will need to include a full range of outreach, beginning with general energy awareness to specific, targeted, customer selected options. By achieving the forgoing objectives, SDG&E will empower customers to better manage their energy usage and minimize emissions, consistent with the state's policy goals.

SDG&E is also planning to provide various applications for on line presentment of energy usage, rate comparison analysis, near real time information and month to date bill alerts, month end bill projections and high bill analysis.

Maximizing Benefits of the Home Area Network and Other Customer Premise Technologies

Customers will be empowered to participate in and respond to markets on the technical platform created for Home Area Networks (HAN) and other customer premise networks. The platform is comprised of several core components that include the Demand Response Control Application (DRCA), the network communication path into the home or building, the HAN or other devices at the customer's premises, the customer portal applications, and the back office integrations required to support those systems. "Behind the meter" services and applications accessed by the customer inside their premises, such as monitoring and management of devices connected to the HAN, could be expanded beyond third parties and extended to utilities, thereby giving customers more choices.

Accommodating Increased Plug-in Electric Vehicle (PEV) Penetration

The "Smart Customer" may drive an electric or plug-in electric vehicle and SDG&E is prepared to accommodate their increased market adoption. After 2012, thousands to tens of thousands of PEVs are estimated to be owned by SDG&E's customers. With an estimated load of 3.3 kilowatt (kW) per vehicle (6.6 kW per vehicle after 2012) this equates to 45 megawatts (MW) of new load[2], which if not managed and integrated properly, could have a significant impact on the local electric distribution system and potential generation needs. If SDG&E's service territory experiences rapid adoption of PEVs, the outlook for 2020 could be as much as 200,000+ vehicles in the greater San Diego region. Stakeholders in the municipal arena have expressed concern about the impact of the coming "wave" of PEVs.

One of many challenges associated with PEV growth rates will be the "clustering" of PEV ownership (i.e., two or more PEVs served by one neighborhood transformer). This could

[2] SDG&E EOY2012 estimate

be particularly an issue in the older coastal areas of SDG&E's service territory. In most instances these coastal homes are smaller, do not have air conditioning and the number of customers connected per transformer is greater than neighborhoods with air conditioning load in the inland areas. A 3 kW charging load is comparable to large central air conditioning load that is added to the local distribution system. SDG&E is currently involved with an Electric Power Research Institute ("EPRI") project to further assess the impact of PEVs on the grid, as well as monitoring the PEV loads and charging patterns of PEV customers during the 2011 deployment. Proactively, SDG&E believes it is imperative to examine three areas of system activities: the need for existing facility upgrades, an effective use of smart (monitoring) transformers and understanding the loads generated from the use of public charging infrastructure in order address the coming PEV charging demands, and supporting PEV service providers to provide timely and adequate charging infrastructure.

Finally, under SDG&E's Smart Grid Deployment Plan Vision, SDG&E will enable and support the growth of electric transportation while ensuring the safe, reliable and efficient integration with the grid. SDG&E desires to create an excellent customer experience and build consumer confidence in clean electric transportation.

Customer Experience of the "Smart Utility" of the Future

To ensure that the "Smart Customer" is empowered and informed, SDG&E envisions a customer service experience that meets their preferences and needs while protecting their privacy.

Today's technology, including the internet and smart phones, has changed how SDG&E's customers receive information and handle transactions. They have come to expect instant access to information and via multiple technology platforms. Thirty eight (38) percent of SDG&E's customers have opted to view and pay their bill online using My Account, and they can already view their hourly energy data on Google PowerMeter. Later this year they will be able to see hourly data through My Account. Smart Meters and access to energy consumption information will provide its customers the opportunity to have more control over their energy use. They will look to SDG&E to provide them with the tools to understand the information as well as solutions to save energy and money. Communicating this information in an easily understandable and timely way is what customers will expect and soon come to demand. Customers want choice in communications channels: "text me" with outage info and updates, but "email me" about new programs. In order to meet the needs of its customers and establish the kind of relationship they want from their utility, SDG&E has a responsibility to be able to reach them through their preferred communication channel.

Customers' concerns about the environment and their economic situations are also growing. Customers want help evaluating savings opportunities associated with replacing their appliances with more efficient ones. With dynamic pricing, customers want to know how they can use in home displays and HANs to program appliances to go on and off to save money. They are also interested in evaluating investment opportunities like distributed generation, battery storage and electric vehicles and will look to SDG&E for information and insights. Through online channels, interactive web tools, and use of media/video; these often complex analyses and concepts can be more clearly presented, significantly increasing understanding, customer satisfaction and ultimately adoption and engagement in sustainable energy practices.

SDG&E's investments in mobile applications and social media are necessary to provide the array of utility services (billing, bill payment, energy usage information, demand response programs, energy efficiency programs, low income assistance, etc.) to customers on their chosen communications channels. SDG&E must invest in technical infrastructure and supporting applications to integrate and communicate with its customers.

Empowering customers means providing them with information that raises their awareness so that they can make intelligent (smart) choices regarding their energy usage. Such information must be delivered to the customer in a timely, transparent, relevant and reliable manner using the customer's preferred channel. Customers will then be most likely to make decisions (behavior changes) regarding energy consumption. The "Smart Utility" will also need to maintain the ability to communicate with customers that do not use any new electronic media.

SDG&E's "Smart Customer" vision is to be proactive and collaborative with its customers to deliver mutually beneficial outcomes. This means that SDG&E will continuously work with customers to understand their preferences and provide services via the channels that they value. SDG&E will continue to adapt to its customers' changing expectations.

As the population in its service territory changes, SDG&E will continue to provide appropriate, multi-lingual customer service representatives and non-English printed material to better communicate with its customers.

2.4 "SMART MARKET"

Smart Grid investments will change the existing market by empowering customers to maximize the value of the energy and other services they receive from the grid and participate in demand response and potentially ancillary service markets in the future. With accurate price signals in retail rates, Smart Grid investments will allow markets for DER and PEVs to grow without imposing adverse impacts on customers without DER or PEVs. Smart Grid investments will also improve efficiency in grid operations and reduce costs for customers over time.

Under SDG&E's vision of an innovative, connected and sustainable energy future, the "Smart Market" will enhance customer service and will provide customers with greater energy service choices, control and convenience. SDG&E will protect customers' personally identifiable information in a secure environment. Customers will be able to choose alternative energy management and information services. Consistent with feedback from municipal, business-oriented, and consumer advocacy stakeholders, SDG&E's Smart Grid will ensure that new market participants are able to enter markets and provide services that customers desire. Smart Grid investments will help SDG&E:

- Enhance overall value of identified products as part of the market;
- Improve overall efficiency and operation of DER on grid;
- Facilitate participation of DER into CAISO market (including a pilot program to demonstrate viability);
- Enable time differentiated rates for storage, electric vehicles and small distributed generation;
- Integrate small distributed generation into the California Independent System Operator (CAISO) market; and,
- Enhance CAISO operational flexibility, while maintaining and/or improving SDG&E's grid reliability.

SDG&E will provide information and ensure the existence of a communication infrastructure that fully enables the capabilities and potential benefits of the "Smart Market." SDG&E will leverage open standards and interoperable architectures to enable existing and new participants to trade information, products and services in these markets.

SDG&E's vision for a "Smart Market" will require price signals that accurately reflect costs to provide utility services and avoid burdening one class of customer with costs that were incurred to serve another customer (cross subsidization). This will also help promote rational, sustainable and economically efficient decision making that will allow customers to minimize their energy costs and emissions.

Distributed renewable generation for residential net energy metered customers is a good example of the need for more accurate price signals to create a strategy that will lead to long term support for, and continued investment in, distributed renewable energy in California. A residential net energy metering (NEM) customer is generally a home owner that has sufficiently high wealth or income or a high enough credit rating to afford a PV system. When such a customer installs renewable generation, they use SDG&E like a battery – SDG&E stores the electricity the customer generates beyond their current demand, and returns that electricity to the customer when they need it. They also receive whatever electricity they still need from SDG&E under deeply discounted tier 1 and tier 2 rates. Under current rate design, SDG&E does not charge the NEM customer for the "battery," or "reliability" service it provides. However, these costs are real. Under existing rules, customers that have not or cannot afford to install PV are forced to pay these costs. In order to ensure a long term sustainable market for distributed renewable energy in California, NEM customers should pay the costs that are incurred to provide these services.[3]

SDG&E's discussions with various customers and stakeholders have also led to an additional component of SDG&E's vision for a "Smart Market": as customer needs and desires evolve, it will be necessary for SDG&E to make low emission electricity commodity services available from the utility in various forms so *all* of SDG&E's customers have the option of increased access to renewable energy at reasonable prices. All of California's energy consumers should have the option to choose energy from renewable sources and to reduce their emissions.

2.5 "SMART UTILITY"

A "Smart Utility" understands what its customers want, need, and value. Under SDG&E's vision for a "Smart Utility," it will create the foundation for an innovative, connected and sustainable energy future in its service territory. Customers are expected to increasingly adopt automated energy management systems, install distributed energy resources, utilize energy storage capabilities, and charge electrical

[3] One of the unintended consequences of this policy is that customers have no incentive to consider adopting energy storage as part of their system. Even if energy storage installed with a PV system could provide a more efficient solution for a customer than utility storage, it would not be adopted because PV customers can receive storage for free. For this reason, the inaccurate prices that result from NEM stand as an obstacle to the efficient adoption of storage technologies by PV customers.

vehicles. Customers have already told SDG&E that they want more service options. SDG&E will provide customer usage information, prices and critical event notifications through the customer's preferred communication channels. It will develop the distribution system and information technology infrastructure to enable and support growth in these customer alternative energy solutions.

To do this and accommodate California's RPS, Net Energy Metering and Low Carbon Fuel Standard requirements, SDG&E will need to improve its ability to integrate increased levels of renewable generation and electric vehicles into the distribution grid through various Smart Grid investments.

As a "Smart Utility," SDG&E will promote "Smart Markets" by enabling, facilitating, and/or creating reliable and transparent information services that are valued by customers and market participants. SDG&E will enable standard, consistent protocols across markets to provide secure transactions and protect customer information. It will create a platform that allows for efficient coordination between central station and distributed energy resources, managing energy demand based on accurate price signals to minimize costs and emissions. This Smart Grid platform will enable new markets, participants, products, and services. The platform will also allow for predictive capabilities for grid operators that will help minimize the impact of system disruptions to customers.

From a transmission perspective, SDG&E will implement projects designed to improve the speed with which the utility responds to issues on the transmission grid, provide the utility with additional information to allow it to pro actively avoid potential issues and to allow it to make more efficient use of its resources. Many of these projects will be designed to improve the speed with which the utility is able to respond to system events.

SDG&E will implement the tools necessary to create a self healing and resilient system through the use of real time information to more efficiently utilize its distribution and transmission assets, the expansion of communicating and remotely controllable field devices, and the support of projects which will protect the utility from the elements. For example, synchrophasors will provide real time data about the system's status and will ultimately be used for system control and restoration.

SDG&E will also be able to implement Smart Grid capabilities that enable new products and services that provide customers with differentiated levels of reliability and power quality that are tailored to meet their specific needs.

SDG&E's "Smart Utility" vision includes the provision of balancing, storage, reliability and integration services to customers which reflects the value of the service the utility provides and the infrastructure investment that supports it, particularly for distributed generation customers.

To support SDG&E's larger vision for Smart Grid, the company must also consider what role security will play in this new paradigm. SDG&E envisions that by 2020 all Smart Grid participants, from customers to service providers, to regulators, to utilities, must be able to rely on the availability of the system; trust the integrity of the information produced by the system; and be confident that sensitive information is secure from unauthorized access or disclosure. SDG&E's Smart Grid must be resistant to physical and cyber security threats, as well as resilient to attack and natural disasters. It must be aligned with industry standards and best practices. Because resources are finite, it must be built on a security program that uses well established risk management methodologies to maximize its security investments.

To realize this vision, security programs and infrastructure must make Smart Grid participants aware of the following: the utility must have greater visibility into the system state, as well as events taking place on the system; customers must understand their own role in better protecting their privacy; each system stakeholder must have more information to help the utility reduce the overall risk of the Smart Grid with an emphasis on creating a culture of security[4]. Security management functions must converge with central governance by the utility. This management must be open and federated for company to third party interoperability. Company security processes, such as incident response, must be integrated. For system resistance and resilience, centrally managed security policies will disperse, being driven into localized islands or communities of infrastructure to allow the system to continue to protect itself in the event it becomes isolated from the whole.

SDG&E's Smart Grid Deployment Vision for security will benefit customers by ensuring a trusted and reliable infrastructure that will enable them to better manage their energy usage and will provide them a broader choice of energy opportunities that fit their lifestyle, whether it is saving money or choosing from a wider selection of sustainable energy generators.

Being resistant to physical and cyber attack is a key theme of SDG&E's Smart Grid Deployment Plan Vision. It is essential that the Smart Grid be designed around industry best practices and standards. It is important to develop a risk management based security program that enables business risk owners to apply resources where the Smart Grid needs them most, based on known threats, vulnerabilities and impacts to the Smart Grid. It is also imperative that the utility enhance its situational awareness capabilities to identify and respond more quickly to physical or cyber events that could be precursors to a larger security incident.

Security will not only be embedded in SDG&E's Smart Grid's operational processes and technologies, but also in the people that participate in the generation, transmission, distribution and consumption of energy, including utilities, third parties and customers. These risk owners within SDG&E will continue to include physical and cyber security

[4] Aligns with the Energy Sector Control System Working Group's "Roadmap to Secure Energy Delivery Systems."

risks in their decisions. Utility employees, third parties and customers are informed and understand the shared obligation to protect every individual's privacy as well as the Smart Grid itself.

Smart Grid will act as an important and powerful economic driver for the region, as it serves as a platform that can be a focal point for new, innovative products and services, thereby giving rise to the growth and development of new and existing businesses. By introducing experienced, qualified and certified Diverse Business Enterprise (DBE) suppliers and helping new potential DBE providers expand their technical capabilities and capacity, SDG&E will leverage Smart Grid to ensure the continued growth of opportunities for DBEs.

A "Smart Utility" will require a smart workforce. As stakeholders in academia have recommended, SDG&E plans to develop a labor pool in partnership with universities, colleges, and trade schools that is trained and prepared to install, integrate, and manage smart technologies for the utility and third parties. This will lead to a workforce that is motivated, enabled, and competent to meet the needs of all the domains and functions of the Smart Grid initiative, maintain systems that support and create a workforce that is flexible and able to adapt to both immediate needs as well as needs 5-10 years in the future, and ensure that all supporting HR systems are aligned and consistent with the strategies of the Smart Grid initiative.

SDG&E has a strong commitment to ensure its workforce reflects the labor markets it serves. Therefore, as with all of its recruitment strategies, SDG&E will ensure the outreach for all employment opportunities related to Smart Grid is inclusive to all communities.

2.6 IMPLEMENTING THE POLICIES OF SB 17

In D.10-06-047, the Commission requires utilities to explain how their Smart Grid Deployment Plan Vision will further the following policies embraced in SB 17:

a. Create a self healing and resilient grid;

b. Empower consumers to actively participate in operations of the grid;

c. Resist attack;

d. Provide higher quality of power and avoid outages, saving money;

e. Accommodate all generation and storage options;

f. Enable electricity markets to flourish;

g. Run the grid more efficiently;

h. Enable penetration of intermittent power generation sources;

i. Create a platform for deployment of a wide range of energy technologies and management services;

j. Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources; and,

k. Significantly reduce the total environmental footprint of the current electric generation and delivery system in California.

SDG&E's plans for implementing these policies in 2015 and 2020 are summarized below.

A. CREATE A SELF HEALING AND RESILIENT GRID

SDG&E's Smart Grid vision includes implementing the tools necessary to create a self healing and resilient system through the use of real time information to more efficiently utilize its distribution and transmission assets, the expansion of communicating and remotely controllable field devices, and the support of projects which will protect the utility from the elements. Synchrophasors will provide real time data about the system status and will ultimately be used for system control and restoration. These applications at substation systems will utilize algorithms to make decisions at the transmission and distribution level. This will allow isolated fault detection and remove operator or human intervention that tends to increase restoration times. Automated decisions will reduce outage durations and increase reliability.

Under SDG&E's vision, SDG&E will implement increased self healing properties and resiliency on its distribution system under the following implementation roadmap:

By 2015

- Automatic fault detection, isolation, and service restoration capabilities are being enabled, requiring minimal human intervention and leading to improvement in outage reporting measurements.
- PEV growth is supported and encouraged through the application of new technologies to manage customer load and facilitate electric vehicle charging to minimize impacts to the grid.
- The network is designed and provisioned with alternate communication coverage should a critical node fail. Grid communication protocols and placement of wireless aggregation radio sites support intelligent automated failover.

By 2020

- Supply side network reliability management and predictive capabilities are in place.
- SDG&E is enabling differing levels of reliability, depending on customer needs for self sufficiency, with corresponding tariffs (particularly for C&I customers).
- Redundant network services are deployed to targeted areas to ensure continued availability for critical applications.
- Full self healing infrastructure allows for proactive repair of the system before events become customer impacting incidents.

B. EMPOWER CONSUMERS TO ACTIVELY PARTICIPATE IN OPERATIONS OF THE GRID

It is SDG&E's vision to provide customers with near real time signals via price and/event triggers to balance supply and demand. Customers may elect to participate in programs with event triggers that manage and control customer end-use load. Utilities, the CAISO and/or third parties will provide capacity payments or incentives, or markets for energy or ancillary services that will be available for customer participation (same day and near real-time programs) as described in the prior "Smart Market" description. Pricing will reflect the value of capacity to the utility and society (value of service). Programs will provide customers with capacity payments or other incentives for capacity. SDG&E will facilitate and empower consumers to actively participate in grid operations by providing more information about the grid's operational condition and associated energy pricing. The utility will develop systems that will enable dynamic optimization of grid operations and resources, including appropriate consideration for asset management and utilization. All customer and grid systems monitoring, controls and information transmission will adhere to cyber security standards; and customer privacy will continue to be protected according to best practices.

SDG&E's vision for empowering customers through Smart Grid deployment is set forth in greater detail below.

By 2015

- SDG&E and third parties are providing HAN and other customer premise network capabilities, providing customers real-time feedback on power consumption and energy pricing.
- Standardized/reliable customer specific interval usage information and time-differentiated price signals are available and transparent, enabling customers to make informed and cost-based energy use decisions.
- SDG&E is providing options for customers to control and prioritize control of their loads to accommodate distributed renewables and efficiently integrate PEV loads.
- HANs and other customer premise devices are improving price-based and event-based demand response through automation. HAN and other customer premise

devices act as low cost interfaces with automated applications for demand bidding and other DR program participation.

- SDG&E is implementing two way communications between utility field networks and customer premise networks to enable customers to participate actively and securely in demand response, electric vehicle home charging, and retail wind and solar energy programs.
- SDG&E has extended grid communications to the distribution system, enabling distributed generation customers who provide energy back to the grid to report and view near real time status of usage, rates, and system status.

By 2020

- HAN and other customer premise communications continue to be extended into multi tenant buildings (i.e., apartment buildings, high rise, and premises physically removed from the meter location).
- Energy management systems capabilities are being embedded into most electronic devices such that direct communication via the Internet is an option for customers and manufacturers of appliances and other equipment. Utilities or other third parties can transmit to and receive signals from such devices.
- SDG&E is providing options and tariffs for customers to sell generation using distributed energy resources, dynamic market pricing, "electric vehicle to grid" applications, or energy storage discharge to optimize overall system efficiency and costs.
- Integrated systems are enabling a holistic approach to data management of customer information, GIS and other data that will lead to further innovation and cost effective energy use decisions.

C. RESIST ATTACK

Being resistant to physical and cyber attack is a key theme of SDG&E's Smart Grid Deployment Plan Vision. It is essential that the Smart Grid be designed around industry best practices and standards. It is important to develop a risk management based security program that enables business risk owners to apply resources where the Smart Grid needs it most, based on known threats, vulnerabilities and impacts to the Smart Grid. It is also imperative that the utility enhance its situational awareness capabilities to identify and respond more quickly to physical or cyber events that could be precursors to a larger security incident. SDG&E realizes that it cannot achieve its security goals alone. Raising the awareness of every actor and participant, including utility employees, third parties, consumers, and even regulators of a Smart Grid will be imperative to ensuring everyone understands their shared obligation to protect the Smart Grid.

SDG&E's vision is to converge security management and customer privacy capabilities across its risk owners and set enterprise wide policies that can be collectively acted on by a wide variety of disaggregated defense mechanisms through the use of intelligent automation. This convergence allows the utility to establish inter connected security capabilities such as incident response or key management, which work together within the utility and interoperate with third parties that have need to know or need to share security information with the utility. Finally, by disaggregating security control capabilities, such as video surveillance, malware prevention, event logging or intrusion prevention, SDG&E recognizes that even small portions of Smart Grid archipelagos need to be able to better protect themselves if they are disconnected from the larger whole for periods of time with response times improved to better support a real time environment.

All SDG&E projects will be done in a manner that is designed to resist attack. For example, SDG&E envisions that its transmission system will involve increased transfers of data, remote or automated control and increased interactions with customers, generators, the CAISO and other market participants. SDG&E will proceed only when the security of the system will not be compromised.

SDG&E will also strive to ensure that the electric system, IT systems, smart meters and new Smart Grid technology deployments are designed to resist attack from outside sources so that service reliability is not jeopardized. This will be accomplished as follows:

<u>By 2015</u>

- SDG&E continues to ensure that all Smart Grid technologies applied to the electric distribution system are designed with control and communication systems that are highly resistant to outside intrusion or other unauthorized uses.
- Equipment manufacturers are using internal component designs that have hardware enabled detection for outside intrusions to enable isolation of affected equipment.
- End point security enforcement and centralized security policy management are increasing system security inside and outside data and control centers.
- Smart Grid network security continues to improve, further protecting against unauthorized access and incorporating responsive intrusion detection and prevention measures.
- Communications networks are architected, configured, operated, monitored, and audited consistent with evolving regulatory policy and security best practices.

<u>By 2020</u>

- SDG&E continues to work with technology providers to develop new control systems that can automatically detect an attack and reconfigure to resist attack.
- Enhanced security, accountability and auditing capabilities in private and public clouds are enabled, lowering the overall costs of data storage and computation while improving the system's resistance to attacks.

- Smart Grid applications provide detailed logging of events enabling transactions to be traced from end to end and correlated with other events or messages for improved security, problem resolution, and performance monitoring.

D. PROVIDE HIGHER QUALITY OF POWER AND AVOID OUTAGES

SDG&E will provide higher levels of power quality, reduce outages, and reduce restoration time by implementing new technologies. These will provide dynamic voltage regulation to increase power quality as well as automated fault location and switching during forced or unplanned outage conditions. Under SDG&E's vision, SDG&E will implement Smart Grid capabilities that enable new product and services that provide customers differentiated levels of reliability and power quality that are tailored to meet their specific needs. Automated demand response methods will also be used to balance local system conditions, and smart meters will provide "last gasp" alarms which will assist in real time identification of local outages.

Improved measurement, control, protection, management, and optimization of the grid will allow SDG&E to avoid outages by anticipating potential problems and responding before they become an issue, or by quickly adjusting the transmission and distribution system to minimize any potential outages. The increased data about the conditions of the system will allow SDG&E and the CAISO to provide a higher quality of power by more quickly recognizing when the power quality is deviating from ideal and adjusting the transmission system to correct issues at an earlier time period. The initial steps in this process will focus on increased measurement and recording through new systems, followed by putting that data to use in control and protection projects.

Under SDG&E's Smart Grid Deployment Plan Vision, power quality issues will be more easily identified through the use of detailed, widespread, and dependable data collected throughout the system. Outages will be more clearly defined through the use of smart meters and other sensors, and lessened or avoided by the expansion of remotely controllable field switches and self healing practices.

Cost based rates, dynamic pricing and demand response will also enable new products and services to help customers manage their energy usage. Third party information service providers, demand response aggregators, and alternative energy management service providers will provide value added services given transparent and timely price signals.

SDG&E's vision for providing higher quality of power and to avoid outages is set forth in greater detail below.

By 2015

- SDG&E, along with the CAISO, continues to develop and deploy solutions that mitigate intermittency caused by high penetration of renewable generation.
- Automatic fault detection, isolation, and service restoration capabilities are being enabled, requiring minimal human intervention and leading to improvement in outage reporting measurements.
- PEVs are being integrated in larger numbers, without impacting distribution service reliability.
- Proactive outage communication, fewer and shorter outages, higher customer satisfaction, and fewer complaints are achieved through application of new communications, sensor, and control technologies.

By 2020

- Distributed generation, energy storage, and demand response are being managed for use as virtual power plants and other applications.
- Fully integrated data systems are enabling a holistic approach to data management improving overall utility situational awareness regarding the state of the grid.

- SDG&E is installing advanced voltage regulation equipment to improve power quality.
- SDG&E continues to work with the industry to develop interfaces with customer loads to allow dynamic control and regulation.

E. ACCOMMODATE ALL COST EFFECTIVE GENERATION AND ENERGY STORAGE OPTIONS

SDG&E will strive to accommodate all cost effective generation and energy storage options by implementing new Smart Grid technology which will address voltage regulation, power quality issues and other impacts caused by new variable energy resources. The following outlines SDG&E's vision for implementing these capabilities.

By 2015

- Open systems and standards exist to facilitate a "plug and play" approach to the integration of various DER sources, energy management systems, and services.
- SDG&E's system integration platform provides improved interoperability among different systems.
- Smart Grid communications are enabled along distribution lines connecting DER and energy storage providers, enabling timely and secure information exchange with distributed renewable energy providers, energy storage partners, and the CAISO markets.

By 2020, PEVs and DER products and services will reach mainstream, supported by regulatory mechanisms. Third parties will help customers with making supply and storage decisions. All electronic devices will be networked with energy management capabilities such that customers can maintain comfort, control, and choices with a net zero energy home and businesses. SDG&E's vision is to enable these capabilities as follows.

By 2020

- SDG&E continues to develop control and communication systems to facilitate aggregation of energy storage and distributed energy resources, including "vehicle to grid" applications.
- SDG&E continues to develop forecasting capabilities for energy storage capacity and distributed energy resources.
- SDG&E is providing customers with opportunities to actively participate in the market using open standards and commercial-off-the-shelf (COTS)/in-house applications by leveraging time series data and event correlations, as well as meter data brought together using system integrations.
- Next generation wireless communication technologies enable greater geographic coverage and higher data capacity for monitoring and managing an increasing number of Smart Grid field area network devices.

F. Enable Electricity Markets to Flourish

Under SDG&E's Smart Grid Deployment Plan Vision, customers will have access to energy and ancillary service markets at the CAISO and SDG&E will work with the CAISO and other market participants to ensure that new markets are developed, or existing markets are improved to provide for services or energy needed for the continued operation of the grid. Third parties will continue to develop value-added services to meet customer and market needs, and SDG&E will provide the platform. SDG&E's customers' energy-related decisions will be integrated with other parts of their lives—e.g., mobile devices, PEV charging at the mall. It is even possible that aggregation of energy demand and renewable generation resources develop. SDG&E provides the core technical platform on which these services can be provided. In addition to various Smart Grid investments, this transition will also require a transition to accurate price signals, so efficient markets emerge and customer decisions can be made that minimize energy costs and emissions, without unfairly benefitting customers that have alternatives such as rooftop solar at the expense of those that do not. It is also important to SDG&E that all market segments have access to distributed energy systems, including underserved communities.

SDG&E will facilitate its customers' participation in DR rates and programs. Automated Demand Response (Auto DR), Residential Automated Control Technologies (RACT) and other automated technologies will receive dispatched triggers or prices and will be able to initiate localized responses to balance or control local grid conditions.

SDG&E will continue to support and implement technologies that adhere to industry open standards for interoperability and integration. These system compatible technologies will provide energy management services and systems and controls functionality that are integrated with the HAN and SDG&E support systems.

More specifically, SDG&E's vision is to encourage, promote, and assist electricity markets to flourish through application of new technology and communication systems as follows:

By 2015

- SDG&E and third parties are enabling greater customer choice through HANs and other customer premise networks.
- SDG&E's system integration platform provides improved and more cost effective interoperability among different systems.
- SDG&E is implementing identity federation to ease customer access to different applications and third party applications with a single identity.
- SDG&E continues to deploy flexible web and mobile application platforms providing easy information access for customers via different channels: portal, mobile access, etc.

- SDG&E is providing customers with a choice of user interfaces (e.g. portal, client, smart device) and notifications services (SMS text, Facebook, Twitter, etc.) that allow them to manage access, and view pricing information.
- Distributed energy resources are able to participate in CAISO markets, enabling improved utilization of all energy resources within the CAISO operating area.

By 2020

- SDG&E's Distributed Energy Resource Management System (DERMS) is fully functional and interfacing with customer loads and resources, supporting the planning and utilization of all distributed energy resources.
- The market continues to efficiently integrate the aggregation of distributed resources, including electric vehicle to Grid applications, and energy storage.
- Price signals reflect efficient markets and the utility role moves toward that of a market facilitator.
- Energy management systems capabilities are being embedded into most electronic devices such that direct communications via the Internet is an option for customers and manufacturers of appliances and other equipment. Utilities or other third parties can transmit to and receive signals from such devices providing capabilities for finer grained management of distribution resources and loads.

G. RUN THE GRID MORE EFFICIENTLY

SDG&E's vision will be implementing several projects that will lead to a more efficient grid. A major theme within this will be the use of dynamic ratings in order to optimize the utilization of its assets. This will be especially helpful as SDG&E finishes a phase identification process to optimize capacity.

The expansion of remotely controllable isolation devices and other wireless technologies monitoring the grid will provide a detailed representation of SDG&E's real time operations from which educated and effective decisions can be made. To ensure its field force is as efficient as possible, workforce enablement projects have been put in place to digitize SDG&E's crews and start to have a faster, more environmentally friendly system which will be connected through computers and wireless communications.

Improved data on the conditions in various parts of the grid will allow SDG&E and the CAISO to optimize power flows on the grid and minimize losses, leading to a more efficient grid. Time of use rates will modify customer energy usage patterns. Asset life and operating capacity begin to be optimized via real time information and analytics and maintenance costs will be reduced via better information that begins to enable resource optimization.

As the grid becomes more observable, SDG&E will need to meet the requirements to support advanced grid control and business operations.

SDG&E's vision for ensuring that the electric system efficiency is improved through optimization of design of equipment, implementation, and optimization of control as follows:

By 2015

- Improved voltage regulation of the distribution system through energy storage, automated capacitor switching, and other devices is resulting in lower system losses.
- Robust grid communications are enabling near real time and real time access to information required to more efficiently operate the grid.
- SDG&E continues to improve asset tracking and management through more comprehensive asset synchronization.

- SDG&E continues to enhance near real time analytic services for control room analysis (via time series based or alternative analytic tools) to enable predictive analysis, geospatial analysis.
- "Smart Charging" applications are enabling the integration of greater numbers of PEVs while helping to maximize distribution system efficiencies.
- SDG&E continues to integrate capabilities for field crews, including exploration into alternative tools (e.g., heads up displays, energized line notification, manuals on demand, goggles, wearable computing gear), and provides improved computational resources for field crews at the point of work.
- Community colleges, trade schools, and universities have Smart Grid based curricula that provide utilities with a Smart Grid ready recruiting pool.

By 2020

- Optimization of renewable resource dispatch is leading to more efficient use of resources and lower system losses.
- Ancillary service markets are allowing use of distribution level resources to support the transmission system, resulting in better load dispatch and lower system losses.
- Capital expenditures are deferred or reduced through better planning information and utilization of distributed resources.
- SDG&E is leveraging time series data and event correlations to provide predictive capabilities that improve management of individual assets and system operating performance and health.
- SDG&E is partnering with educators to provide onsite university level training for Smart Grid subjects.

H. ENABLE PENETRATION OF INTERMITTENT POWER GENERATION SOURCES

SDG&E's vision includes enabling high penetration of intermittent renewable resources by using advanced technologies in energy storage (utility, customer and third party owned), providing advanced control of and management of these intermittent renewable resources, and solid state voltage regulation as follows:

By 2015

- SDG&E is architecting and enabling network connectivity and/or network interface points to enable secure and timely information exchange for intermittent power generators to participate in energy information services and events.
- Installation and provisioning of cost effective energy storage, either utility, customer, or third party owned, is helping to resolve voltage regulation, voltage flicker, and intermittency of renewable resources.
- Residential distributed generation output has metering and control options enabled by HANs.
- SDG&E is continuing to expand extranet connectivity for secure third party integrations to the utility and Smart Grid applications.

By 2020

- Advanced inverter controls (for both distributed and central station renewables) are smoothing intermittency associated with solar and wind resources.

I. CREATE A PLATFORM FOR DEPLOYMENT OF A WIDE RANGE OF ENERGY TECHNOLOGIES AND MANAGEMENT SERVICES

SDG&E's vision is to provide an infrastructure for the electricity grid that allows for the utility, customers and third parties to install a wide range of energy technologies and system management services. These will enable a wide range of energy technologies to be incorporated into the grid without adversely affecting, and indeed actually assisting, in the reliable operation of the grid. SDG&E's vision of this platform includes:

By 2015

- SDG&E's communication platforms for distribution Smart Grid devices allow future expansion and enable new technologies and services to integrate into the network.
- SDG&E continues to provide open access for applications/services with common data standards for both internal and external information exchanges.
- SDG&E's secure wired and wireless networks enable deployment of a wide range of energy technology devices and services, with layered RF networks enabling communication solution flexibility.
- SDG&E's HAN and other customer premise communications capabilities facilitate the continued integration of new energy management devices including end use control automation.
- SDG&E continues to conduct RD&D with other parties to help bring more smart grid related technologies to the market.

By 2020

- New Smart Grid distribution sensing and control devices are being integrated to improve distribution system scheduling, management, and operational support.
- Synchrophasor data is being used to assess the condition of the grid and respond to changes before they become problems. This functionality will potentially enable and/or require new products and services in the CAISO markets, especially the ancillary services market.
- Next generation wireless communications technologies and techniques are improving to support the increased volume of vaulted and underground distribution electric infrastructure.

J. ENABLE AND SUPPORT THE SALE OF DEMAND RESPONSE, ENERGY EFFICIENCY, DISTRIBUTED GENERATION, AND STORAGE INTO WHOLESALE ENERGY MARKETS AS A RESOURCE, ON EQUAL FOOTING WITH TRADITIONAL GENERATION RESOURCES

SDG&E will work with the CAISO to ensure that those resources that can, and want to, can participate in the CAISO wholesale energy and ancillary service markets. Under its Smart Grid Deployment Plan Vision, SDG&E plans to make automated technology available to customers and facilitate third party provisioning of technology that can dispatch demand response, DG and storage on an individual customer basis or as an aggregator. Wholesale energy markets and wholesale prices will be translated into retail prices for customers in a transparent and timely manner. As SDG&E empowers its customers to become more involved in their energy usage, SDG&E envisions a new grid with complex systems allowing demand response programs that help both the utility and the customer, energy efficiency practices that become the norm and not just for those who are "green," the further expansion of distributed energy, and the introduction of energy storage to support the system.

SDG&E will provide customers with their own customer specific information on energy usage and dynamic pricing which will enable:

- Energy conservation because of the information feedback impact;
- Energy efficiency investment measures (equipment, appliances, others);
- Demand response; and,
- Distributed generation and storage investments for an on premise energy source and market availability of stored energy (customers can sell into market at a price if combined with automated demand response).

SDG&E will support the sale of demand response, energy efficiency, and distributed energy storage and generation into wholesale energy markets as is described in greater detail below.

By 2015

- Energy awareness provided by HANs and other customer premise networks, integrated with smart appliances and other communicating devices, is allowing customers to better conserve energy and more intelligently target their EE investments.
- HAN and other customer premise automation technologies like PCTs, load control devices, and smart appliances are allowing for improved DR response from individual customers, driving down the cost to participate and allowing smaller and smaller loads to economically participate in DR.

By 2020

- Price driven demand response capabilities are continuing to improve, enabling more efficient use of resources and market integration for demand response, energy efficiency, distributed generation, and energy storage.
- Widely adopted NIST standards are creating a ubiquitous market of plug and play networked devices in homes and businesses.

K. SIGNIFICANTLY REDUCE THE TOTAL ENVIRONMENTAL FOOTPRINT OF THE CURRENT ELECTRIC GENERATION AND DELIVERY SYSTEM AS WELL AS VEHICLE EMISSIONS IN CALIFORNIA

SDG&E's Smart Grid Deployment Plan, in combination with other programs, will reduce SDG&E's total environmental footprint. Its Smart Grid Deployment Plan Vision includes enabling the promotion of economic investments in energy efficiency investment measures (equipment, appliances, others), demand response with dynamic price signals, enabling the use of distributed generation and storage as on premise energy source and/or provider of services to the market. SDG&E will pursue this in conjunction with information and communications with its customers to enable and maximize conservation impacts.

Implementation of SDG&E's Smart Grid Deployment Plan Vision will also improve the efficiency of the current system, allow for the more efficient interconnection of and utilization of intermittent resources such as wind and solar projects, and foster new and innovative ways to reduce GHGs. As the system becomes more efficient, the energy lost during transmission will be reduced, thereby resulting in less overall losses and less energy need to be generated to meet demand.

The efforts SDG&E will make to ensure that all types of generation and storage can connect and that the grid is able to accommodate the increased intermittency that will accompany the vast expansion of renewable resources are specifically designed to help reduce the environmental footprint of electricity in California. Further, by allowing the grid to be operated more efficiently (for example with less system losses) and by carefully planning what additions are needed the environmental impact of the transmission system itself will also be reduced.

"...conservation impacts create the cleanest electricity available, that which is never generated."

SDG&E strives to be a leader in reducing the environmental footprint. SDG&E's vision will help accomplish this objective through its support for enabling renewable resources and the adoption of PEVs. By enabling the growth of renewable energy resources and the safe, reliable and efficient integration of PEV loads with the grid, SDG&E will make a significant contribution to efforts to lessen the amount of fossil fuels burned, drive down the need for new power plant construction, reduce the dependency on the oil market, and create an overall awareness for the environment throughout the company and its customers.

SDG&E's Smart Grid Deployment Plan Vision recognizes that conservation impacts create the cleanest electricity available, that which is never generated. Because demand response allows the electricity grid to avoid using inefficient peaking generation, it also can have a material impact in reducing total GHG emissions. SDG&E's

vision for reducing the overall environmental footprint of the electric system and vehicle emissions is outlined below:

By 2015

- SDG&E, customers, and other third parties continue to install energy storage to enable more efficient use of renewable resources and to reduce overall base load generation requirements.
- SDG&E is relieving congestion by utilizing dynamic line ratings and synchrophasor data to more efficiently operate the grid.
- SDG&E is deploying highly energy efficient data center infrastructure through virtualization and server consolidation, including active power management for server and storage systems.
- SDG&E and its stakeholders continue to build capabilities to track emission reductions associated with PEV charging, in compliance with the California Air Resources Board Low Carbon Fuel Standard.

By 2020

- The ability to aggregate energy storage and distributed resources is leading to more efficient dispatching of resources.
- Data storage and computing systems are leveraging ultra low power technologies.
- SDG&E is enabling automatic server workload migration capabilities, based on availability, cost, and source (fossil fuel, solar, wind generated) of power.
- SDG&E's information systems and applications are being deployed on infrastructure with lower energy usage.

Section 3 – DEPLOYMENT BASELINE

3 DEPLOYMENT BASELINE

3.1 INTRODUCTION

SDG&E sees Smart Grid as an evolution not a revolution; however, the pace of evolution is accelerating. SDG&E has historically been proactive in adopting new technologies. For example, SDG&E installed its first generation geographic information system (GIS) and outage management system (OMS) in the early 1980s. SDG&E has been deploying transmission, substation, and distribution line SCADA since the mid 1980s, has deployed high temperature low sag conductors as well as synchrophasors on the bulk power system, and deployed a STATCOM (static VAr compensation) device at Talega substation to provide dynamic VAr support on the transmission system.

Consistent with its Smart Grid vision, SDG&E continues to make smart technology investments to meet state and federal policy requirements and drive value to customers, laying the foundation for an innovative, connected and sustainable energy future in its service territory. SDG&E also recognizes that maintaining consumer trust in the electrical grid as it modernizes into the Smart Grid will be essential, especially in enabling consumer choice while protecting consumer privacy through technologies like smart meters. Current investments have been evaluated and undertaken because they enable customer choice, control and convenience; provide improvement of the utility network's effectiveness and efficiency; or are clearly aligned to policy compliance. In addition, these investments have been made with an objective to allow for the utmost flexibility, so that future investments can address emerging requirements as they present themselves and capture new benefits where they exist.

SDG&E's "OpEx 20/20" program (Operational Excellence with a 20/20 vision, which encompasses the re engineering of key operational business processes to support Smart Grid, along with new versions of key associated software systems) is a prime example of the utility's philosophy as it drives for benefits in managing its network today through enhanced outage management, network visibility, mobile workforce enablement, and customer information presentment. Each of these areas is important to how SDG&E runs its business today, but also combine to provide a critical platform for the deployment of the smart technologies outlined in the SDG&E Smart Grid Deployment Plan Roadmap. For example, its Outage Management System/Distribution Management System (OMS/DMS) investment provides the foundation for managing the increasing number of smart controllable devices the SDG&E network will require. Its GIS investment provides an enterprise view of the network that will allow the utility to respond to shorter planning cycles driven by industry trends, and to be more efficient in its operations. SDG&E's investments in customer management and information presentment can be extended to support new types of information sought by customers in the future.

SDG&E's Advanced Metering Infrastructure (AMI) deployment was nearly complete by year end 2010 with 1,820,000 electric and gas smart meters deployed. The San Diego region is also home to the highest penetration of electric vehicles in the U.S., and accordingly SDG&E's clean transportation and PEV programs are sufficiently advanced to support customers who are choosing these low emission alternatives.

SDG&E also has a number of pilot and demonstration projects in flight to assist its understanding of smart technologies. For example, its Borrego Springs Microgrid project is demonstrating a Smart Grid alternative service delivery model and technologies that SDG&E believes can support reliability and incorporate a wider group of energy generators (e.g., wind, solar, storage, etc.).

These investments and other existing major smart technology investments are discussed in more detail in this section. This section also includes a description of the current state of SDG&E's grid including transmission and distribution infrastructure, communications, and generation resources currently existing in SDG&E service territory. Lastly, it presents the security and privacy features of our existing Smart Grid investments.

3.2 CURRENT STATE OF SDG&E'S GRID

The key generation, transmission, and distribution characteristics of SDG&E's grid as of December 31, 2010 are described below. They are provided as context for the current and planned Smart Grid investments that are discussed in this deployment plan.

3.2.1 GENERATION

The generation fleet that is currently connected to SDG&E's grid is undergoing a transition. The plants that were built in the 1960s and 1970s are methodically being retired and replaced with new plants that are based on technologies that are better equipped to meet the needs of the grid going forward.

- The current mix of generation units connected to SDG&E's system that provide power to the grid are:
  - Combined Cycle Plants: 1,160 MW
  - Steam Plants: 960 MW
  - Simple Cycle Peaking Plants: 688 MW
  - Renewable Plants: 75 MW
  - Cogeneration (Combined Heat and Power) Plants: 157 MW

Since 2000, the generation fleet connected to SDG&E's grid has undergone the following changes:

- Two new combined cycle plants have added approximately 1,160 MW of new generation capacity. These units are about 1/3 more efficient than the generation fleet they are replacing. Combined Cycle plants have a heat rate of about 7,000 British thermal units/kilowatt hour (Btu/kWh) as compared to the older steam plants with heat rates in excess of 10,000 Btu/kWh.

- Ten new peaking units of about 50 MW each at seven different locations have added approximately 500 MW of new capacity. These units are capable of going from offline to full power in less than 10 minutes.

Several of the older vintage plants currently connected to the grid are expected to be retired soon. These include:

- The Encina Power Plant, a five unit, 960 MW plant that uses steam boiler technology; is expected to retire by 2017 due to increased restrictions in the state's policies regarding the use of once-through cooling technologies that rely on ocean water.

- The Cabrillo II Peaking Plants are 12 peaking units, each with a capacity about 16 MW, located at three different sites. These units are expected to retire at the end of 2013 when their land leases expire. These old inefficient units have extremely high heat rates (above 15,000 Btu/kWh) and have very limited operating hours (under 900 hours a year).

The remaining generation fleet connected to the SDG&E grid includes:

- 13 different renewable power facilities that provide about 75 MW (nameplate) to the grid. These facilities are mostly made up of biogas facilities and a wind project.

- Approximately 90 MW of small-scale solar, mostly made up of plants located on business and residential rooftops where the power is consumed at or near the location it is generated.

- Four large cogeneration facilities with a total capacity of 157 MW that provide most of their electrical power to the grid.

- Approximately 80 MW small scale generation combined heat and power facilities where the electrical output is mostly used by the business were the facility is located.

To maintain the generation and load balance SDG&E adheres to CAISO and NERC reliability criteria. Under a one in ten year adverse load forecast scenario, the load and generation balance must be maintained even when the largest transmission line ("N-1"), and the largest single generation plant ("G-1"), are out of service. Thus, absent new major transmission lines, new local generation will need to be added as load increases.

Generation connected to the SDG&E grid consists of both utility owned generation and generation plants owned by independent energy producers. Because the transmission grid is subject to an open access tariff, generation resources connected to the grid do not need to be generation that is committed to serve SDG&E's load. Under an open access tariff, any generator that wants to connect to SDG&E's grid can do so long as it has the necessary studies completed and pays for any required system upgrades.

3.2.2 TRANSMISSION

The San Diego region's transmission infrastructure is typically described as being in an "electrical cul-de-sac" due to its location at the southernmost tip of California adjacent to the Pacific Ocean and the Mexican border, which geographically limits the transmission paths possible in the area. The one existing 500 kV transmission line, also known as the Southwest Powerlink (SWPL), connects the SDG&E grid to Arizona. The Imperial Valley Substation, situated on the one existing 500kV transmission path, is also an injection point for generation located in Mexico and proposed renewable generation in Imperial County.

SDG&E's electric transmission network is summarized as follows:

Transmission (500kV, 230kV, 138kV & 69 kV)

- 1,762 miles overhead
- 105 miles underground
- 14,142 structures
- 22 substations
- 201 tie lines

The Sunrise Powerlink is now under construction and when completed (expected 2012) will add an additional 115 miles of 500 kV and 230 kV electric transmission lines.

Historically, SDG&E has been very proactive in applying technology to its system. SDG&E has utilized high temperature low sag conductors for many years; several lines also have dynamic ratings, transmission engineering has also piloted some composite core conductors and approximately 95 percent of the transmission system is controlled via SCADA. Additionally, SDG&E installed a 300 MVAr STATCOM device at Talega substation to provide dynamic VAr support for the system. SDG&E has deployed a state of the art energy management system, EMS, which controls the SCADA devices and STATCOM device.

3.2.3 DISTRIBUTION

SDG&E's distribution grid is designed as a radial, open loop system. The primary voltages are 12 and 4 kV. Service transformers step down the voltage to the customer supply voltage at or near the customer point of delivery. SDG&E's distribution system contains both overhead and underground circuits with an exceptionally high proportion of the system underground. A summary of the distribution system is as follows:

Distribution (12 kV & 4 kV)

- 10,131 miles underground (60 percent)
- 6,658 miles overhead (40 percent)
- 219,482 wood poles
- 283 substations
- 997 circuits

SDG&E has Commission-regulated underground conversion programs and works jointly with the City of San Diego and other municipalities to underground a majority of the distribution lines within the jurisdiction of those municipalities. These programs convert overhead utilities to underground in accordance with boundaries established by the various jurisdictions within the SDG&E service territory.

SDG&E's Distribution Operations group relies heavily upon SCADA; over 70 percent of distribution circuits are controlled via SCADA. SDG&E already has seven self-healing circuits[5], both centralized and de-centralized, in operation. With its deployment of thousands of "field SCADA" devices since the early 90s, SDG&E is well positioned for a smooth transition into automatic power restoration capability (self-healing) system-wide. SDG&E's cable technology management leadership includes: early adopter of conduit system in the 1960s, excellent failure records, low failure rate compared to industry, an innovative cable fault locating technique & training facility, and unique predictive modeling capabilities to proactively replace cable before failure and to improve reliability. SDG&E utilizes this state-of-the-art cable asset management system along with predictive reliability assessment tools to manage system reliability. Legacy mainframe computer applications are utilized for managing outages. SDG&E has also been installing pulse closing technology to improve operations. An extensive weather network gives SDG&E's staff meteorologist and distribution operators wide area

[5] A self-healing grid is one that automatically reconfigures via autonomous switching operations in response to a system fault improving the local reliability.

situational awareness, better preparing the utility for weather related issues. These are just a few examples of SDG&E proactively applying technology to improve the distribution system's safe, reliable and efficient operation.

The *SDG&E Electric System Reliability Annual Report*[6] provides statistics for the following reliability indicators:

1. SAIDI (System Average Interruption Duration Index) minutes of sustained outages per customer per year.

2. SAIFI (System Average Interruption Frequency Index) number of sustained outages per customer per year.

3. MAIFI (Momentary Average Interruption Frequency Index) number of momentary outages per customer per year.

4. SAIDET (System Average Interruption Duration Index Exceeding Threshold) minutes of sustained outages per customer per year exceeding a defined annual threshold of 150 minutes.

5. ERT (Estimated Restoration Time) sum of the weighted accuracy of each outage divided by the number of customers who experienced an outage. Weighted accuracy is determined by using the time in play and number of customers who received accurate estimates.

The reported results for 2010 are presented in the following table.

6 ftp://ftp.cpuc.ca.gov/ElecReliabilityAnnualReports/2010/SDGE_2010%20Reliability%20Annual%20Report.pdf

Table 3-1: SDG&E Electric System Reliability 2010 Statistics

CRITERIA	SAIDI	SAIFI	MAIFI	SAIDET	ERT
Including CPUC Major Events (2010)	89.77	0.863	0.507	–	–
Excluding CPUC Major Events (2010)	67.74	0.543	0.428	35.82	54%
10-Year Average (2001-2010) Including CPUC Major Events	105.59	0.691	0.589	–	–
10-Year Average (2001-2010) Excluding CPUC Major Events	64.09	0.596	0.569	–	–

The historical reliability indices reported by SDG&E to the Commission are as follows:

Table 3-2: SDG&E Electric System Reliability Historical Indices

	All Forced Interruptions Included			CPUC Major Events Excluded				
Year	SAIDI	SAIFI	MAIFI	SAIDI	SAIFI	MAIFI	No. of Events	Event Cause(s)
2001	68.57	0.870	0.865	52.87	0.636	0.858	7	Fires (2), Load Curtailment (4), and Interruptions Due to Non-SDG&E Facilities (1)
2002	82.68	0.813	0.606	77.35	0.807	0.604	4	Fires (2), Interruptions Due to Non-SDG&E Facilities (2)
2003	298.45	0.860	0.869	76.14	0.717	0.845	2	Firestorm 2003 (1), Wind Storm Affecting >15% of Facilities (1)
2004	93.19	0.672	0.614	78.75	0.615	0.610	5	Fires (3), Interruptions Due to Non-SDG&E Facilities (1), December Storm (1)
2005	61.99	0.637	0.602	58.46	0.567	0.568	10	Fires (4), Interruptions Due to Non-SDG&E Facilities (4), Storms (2)
2006	52.83	0.545	0.494	52.65	0.541	0.494	9	Fires (6), Interruptions Due to Non-SDG&E Facilities (3)
2007	182.17	0.590	0.572	52.00	0.481	0.527	8	State of Emergency Declared (2), Interruptions Due to Non-SDG&E Facilities (2), Load Curtailment (1), Request to De-energize/ Restricted Access (3)
2008	59.17	0.517	0.380	58.92	0.515	0.378	9	Fires (2), Request to De-energize/ Restricted Access (7)
2009	67.06	0.542	0.380	66.01	0.538	0.380	4	Fires (1), Interruptions Due to Non-SDG&E Facilities (1), Request to De-energize/ Restricted Access (2)
2010	89.77	0.863	0.507	67.74	0.543	0.428	12	Storms (2), Interruptions Due to Non-SDG&E Facilities (6), Load Curtailment (1), Request to De-energize/ Restricted Access (3)

Table 3 3: SDG&E Historical System Reliability Data (using IEEE 1366 Exclusion Criteria)

SAN DIEGO GAS & ELECTRIC 2010 ELECTRIC SYSTEM RELIABILITY REPORT

HISTORICAL SYSTEM RELIABILITY DATA (USING IEEE 1366 EXCLUSION CRITERIA)

	All Forced Interruptions Included			Threshold Major Event Days Excluded *		
Year	SAIDI	SAIFI	MAIFI	SAIDI	SAIFI	MAIFI
2001	68.57	0.870	0.865	57.62	0.717	0.858
2002	82.68	0.813	0.606	70.71	0.621	0.588
2003	298.45	0.860	0.869	81.49	0.698	0.856
2004	93.19	0.672	0.614	78.83	0.619	0.610
2005	61.99	0.637	0.602	61.99	0.637	0.602
2006	52.83	0.545	0.494	52.83	0.545	0.494
2007	182.17	0.590	0.572	54.89	0.477	0.530
2008	59.17	0.517	0.380	59.17	0.517	0.380
2009	67.06	0.542	0.380	49.71	0.466	0.362
2010	89.77	0.863	0.507	63.36	0.520	0.441

* Per IEEE Standard 1366-2003 "2.5 beta method" for determining excludable days, days are excluded from a given year's metric if their SAIDI exceeds 2.5 times the standard deviation of daily SAIDI over the previous five year period.

SDG&E has been ranked by an independent utility consulting firm as having the "best" reliability in the western United States for five years in a row and earned the honor of "Best Reliability in the Nation" for 2009[7].

3.2.4 SUBSTATIONS

SDG&E has a total of three hundred and five substations. Twenty two of these are transmission only substations and only have 69 kV or higher voltages while the remaining distribution substations have primary voltages of 138 or 69 kV and secondary voltages of 12 or 4 kV. Ninety five percent of the transmission circuit breakers are SCADA controlled.

[7] "PA Consulting Group recognizes North American Utilities for excellence in reliability and customer service at the 2010 ReliabilityOne™ and ServiceOne Awards," Nov. 18, 2010

New transmission only substations in the last 10 years include the 230/69 kV Silvergate Substation, the 230kV Palomar Energy Substation to interconnect the SDG&E Palomar Energy Center power plant, and the 230kV Otay Mesa Substation which interconnects the Calpine Otay power plant. Other major transmission projects include a 500kV Miguel Substation retrofit with 500 kV Gas Insulated Substation and switchgear to reduce transmission congestion costs and a state of the art static VAr compensation (STATCOM) device at the Talega Substation. The Sunrise Powerlink's 500 kV substation will be SDG&E's third 500 kV substation upon its completion in 2012.

SDG&E's standard 12 kV distribution feeders are fed via 138/12 kV or 69/12 kV substations. The newer distribution substations have a standard design that specifies termination structures, switchgear, transformer banks, surge protection, power factor correction capacitors (if needed), load tap changers (if needed), control, protection and metering. Approximately 86 percent of the 12 kV distribution feeders have SCADA control (660 out of 765).

Finally, SDG&E is phasing out its 4 kV substations that exclusively serve 4 kV feeders (i.e. 69/4 kV or 12/4 kV). None of the 4 kV substations have SCADA control because they are being strategically replaced with 12 kV feeders or 12/4 kV pad mounted transformers.

SDG&E has adopted digital microprocessor relays in its substations since the mid 80s. These devices allow for smarter information & control of its grid, much earlier than most utilities. These technologies lay the foundation for future Smart Grid applications.

SDG&E is also installing condition based maintenance (CBM) to all transmission and distribution substations. This deployment is the largest and first of its kind in the United States. This program is part of the OPEX 20/20 program which will be discussed later.

3.2.5 DATA TRANSPORT

The SDG&E communication infrastructure consists of a private microwave system, a fiber optic network, a 900 MHz licensed radio system used for SCADA, as well as power line carrier (PLC), cellular, voice radio and copper lines. Communication systems are used for voice communication and data transport.

3.3 SAN DIEGO SMART GRID STUDY

In 2005 2006, SDG&E partnered with the Utility Consumers' Action Network (UCAN) on a *San Diego Smart Grid Study Report* prepared for the Energy Policy Initiatives Center (EPIC) at the University of San Diego School of Law and produced by the SAIC Smart Grid Team.[8] The study was one of the first in the nation to apply the Smart Grid concepts developed by the U. S. Department of Energy (DOE) Modern Grid Initiative[9] (MGI) to a specific region. It provided a preliminary analysis to determine the technical feasibility and cost effectiveness of implementing Smart Grid technologies and strategies in the San Diego region. The objectives of the study were to (1) determine whether the future economic and regulatory climate in the San Diego region could accommodate or necessitate a Smart Grid, (2) determine the portfolio of technologies that could implement a Smart Grid, and (3) conduct a cost benefit analysis to determine whether implementing a Smart Grid would be cost effective for the region.

This study provided SDG&E with a vision and early glimpse into the future of the Smart Grid. Applying the MGI, the study considered the application of advanced sensing, communication, and control technologies to generate and distribute electricity more effectively, economically and securely across the San Diego region from its source to consumer appliances and equipment.

The study ultimately provided a useful reference point and helped inform SDG&E's early efforts to develop its Smart Grid roadmap and vision.

[8] http://www.sandiego.edu/epic/research_reports/documents/061017_SDSmartGridStudyFINAL.pdf
[9] Information on the Modern Grid Initiative can be located at http://www.netl.doe.gov/smartgrid/

3.4 SMART TECHNOLOGY DEPLOYMENTS AND INVESTMENTS

3.4.1 OVERVIEW

SDG&E Smart Grid investments to date have helped prepare its network to deliver new and additional customer valued capabilities as the utility strives for greater efficiency and effectiveness across its system. SDG&E has implemented an engineering data warehouse for more than 10 years to integrate various data sources to support better system planning, operations & maintenance. In addition, SDG&E has used its investments as a flexible foundation to prepare for the future and to allow sufficient room to respond to changing drivers and needs.

In order to empower customers, SDG&E has undertaken investments that provide customers with choice, convenience and control over their energy usage or that lay the groundwork for enhanced customer choice, convenience and control. Timely energy usage information and control of in home appliances and equipment can be remotely enabled through the customers' smart meters and HANs. Its AMI deployment was 81 percent complete by the end of 2010 and is supporting six pilots testing HAN devices that provide customers with timely energy usage information and allow them to set alerts about their energy bills. Additionally, the grid automation investments SDG&E has made and continues to make across its network are also ensuring that the grid meets customers' service expectations while complying with the energy policy goals of the state. These investments also enable SDG&E to support additional products and services as market demand and policies emerge.

In maintaining and improving its network, SDG&E's OpEx 20/20 program is supporting the system through a series of investments that will allow SDG&E to manage its infrastructure more efficiently, increase operational effectiveness, and engage customers according to their preferences. SDG&E's OpEx 20/20 program also establishes the foundation for its Smart Grid investments with network visibility and management capabilities that can be extended to include additional technologies as they are implemented.

SDG&E is also investing in pilots to understand and utilize technologies that it believes will play an important future role in allowing the grid to incorporate renewable resources, meet stakeholders' expectations and meet state energy policy goals. Additionally, pilots help SDG&E understand expected future costs and benefits of wider deployments.

3.4.2 MAJOR TECHNOLOGY DEPLOYMENTS

SDG&E has made significant progress deploying a range of technologies to meet state and federal policy requirements; maximize customer energy value; and help create the foundation for an innovative, connected and sustainable energy future in the San Diego region. These include SDG&E's automation, Smart Meter and Sustainable Communities programs. Its smart meter deployment is almost complete and the utility continues to invest in customer serving infrastructure and smart meter enabled programs and rates, such as dynamic pricing programs and information presentation. SDG&E's grid automation and control investments have developed its ability to manage grid performance and set the foundation for additional Smart Grid investments. Through the technologies applied in its Sustainable Communities Program, the San Diego region can see how energy efficiency technologies, green building and renewable energy can significantly reduce customers' environmental footprint.

3.4.2.1 AUTOMATION

SDG&E is improving its existing and extensive automation and control capabilities through strategies and investments designed to meet state and federal policy requirements and to maximize value to customers.

SDG&E's Distribution Automation Control strategy coordinates the switching of discrete devices such as capacitor banks, voltage regulators, and load tap changing transformers.

Objectives include maintaining bus voltages across the network within specified voltage limits, minimizing the number of transmission switching operations, increasing voltage control reserves by keeping the maximum number of devices offline, mitigating circular reactive power flows, and improving voltage security while striving to maintain a high side bus power factor of 0.995.

By leveraging secure, reliable network communications capabilities; this technology deployment is a foundational element to SDG&E's Smart Grid Deployment Plan.

3.4.2.2 ADVANCED METERING INFRASTRUCTURE (AMI) DEPLOYMENT

SDG&E is deploying an Advanced Metering Infrastructure (AMI, also known as the Smart Meter program), throughout its San Diego and Orange County service territory to improve operational efficiencies, enable demand response for customers, and provide customers with information, understanding, and control over how they consume energy. The Smart Meter program will replace a projected 1.4 million electric meters and retrofit 900,000 gas modules and is scheduled for completion by the end of 2012. By the end of 2010, the Smart Meter program had installed 1,820,000 endpoints in its service territory including 1,095,000 electric and 725,000 gas smart meters. In addition, as part of the $572 million SDG&E Smart Meter Commission authorized funding[10], a ZigBee HAN communications module has been included in the electric smart meters. Furthermore, Smart Meter funding provided for the installation of approximately 36,000 programmable communicating thermostats (PCTs) in small business facilities. Additionally, a remote turn on, turn off device was required for all residential meter installations. This functionality is now being leveraged by Customer Call Center representatives and has provided customers an extremely quick turn on or turn off service when moving into new locations.

[10] The CPUC opinion approving settlement on SDG&E's AMI project may be found at http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/66766.pdf

AMI has established a two way communications infrastructure, providing automated meter reading in place of manual meter reading, integrating customer information and billing systems, that measures interval energy use data in fifteen minute increments for commercial and hourly increments for residential customers, and enabling electric demand response and load control devices that will assist customers to reduce peak energy use.

Customer information presentation will soon be supported by the My Account web portal[11] which will provide hourly electric usage information the day following its collection. In addition, customers can already obtain alternative smart meter data presentment on an opt in basis through Google's PowerMeter gadget (application)[12]. Furthermore, implementation of systems based on OpenADE[13] in 2011 is expected to accommodate "customer authorized" third party energy usage presentment providers. Near real time customer energy usage information will be available through HAN compatible devices (in home displays) and other HAN enabled equipment, appliances and information technologies.

While most of SDG&E's large commercial customers (>200 kW demand) already have automated meter reading solutions in place, this project will provide such metering capabilities for all residential and small and medium business customers.

Expected benefits of the Smart Meter program include:

- Improved customer service
- Outage management detection

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[11] SDG&E's My Account website is http://myaccount.sdge.com. Online interval data presentation will be generally available to customers in 2Q2011.
[12] PowerMeter is a project from google.org, a philanthropic part of Google that develops technology projects. Information on PowerMeter and google.org can be found at http://www.google.com/powermeter/about/index.html
[13] OpenADE is the Open Automated Data Exchange task force within OpenSG, which defined requirements and initial service definitions prior to transitioning their work to the North American Energy Standards Board (NAESB), a standards development organization, where the work continues under the Energy Services Provider Interface task force. Additional information can be found at http://osgug.ucaiug.org/sgsystems/OpenADE/default.aspx and http://www.naesb.org/espi_task_force.asp.

- Reduced need to access customer property
- Energy information availability which is leading to customer energy awareness and associated behavioral changes that increase energy efficiency
- Enables dynamic pricing and demand response

Additional benefits accrue to society when residential and small business customers change their energy use patterns and take advantage of rebates for kilowatt hours saved during peak usage periods. As customers shift their energy usage, more electricity becomes available, delaying the need for additional energy supply sources on peak usage days.

3.4.2.3 SUSTAINABLE COMMUNITIES PROGRAM

The Sustainable Communities Program (SCP) integrates clean energy generation systems in sustainably designed, energy efficient buildings throughout SDG&E's service territory. The SCP was approved by the Commission in the SDG&E 2004 Cost of Service proceeding and again in the SDG&E 2008 General Rate Case. The SCP has been recognized by the Commission as an example of the *California Long Term Energy Efficiency Strategic Plan* goal of demand side management coordination and integration[14]. Its requirement that program participants' buildings be highly energy efficient and sustainably built results in showcase projects that demonstrate the integration of energy efficiency measures, green building practices and clean distributed energy.

3.4.3 MAJOR INFLIGHT PROJECTS

SDG&E's investments include key programs and projects that are in the implementation stage including the ongoing OpEx 20/20, Security Event and Incident Management, fiber

[14] http://www.cpuc.ca.gov/NR/rdonlyres/D4321448 208C 48F9 9F62 1BBB14A8D717/0/EEStrategicPlan.pdf

optic communications to substations, and other undertakings to support a connected and sustainable smart energy future for its service territory. These investments are targeted to improve SDG&E's ability to manage the system and provide customers with engagement they value.

SDG&E is also investing to understand nascent "smart" technologies and how their value can be maximized in programs like the Borrego Springs Microgrid demonstration. These programs and pilots can also be found in the accompanying Smart Grid Deployment Plan Roadmap.

3.4.3.1 OPEX 20/20

OpEx 20/20 is the program name for a portfolio of 20 enterprise wide initiatives that focus on technology upgrades and process improvements to enhance the capabilities of front line employees within Electric Operations, Gas Operations, back office field and mapping support, Customer Service Field, and the Customer Contact Centers.

OpEx 20/20 (formerly called "Utility of the Future") enables SDG&E to continue to deliver Operational Excellence. "20/20" symbolizes a clear vision guiding the efforts over a 15 year program with initiatives that start and roll out at various times over several years.

OpEx 20/20 is providing new functionality to support decision making and greater visibility across the utility's operations and infrastructure and is allowing SDG&E to replace legacy software applications with commercial off the shelf products that cost less to maintain.

The advances in technology are enabling new, more efficient business processes and provide actionable information directly to employees.

Several of the new technologies listed below, such as Mobile Data Terminals (MDTs), are already in use at SDG&E[15].

With new technologies in place, many changes will occur.

- Expanding the use of **Mobile Data Terminals** with more functionality to more field crews and front line field supervisors reduces paperwork and makes high quality information readily available
- Building an enterprise **Geographic Information System (GIS)** consolidates foundational Smart Grid data into a single enterprise wide repository and enables field employees to access or update electronic maps of the transmission and distribution systems through mobile devices
- Implementing new **Outage and Distribution Management Systems (OMS/DMS)** immediately pinpoints electric outages and help take corrective action to minimize customer impact and more quickly restore service to customers
- Adding **Forecasting, Scheduling and Dispatching Systems** improvements support SDG&E's ability to plan work and route crews more efficiently reducing travel time and rescheduling changes automatically
- Implementing **Condition Based Maintenance** provides more effective use of large equipment, by proactively and automatically monitoring conditions that could impact reliability
- Offering **additional online services** for customers supports customer preference for these types of transactions

[15] The OpEx 20/20 programs include investments for both of Sempra Energy's regulated California utilities.

- **Single View of the Customer** enables understanding of an individual customer's activities across various programs and channels (such as the web, phone, and mail) so that it can provide improved service

3.4.3.2 MICROGRIDS

SDG&E's DOE funded and California Energy Commission (CEC) funded microgrid projects promote active customer participation to help support the community of Borrego Spring's energy needs and address standards, integration, and interoperability challenges for Smart Grid. Both microgrid projects are collocated in Borrego Springs, 100 miles northeast of the city of San Diego, with a population of 2,500 residents, and when complete, will form the largest U.S. microgrid in terms of capacity and the number of customers served.

A microgrid is a group of energy generators (e.g., wind, solar, portable generation, battery storage) and customer loads within a clearly defined area that can be controlled to act as single controllable entity with respect to the larger electric grid. A microgrid may have the ability to connect and disconnect from the grid ("island") in response to system disturbances, enabling it to "ride through" outages by temporarily supporting the microgrid's energy needs.

As the San Diego region's population and development growth continues further inland to the east, the peak to average MW capacity profile will continue to increase. This will likely increase reliability issues, making distributed energy resource (DER) based microgrids a necessary part of the grid design process where cost effective reliability is the priority. SDG&E's microgrid projects are using proven technologies, including renewable and distributed generation, battery storage, automated switching technology and smart meter data that will be, for the first time, deployed holistically on a utility grid. A large part of the funding is through grants SDG&E received through the DOE and CEC for a Smart Grid Demonstration of Renewable Distribution Systems Integration. The remaining funds come from SDG&E and its 10 partners who are developing this microgrid demonstration.

3.4.3.3 SECURITY EVENT & INCIDENT MANAGEMENT (SEIM) TECHNOLOGY

This initiative enhances SDG&E's cyber security capabilities with a more advanced solution to manage security events and incidents. It includes the design and implementation of a SEIM service that supports current production and regulatory requirements and is a foundation for future enhancements that will support strategic utility programs like Smart Grid. The SEIM service streamlines and enhances security event and incident monitoring, management, trend analysis, alert reporting and escalation processes.

Benefits of SEIM technology include:

- Greater ability to monitor security events across SDG&E's systems
- Provides the foundation for a single, consolidated security monitoring interface, helping to avoid costs of multiple solution management tools
- Avoids costs of per user/device product licenses
- Simplifies security incident and event decision workflow
- Increases capability to design and deploy connections between multiple log source devices and the SEIM
- Increases capability to design and deploy event correlation procedures from multiple log sources
- Centralizes management and view of security incidents and events
- Enhances and extends compliance with NERC/CIP, SOX, and Sempra business continuity/disaster recovery objectives
- Improves system performance based on dual site workload load balancing to meet incident and event volume growth

3.4.3.4 FIBER OPTIC COMMUNICATION SYSTEM TO SUBSTATIONS

This project builds out a fiber optic network to all transmission substations, including installation in the Sunrise Powerlink line corridor. The fiber optic network will replace aging and less reliable communications to substations that will enable advanced protection and monitoring. In the future, it may provide backhaul capabilities for other Smart Grid communications and distribution operations.

3.4.3.5 LOW POWER WIDE AREA COMMUNICATIONS NETWORK

This project builds out the low speed, low power wireless network and backhaul connectivity to enable electric T&D to deploy and monitor fault circuit indicators (FCIs), and to perform required daily manual monitoring of aviation lights. The project will support existing and new aviation lights, fault circuit indicators for High Risk Fire Areas (HRFA), and other FCIs.

Benefits include:

- Enhanced situational awareness for T&D multi phase circuits
- Overhead FCI cost savings, reduced response times in HFRA
- Enhanced fire safety
- Elimination of costly manual inspection of 530 existing and future aviation lights.

3.4.3.6 SMART ISOLATION AND RECLOSING TECHNOLOGY

This project applies off the shelf limited discharge energy technology on the distribution system. Sensor equipped devices reduce the energy let through when reclosing into a distribution line which switched off due to a fault. Benefits include enhanced safety, reduced equipment stress, improved power quality and reliability. Protective device coordination is also enhanced, and the technology provides system automation at locations presently operated manually.

3.4.4 INVENTORY OF OTHER SMART GRID INVESTMENTS

In addition to the deployments and in flight investments described in this section, SDG&E has a number of baseline projects designed to support its Smart Grid planning.

3.4.4.1 INTEGRATION OF INTERMITTENT RENEWABLES TRANSMISSION PLANNING STUDY

SDG&E is undertaking a Transmission Planning Study to determine the impact of increased levels of intermittent renewables attached to its transmission and distribution systems. The study will identify potential issues and inform mitigation strategies.

3.4.4.2 DEMONSTRATION OF COMPOSITE CORE CONDUCTOR INSTALLATION

This project is a demonstration of composite core conductor installations. These technologies may provide increased power transfer capacity, and thus decreased needs for new transmission. It may also reduce environmental impacts.

3.4.4.3 TRACKING AND MONITORING OF EV CHARGING FACILITIES

SDG&E has implemented a new process and control system that is integrated with GIS capabilities to track electric vehicle charging installations within the SDG&E service territory and to monitor performance. This effort is intended to ensure that the electric distribution system is capable of accommodating new customer loads due to electric vehicle charging. This process and control system includes vehicle registration and identification provided by the vehicle manufacturer and ECOtality, the electric vehicle infrastructure installer under the DOE funded electric vehicle project in San Diego.

Service orders issued to operating districts require evaluation of electric distribution infrastructure for capacity, graphical mapping of the location of the new customer load, and installing monitoring equipment on associated distribution transformers. The consumption patterns and loading of the associated distribution equipment will be monitored to assess the impact and quickly identify any facility overloads or voltage problems and take corrective action. This information will also be useful for assisting planning studies to model future impacts.

3.4.4.4 IMPLEMENTATION OF SYNCHROPHASORS

In 2007, SDG&E successfully completed a project to integrate synchrophasor data into the operation of the State Estimator application on the Energy Management System. This CEC funded project was the first utility implementation demonstrating the ability to use synchrophasors for state estimation in a working EMS. In 2009, SDG&E integrated synchrophasor data into a SCADA application which provided real time phase angle measurements between two 500 kV substations, allowing for faster system restoration following 500 kV line outages. In 2010, SDG&E initiated a project to install synchrophasors at all major transmission substations for use at the transmission level. This project is expected to be completed by 2013. The project will include real time collection of synchrophasor data and a visualization and operator interface system to aid in real time operations of the system.

3.5 CUSTOMER DATA PRIVACY AND SECURITY

3.5.1 CUSTOMER DATA COLLECTION, SHARING, AND RETENTION

What data is SDG&E now collecting? For what purpose is the data being collected? With whom will SDG&E currently share the data? How long will SDG&E currently keep the data?

In order to conduct business, SDG&E collects and utilizes a broad range of customer information (e.g., customer contact information, energy usage information, program enrollment and participation information). The amount and types of information collected have evolved over the years. For example, manual, monthly register meter reads were once the norm but are now being replaced with automated, remote reading of interval data (hourly for residential, 15 minute for commercial) multiple times per day via SDG&E's Smart Meter system.

SDG&E collects customer information beginning with the account set up / service establishment process during which personal information is collected to establish and verify the identity of the customer of record along with premise information to ensure the correct linkage between the customer, meter and account (newly established). This information is necessary to enable effective customer service for billing and outage notification and for customer communication, outreach and education purposes. SDG&E customers' primary or preferred language is also collected and, in the case of businesses, information regarding responsible officers of the company and other business specific information can be collected. Information necessary to run a credit check and to help determine the credit risk associated with the account is also collected in order to determine if a meter deposit will be required and premise ownership and landlord information is collected in order to enable such things as 'revert to owner' services (in which service is not interrupted upon move out, but rather transferred back to the owner's name in order to facilitate property showing and follow on rental). Additionally, information necessary to determine eligibility for medical baseline or life support status is collected.

Once the account is established, various data is collected during the normal course of utility transactions such as energy usage information, billing and payment information and program enrollment information. This can include the collection of household income information to determine eligibility for various utility programs, such as the California Alternate Rates for Energy or CARE program, demand response programs (such as the Summer Saver or air conditioning cycling program) and energy efficiency programs. In some cases when an in home energy survey is conducted, very detailed information about a customer's premises is collected including types and numbers of appliances and lighting, for example. Information is also maintained regarding vegetation management associated with SDG&E's system with tree trimming information which can sometimes be associated with customer premises.

SDG&E retains information collected as necessary to efficiently and effectively fulfill its obligation to serve its customers.

SDG&E shares customer information with third parties in the conduct of its business. This includes contractors acting on the utility's behalf (e.g., fulfilling Energy Efficiency program enrollment, CARE recruitment, etc.) and third parties whom customers have designated to receive information (such as Commission certified Energy Service Providers, for example). Third parties with whom SDG&E has a direct business relationship are bound by strict contractual terms and conditions including non disclosure requirements and usage limitations, as appropriate, and that allow for proper remedies if third party actions so warrant.

3.5.2 DATA ACCURACY AND RELIABILITY

What confidence does SDG&E have that its data is accurate and reliable enough for the purposes for which it was being used?

SDG&E's practices and procedures regarding data gathering, maintenance and storage are aimed at ensuring the integrity of that data to fulfill the purpose for which it was gathered. Over time and when new systems or rules are put in place, these practices and procedures evolve and SDG&E strives for constant and incremental improvement. During the account set up process or other processes, personally identifiable information is provided and verified by the customer. Customer personally identifiable information (PII) or other less sensitive information that is required to complete a utility and / or customer transaction (e.g., billing, field order) includes such data as service address, billing address and other contact information. At the time the order is completed, the proper service address and other premise or customer data is validated against the utility data base to ensure accuracy.

Customer usage data (for billing purposes) is collected via the smart meter. The accuracy of the smart meter has been verified through the smart meter testing and installation process. The customer usage data collected via the smart meter communications system may not be complete if a smart meter fails to transmit data through the AMI network. Typically, the missing data will be collected in a subsequent read attempt. Collected data is processed through the validation, estimating and editing (VEE) process. The accuracy of monthly read data (monthly usage billed on the tiered structure) must pass several comparison tests with the manual read as a validation test.

In addition to PII and usage data, other processes that rely on customer data generally have checks and balances included (such as multiple employees involved), and when possible, a single source of the data is utilized in order to ensure accuracy.

3.5.3 PROTECTION AGAINST DATA LOSS OR MISUSE

How does SDG&E protect the data against loss or misuse?

SDG&E employs a robust information security program that focuses on the three core competencies that operate together to protect against data loss or misuse: Governance, Engineering, and Operations.

The Security Governance organization is tasked with company security policy and policy compliance, which includes the drafting and maintenance of policy artifacts, and assures that the company is in compliance with all required legal and regulatory cyber security requirements; security awareness, which ensures every employee understands and executes their role in protecting company information; security strategy and architecture, which oversees the future direction of security controls across the company; and the security program office, which leads projects that implement new security controls. The Governance organization also maintains security contractual language that is used during negotiations with third parties to ensure that if the relationship calls for the sharing of company information, the information is adequately protected.

The Security Engineering organization is responsible for developing and maintaining company security standards and requirements, and ensuring that every new project adheres to each of these.

Finally, the Security Operations organization is responsible for monitoring company networks and systems for potential cyber threats and vulnerabilities, ensuring that vulnerabilities are quickly remediated, and if threats materialize, they are contained quickly so the damage caused is minimized.

3.5.4 SHARING CUSTOMER INFORMATION AND ENERGY DATA

With whom does SDG&E share customer information and energy data currently? With whom does SDG&E reasonably foresee sharing data in the future?

The question "With whom does the utility share customer information and energy data currently?" is addressed in section 3.5.1.

Depending on the specific data elements, customer PII and usage data will be shared with the customer. The customer is able to access their specific account information (including PII) via SDG&E's My Account. The customer must have an established My Account log in ID and password. Customer usage data will be available to customer authorized third parties given the customer's explicit consent. Customer authorized third parties could be information service providers, energy service providers, energy management services and other third party home area devices (including in home displays). SDG&E agents who act on behalf of SDG&E may also have access to customer data depending on services contracted by SDG&E (e.g., energy efficiency services, low income program outreach and enrollment). SDG&E will also contract with various software vendors that provide on line presentment, energy bill management and analytical tools that require access to customer data. These third party vendors will be under contract/licensed by SDG&E with appropriate non disclosure agreements regarding customer related data.

3.5.5 THIRD PARTY DATA USAGE PURPOSE

What does SDG&E anticipate is or will be the purpose for which the third party will use the data?

The primary purpose for customer authorized third party access to their usage data is to help the customer better understand and control their energy usage.

3.5.6 INFORMATION SECURITY AND PRIVACY FOR SHARED DATA

What measures are or will be employed by SDG&E to protect the security and privacy of information shared with other entities?

The primary measures by which SDG&E protects the security and privacy of information shared with other entities are via the contractual terms and conditions included in the contracts between SDG&E and the entities that receive this information. SDG&E structures its agreements with third parties with the goal of protecting customers' information. The utility's standard confidentiality language includes the following provisions designed to protect customers' information:

- SDG&E uses a broad definition of "Confidential Information" to protect a wide range of information related to customers;
- SDG&E limits vendors' use of such Confidential Information to be solely for purposes of performing services under its agreements (i.e., vendors cannot use Confidential Information for their own benefit or commercial purposes);
- SDG&E requires vendors to use reasonable security procedures and practices to protect Confidential Information from unauthorized access, destruction, use, modification or disclosure. For third parties, onsite security evaluations may be performed to ensure appropriate security controls are in place, except in some cases where current certifications (e.g. ISO 27001) performed by accredited firms exist;

- SDG&E requires vendors to deliver or destroy any Confidential Information upon request; and
- SDG&E specifies that confidentiality provisions related to customer Confidential Information remain in effect for perpetuity.

3.5.7 LIMITATIONS AND RESTRICTIONS ON THIRD PARTY DATA

What limitations and restrictions will SDG&E place on third party use and retention of data and on downstream sharing?

SDG&E has limited contractual controls, enforcement authority or imposed penalties on customer authorized third parties. If the customer directs (via explicit consent) SDG&E to provide their specific customer usage data to a third party, then direct contractual relationship and potential business transactions are between the customer's third party and the customer. SDG&E has limited authority to interfere with the customer's third party relationship, including the third party use of the customer usage data and potential sharing downstream. At best, SDG&E can terminate transfer of customer usage data to a third party if that third party is deemed a "bad actor".

Each vendor SDG&E utilizes is required to have their agents, representatives, subcontractors and suppliers familiar with, and abide by, the customer confidentiality provisions in its agreements as more fully described in the response to question 3.5.6 above. Generally speaking, these customer confidentiality provisions prohibit the use or sharing of customers' Confidential Information for any purpose other than performing services for SDG&E under its agreements. Additionally, these provisions include requirements to protect customer information using reasonable security measures and allow SDG&E to seek the return or destruction of any Confidential Information.

3.5.8 ENFORCEMENT OF LIMITATIONS AND RESTRICTIONS

How will SDG&E enforce those limitations and restrictions?

In the case of SDG&E's contractual third parties, limitations, restrictions, conditions and defined damages can be specified in the specific contract terms and conditions. Per response to 3.5.7, SDG&E has limited authority with regard to customer authorized third parties. SDG&E will require customer authorized third parties adhere to specific data transfer protocols (i.e., OpenADE/NAESB ESPI standards, SEP) to ensure security encryption, customer verification and device compatibility.

3.5.9 INDIVIDUALS' ACCESS TO THEIR DATA

How do individuals have access to the data about themselves?

Customer's personally identifiable information (PII) can be accessed by the customer through their My Account log in ID, by calling SDG&E's customer contact center, or by visiting one of SDG&E's branch offices.

3.5.10 AUDIT, OVERSIGHT, AND ENFORCEMENT MECHANISMS

What audit, oversight and enforcement mechanisms does SDG&E have in place to ensure that the utility is following its own rules?

As a California utility, SDG&E is subject to multiple checks and balances to ensure it is in compliance with its internal policies and procedures. SDG&E has put in place several mechanisms to provide governance, oversight and enforcement of security and privacy controls. For example, SDG&E uses both internal and external mechanisms to provide oversight over security and privacy controls.

Internally, these include a System Development Lifecycle Methodology that injects security and privacy requirements early in a project to ensure the project will comply with internal policies as well regulatory requirements. This methodology is also used to test planned components for security vulnerabilities in new infrastructure to verify that security and privacy requirements have been met.

SDG&E security and privacy controls are also regularly reviewed by a corporate internal audit department that reports to Sempra Energy's Board of Directors. This internal audit organization uses the company's security policy, requirements and industry standards to verify the state of security and privacy controls and makes recommendations to improve when necessary.

Externally, SDG&E uses independent third party auditors and professional security control testing organizations to enhance its perspective of how well its security and privacy controls are meeting expectations.

Finally, SDG&E is regularly audited by industry governance organizations, such as the North American Electric Reliability Corporation (NERC), to ensure compliance with specific security controls.

3.6 CONCLUSION

SDG&E's current investments and practices have been undertaken because they are clearly aligned to policy compliance, providing customer valued capabilities, and maintaining SDG&E's network efficiency. They are intended to support SDG&E's vision for Smart Grid, while maintaining sufficient flexibility to respond to emerging requirements. SDG&E has been working for some time to build the "Utility of the Future." The enhancements it has made will ensure that it continues to attain the highest reputation for reliability while looking out for its customers' best interests, including the privacy of customers' personally identifiable information.

Section 4 – SMART GRID STRATEGY

4 SMART GRID STRATEGY

4.1 INTRODUCTION

SDG&E's Smart Grid Deployment strategy focuses on empowering customers with technology and service choices that maximize their comfort and convenience, while also maximizing the value of their energy and protecting the privacy of their energy usage and other personal data. It embraces the evolution of the Smart Grid by maintaining system reliability with self-healing[16] and resilient capabilities, while also incorporating increasing levels of renewable energy from centralized and distributed intermittent resources. The Smart Grid platform described in this plan supports California's emission reduction goals by integrating renewable resources and large numbers of PEVs, while also maximizing the efficiency and maintaining the security of the electricity and information infrastructure that serves the San Diego region. This Smart Grid platform will empower customers with opportunities to incorporate multiple options for demand response, energy efficiency, generation, and storage into existing and future energy markets. SDG&E's Smart Grid deployment efforts as a whole will significantly contribute to the reduction of the environmental footprint of electricity generation and delivery in the region by integrating renewable resources, electric vehicles, and other technologies that will assist in the avoidance of emissions associated with traditional solutions.

In developing its Smart Grid Deployment Plan, SDG&E's strategy was to engage employees and a broad cross-section of stakeholder groups from across the service territory in the process. SDG&E's outreach sought and received input from over 25 organizations representing a wide variety of customer interests, including municipalities, regional organizations, industry, and academia. Following a framework derived from the NIST Smart Grid Conceptual Model[17], 10 domain teams led by SDG&E directors and

[16] A self-healing grid is one that automatically reconfigures via autonomous switching operations in response to a system fault improving local reliability.
[17] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGConceptualModel

executives from across the company developed perspectives and plans that were then integrated together. Its strategy for Smart Grid deployment includes ongoing efforts to further integrate Smart Grid into company planning and operations, and to continue engaging SDG&E's stakeholders in order to align the utility's plans to their priorities. Because this Smart Grid Deployment Plan is based on SDG&E's best estimates of inherently uncertain outcomes, SDG&E intends to adaptively manage, revise, and update this plan on an ongoing basis, to ensure that it evolves as customers, stakeholders, technologies, and services evolve.

SDG&E's Smart Grid strategy rests on three pillars: policy, customer value and pilots. While state and federal policy frequently drives Smart Grid technology requirements and investments, maximizing the customer's energy value by enhancing their energy experience and supporting their preferences is the criteria against which all new technology investment is evaluated, even where it is required to comply with state or federal policies. While policy-driven investment decisions are always evaluated for least-cost/best-fit, potential customer and societal benefits are calculated as well. In other cases, it is customer value, where the projected benefits outweigh the costs or where the investment is necessary to effectively communicate with customers that drive SDG&E's deployment strategy. The piloting component of SDG&E's Smart Grid strategy is employed as a mechanism to mitigate risk and determine, prior to full deployment, whether the technology investment will deliver the benefits anticipated and within the costs projected.

SDG&E began making foundational "smart" utility investments many years ago even prior to SB 17's enactment and before the Commission ordered utilities to file Smart Grid Deployment Plans. As a result, its Smart Grid strategy is also based on experience and the best practices in technology evaluation and in the implementation it has developed and is continually refining. SDG&E is also positioned to build cost-effectively on this foundational platform by leveraging prior investments in AMI, OpEx 20/20 and other infrastructure. These prior investments are consistent with its Smart Grid strategy because they help the utility deliver customer value by supporting their preference to adopt distributed solar generation and PEVs ahead of the national curve, and meet SDG&E's commitment to achieving state and federal policy objectives. Lastly, SDG&E's strategy for interoperability will be based on the use of open standards where possible and will avoid stranded costs through piloting new technologies to ensure they meet the utility's Smart Grid requirements.

As SDG&E transitions to a smarter grid, much of its power delivery infrastructure and customer experience and service focus will remain the same. However, the way SDG&E manages the grid and the types of services it provides will change significantly, which will cause the value of services provided to customers to increase. The integration of digital computing and communications technologies will be the biggest enabler of this transition. This section of SDG&E's Smart Grid Deployment Plan describes the utility's strategy for making the investments that will make this possible.

SDG&E's Smart Grid Deployment Plan Strategy will be driven, in large part, by the pace of change in its customers' expectations and decisions (e.g., distributed generation deployment, PEV growth, use of after meter automation, etc.). SDG&E's strategic framework places a top priority on fulfilling state and federal policy objectives and requirements (e.g., ensuring the safe, secure and reliable delivery of electricity at just and reasonable rates, and complying with other state and federal policy requirements).[18] The utility will also continue to work collaboratively with customers and other key stakeholders to create the foundation for an innovative, connected and sustainable

[18] In this Smart Grid Deployment Plan, SDG&E categorizes investments as either necessary to achieve state and federal policy objectives or as warranted by the value the investment would create for customers. The term "Policy" as used in this Smart Grid Deployment Plan is distinct and distinguishable from the concept of "policy-driven" investments as used by FERC-jurisdictional transmission operators such as the CAISO; as used herein, the term "Policy" includes investments necessary to ensure reliability and safety as well as other investments necessary to comply with SDG&E's obligation to serve, regulatory compact with the state of California and ratepayers, and other federal and state-imposed utility obligations.

energy future in a manner that maximizes customer value, is aligned with SB 17 goals[19], maximizes interoperability, is secure, and supports customer data privacy.

Consistent with the requirements of D.10 06 047, SDG&E includes in this Smart Grid Strategy section a discussion of the following:

- How the utility will ensure our Smart Grid investments deliver value added services and benefits to customers;
- How the utility will prioritize its technology evaluation and deployment efforts to meet the goals defined in Senate Bill 17 and promote the goals of General Order 156[20];
- How the utility will evaluate whether using existing communications infrastructure can reduce the costs of deploying the Smart Grid;
- How interoperability standards will be used;

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[19] These goals are to achieve the following benefits:

- Be self-healing and resilient;
- Empower consumers to actively participate in the operations of the grid;
- Resist attack;
- Provide higher quality of power and avoid outages;
- Accommodate all generation and storage options;
- Enable electricity markets to flourish;
- Run the grid more efficiently;
- Enable penetration of intermittent power generation resources;
- Create a platform for a wide range of energy technologies and management resources;
- Enable and support the sale of demand response, energy efficiency, distributed generation and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources; and,
- Significantly reduce the total environmental footprint of the current electric generating and delivery system in California.

[20] General Order 156 is intended to increase utility procurement from women, minority and disabled veteran business enterprises' (WMDVBE) in all categories.

- How SDG&E will minimize the risk of stranded costs in cases where consensus standards are evolving; and,
- Our plans for adopting and developing interoperable architecture designed to protect the privacy of customer data.

4.2 STRATEGIC DECISION MAKING PROCESS

SDG&E's Smart Grid vision provides a sense of direction and guidance and provides a view of the desired end state. While not mandating specific technical solutions, the utility's vision allows flexibility regarding the evaluation and adoption of emerging technologies. This approach is critical since industry drivers and technology are rapidly evolving in the Smart Grid space and it is difficult to adequately evaluate and project the technologies that will most likely be adopted by customers. Accordingly, SDG&E's strategy is designed to maximize SDG&E's ability to make the right Smart Grid investments for customers at the right time, while recognizing that technology is always changing.

SDG&E's Smart Grid Deployment Plan is designed to ensure that the utility fulfills state and federal policy goals; works with key stakeholders to create the foundation for an innovative, connected and sustainable energy future in a manner that is aligned with SB 17 goals; maximizes interoperability; minimizes risk through appropriate security controls; and ensures customer data privacy.

In order to do this successfully, SDG&E takes a strategic approach to technology evaluation and adoption. It is first necessary to understand the different kinds of Smart Grid investments that could be pursued, how they would operate across the various SDG&E business processes and functions, the state and cost of current technology, the benefits that could be achieved with any given investment, and whether an investment is necessary to comply with state and/or federal policies. This approach can be summarized as the following steps:

1. Identify applicable federal and state laws, regulations, and policies.
2. Identify options that could meet those requirements.
3. Determine to what extent those options aid in meeting those requirements.
4. Determine to what extent those options enhance customer value.
5. Select solutions based on their fit to policy requirements, cost effectiveness, and customer value.

In order to ensure that SDG&E has a robust understanding of the universe of potential Smart Grid investments and applications and the potential effects on SDG&E, the utility considers a number of outside sources. These sources are summarized below and discussed in greater detail in the sections that follow.

- The U.S. Department of Energy funded Smart Grid Maturity Model (SGMM) – The SGMM has assisted SDG&E in setting strategic priorities and allowed it to drive to a common internal understanding of industry tenets. This model helps SDG&E understand the stage of its current technology investments and its aspirations.

- The U.S. Department of Energy's (DOE's) Modern Grid Vision – SDG&E believes that this alignment is crucial to adopting a California view that is consistent with the federal view and allows SDG&E and other California utilities access to solutions that will be developed earlier due to consistent requirements nationwide. This also ensures that SDG&E is supporting and aligned to interoperability and security standards while meeting industry wide customer privacy expectations.

- *Defining the Pathway to the California Smart Grid of 2020* – SDG&E was a key contributor to this report led by the Electric Power Research Institute (EPRI) and funded by the California Energy Commission (CEC).[21] This effort resulted in a high level vision and roadmap that the three California Investor Owned Utilities (SDG&E, SCE, and PG&E) supported and adopted. More important, the EPRI report provided a useful reference for SDG&E in the development of its own deployment plan.

- The National Institute of Standards Technology (NIST) – The projects identified in SDG&E's Smart Grid Deployment Plan Roadmap were identified by following the NIST Smart Grid conceptual model and framework to achieve a broad perspective on this Smart Grid Deployment Plan and to understand the implications of Smart Grid investments across the company. More specifically, SDG&E formed teams of internal experts specific to each domain. These teams first identified projects already being considered that might either be Smart Grid projects, or contain elements that might be considered Smart Grid. Then, the teams identified additional potential Smart Grid projects necessary to comply with the utility's obligation to serve as customers' needs and applications change and/or those which are cost beneficial and would further the objectives of SB 17, customers and other stakeholders. These teams screened out projects that are not worthy of pursuit at this time, and projects underway or planned that were not identified as "Smart Grid". The projects with merit that were identified by those teams are included in this Smart Grid Deployment Plan. This was not a one time process; SDG&E will continue to monitor the market and solicit input from customers and stakeholders, and the utility will adapt and modify its Smart Grid Deployment Plan as changing circumstances warrant, in the same way that this Smart Grid Deployment Plan is not a wholly new construction, but adapts, modifies, and builds on SDG&E's previous plans for deploying new technology.

[21] This report has not been published as of May 2011, and is expected to be publicly available in the second half of 2011.

SDG&E's strategic decision making process also consistently applies the utility's evaluation framework of enhancing customer value and delivering customer benefits while complying with state and federal policy, which is explained further in the following section.

To address the rapid development of digital technologies, SDG&E has designed a technology selection process that recognizes pilot and field evaluation as an integral part of technology evaluation. SDG&E will invest in technologies that work for its customers and on its system and where adequate protection exists to protect customer privacy and data security. Where necessary, SDG&E will conduct pilots to ensure that new technologies meet these requirements prior to a wide scale deployment.

California, with its ambitious renewable and environmental goals and technology savvy consumers, moves SDG&E into an early technology adopter role. As the quantity of both bulk and distributed renewable resources continues to increase on SDG&E's system, Smart Grid technologies are needed to mitigate the impact of variability while maintaining and/or improving reliable service to customers. SDG&E incorporates the support of these goals in the criteria that it uses to evaluate Smart Grid initiatives.

SDG&E will continue to support General Order 156 in the supplier selection process. Supplier diversity is embedded in the company DNA and it's how the utility does business every day. SDG&E has been a leader within the California IOU's in delivering results and in 2010 procured 36 percent of its goods and services through Diverse Business Enterprise vendors, consultants and manufacturers. SDG&E will continue to champion and strive to exceed the 30 percent goal for DBE eligible purchases across every segment of the organization, including capital projects and other major initiatives. Additionally, SDG&E requests its prime contractors to subcontract 30 percent of costs to diverse suppliers and Smart Grid projects are no different.

SDG&E's decision making strategy provides a flexible framework that does not restrict SDG&E to the status quo or "as is" processes, but rather enables it to adaptively manage

Smart Grid initiatives as policies, technologies, and customer behaviors evolve. This flexibility will allow SDG&E to meet one of the Commission's requirements: that its Smart Grid Deployment Plan is "adaptable to change."

4.3 SDG&E'S STRATEGIC PRIORITIES

As mentioned above, SDG&E has set two priorities at the heart of its Smart Grid plan, compliance with state and federal policy requirements and ability to deliver enhanced customer value and communication. SDG&E assesses projects according to their support of these priorities. SDG&E will first prioritize its Smart Grid investments based, primarily, on whether they are necessary to fulfill state and federal policies such as on their alignment with SB 17 goals. Additional projects will be prioritized based on input from customers and stakeholders and on what they value the greatest and against other important criteria such as DOE's Modern Grid vision and on their ability to help SDG&E fulfill its own Smart Grid vision of creating the foundation for an innovative, connected and sustainable energy future in the San Diego region.

4.3.1 STATE AND FEDERAL POLICIES

State and federal policies require and SDG&E's customers expect the safe, secure, and reliable delivery of energy at just and reasonable rates as well as the realization of state energy policy goals. SDG&E views these as utility obligations and as top priorities in making Smart Grid investments.

Several state and federal policies drive this Smart Grid Deployment Plan and its urgency. They include the Renewable Portfolio Standard (SB x1 2[22]); the California Solar Initiative; AB 32, the *California Global Warming Solutions Act*; energy efficiency policies; and reliability and security standards set forth by NERC and FERC. Additional discussion of these policies is in the Roadmap section.

[22] Senate Bill 2, 1st Extraordinary Session, referred to herein as SB x1 2

Due to new operational challenges posed by intermittent distributed generation resources, automated demand response requirements and significant incremental load from PEVs, the need for timely investments to ensure that existing service levels are maintained is paramount. Absent timely Smart Grid investments, a number of trends in SDG&E's service territory are expected to degrade service levels. SDG&E will prioritize its Smart Grid investments based, primarily, on whether they are necessary to comply with state policies, including the provision of safe and reliable service and effective communication of information to customers regarding their energy use. For example, if rapid penetration of distributed generation on a particular circuit, or in a given region, necessitates Smart Grid investments to maintain reliability, SDG&E will place its highest priority on making those investments. The same is true of investments that may be necessary to accommodate PEV growth in the future without adversely impacting reliability to customers and investments necessary to empower customers regarding their energy use.

SDG&E's strategy in making the investments necessary to address these policy-driven situations is to ensure that the utility understands the costs and benefits of all potential solutions and implements the most cost-effective means of ensuring continued safe and reliable electricity service on this basis. SDG&E has identified in its Smart Grid Deployment Plan Roadmap the most cost-effective means to maintain safe, secure and reliable delivery of energy that will address the changes it is seeing in its service territory.

In addition to reliability and security, SDG&E's programs around Renewable Growth and Electric Vehicle Growth will help achieve SDG&E's vision of being the foundation for an innovative, connected and sustainable energy future in its service territory. These investments will allow SDG&E to apply technologies that will mitigate anticipated operational challenges. SDG&E applies appropriate project planning principles to ensure it is pursuing the least-cost, best-fit solutions that meet system needs.

In addition, SDG&E's workforce development program will ensure that it has the right workforce and skills to support these changes, while its Smart Grid Research, Demonstration, and Development (RD&D) program will enable it to evaluate and pursue new solutions.

SDG&E applies appropriate project planning principles to ensure it is pursuing the least cost, best fit solutions that meet system needs.

4.3.2 CUSTOMER VALUE

SDG&E's priorities for pursuing additional Smart Grid investments will be based on the pace of customer adoption of various technologies and a business case that defines anticipated costs balancing these costs against the increased customer value created, safety, state and federal policies, meeting mandated regulatory requirements, maximizing customer value based on input from customers and stakeholders, protection of data and facilities, financial benefit and alignment with SB 17 goals and the DOE's Modern Grid vision, and where interoperability and data security can be assured.

Prior investments, such as AMI, have created a platform that enables better and more effective communication with customers. In the same way that SDG&E must effectively communicate with customers in their language of preference, it must effectively communicate with its customers through and about new technology applications that have been enabled by the Smart Grid platform already created through previous investments, even though the value of that communication may be difficult to quantify.

As described in the Smart Grid Vision section, SDG&E has reached out to customers and a number of other key stakeholders for input into the development of this Smart Grid Deployment Plan. SDG&E will continue to incorporate the input and views of its customers into Smart Grid capabilities, Smart Grid investment priorities and specific Smart Grid projects. In order to obtain continued input from customers and stakeholders, SDG&E intends to proactively develop a methodology to continue an ongoing dialogue with customers and other key stakeholders. Additionally, SDG&E will form a stakeholder advisory panel and hold regular discussions to better understand the priorities and desires of customers, who should be the focus of these investments. During these dialogues, SDG&E plans to solicit input and recommendations to ensure that its Smart Grid capabilities and investments are focused on areas that customers value.

4.3.3 PILOTS

SDG&E's program areas develop capabilities that require a range of technical solutions, some of which are nascent and still maturing. In some cases, there are different technical solutions that could support the same capability, such as different storage solutions to address renewable intermittency. SDG&E's strategy is to utilize pilots to vigorously test new technologies, ensure adequate functionality, interoperability, security and identify best and least cost ways to deliver needed capabilities and benefits. Pilots are viewed as integral phases in early project planning, but, depending on the evaluation of a technology's maturity, pilots are sometimes organized as separate projects. SDG&E will share results of pilot efforts with other utilities and stakeholders, and will also seek to learn from others' pilots and other research efforts.

4.4 STRATEGY TO ENSURE ALIGNMENT WITH STATE AND FEDERAL POLICY GOALS

4.4.1 SB 17 ALIGNMENT

In D.10-06-047, the Commission has posed a number of questions about how utilities will incorporate the policy goals embraced by SB 17 into the Smart Grid Deployment Plan strategies. SDG&E's responses to these questions are set forth below.

4.4.1.1 PRIORITIZING TECHNOLOGY EVALUATION AND DEPLOYMENT AGAINST SB 17

How will SDG&E prioritize its technology evaluation and deployment efforts against the goals identified for California by SB 17?

SDG&E has built the policy goals of SB 17 into its prioritization, evaluation and deployment criteria for Smart Grid investments. Potential SDG&E projects are evaluated against the SB 17 goals, their fit to the Smart Grid Deployment Plan (SGDP) and the timing requirements. Specifically:

- **Empower Consumers to Actively Participate in the Operations of the Grid.** SDG&E's vision is customer centric and its strategy requires that the utility place a high priority on implementing technologies that empower customers in ways they value and that enable communications with them while complying with state policy requirements. SDG&E will identify those high value technologies based on ongoing dialogue with customers and other stakeholders and pursue technology investments in a manner where customer value exceeds associated costs, where the investment is necessary to effectively communicate with customers, or where required by policy.

- **Be Self healing and Resilient.** Options for additional self healing and resiliency features will be evaluated as SDG&E's system is upgraded and will be implemented in a manner that strives to ensure the associated benefits exceed the costs. SDG&E will monitor the market to ensure that it is aware of these technologies as they develop to optimize the timing of SDG&E's procurement practices.

- **Resist Attack.** SDG&E will place a high priority on technologies that increase the ability of the grid and information systems to resist attack. These technologies will be considered as SDG&E's system is upgraded, and will be implemented as required to secure the system, and will also be incorporated at every level of project evaluation and implementation following "secure by design" practices. As with self healing and resiliency technologies, SDG&E will monitor the market to ensure that it is aware of these technologies as they develop to optimize its procurement practices.

- **Provide Higher Quality of Power and Avoid Outages.** SDG&E has a long standing record of providing the highest level of reliability in the western region of the nation. However, as is discussed above, SDG&E is committed to making those investments necessary to maintain this high degree of reliability while accommodating increased intermittency and new loads such as PEVs while preserving power quality and avoiding outages that would otherwise result. SDG&E places its highest priority on safely ensuring reliability of service to customers. It will also make those investments necessary to improve power quality where adequate customer value and customer demand for this service exists to justify the investment.

- **Accommodate All Generation and Storage Options.** As is discussed above, SDG&E is committed to making those investments necessary to accommodate increased intermittency associated with renewable and distributed generation while preserving power quality and avoiding outages that would otherwise result. The highest priority is assigned to ensuring safe and reliable service to customers and, therefore, SDG&E's strategy requires accommodating all generation and storage options in ways that maintain or improve reliability and support customers' preferences for distributed generation at the least cost.

- **Enable Electricity Markets to Flourish.** By making customer value a key component of SDG&E's investment decision making process, by making those investments necessary to preserve power quality and reliability as new intermittent resources and PEVs are added, and by including effective communication with customers, this decision making process will place a high priority on creating the utility platform necessary to allow electricity markets to flourish. SDG&E will continue to take a leadership role in this endeavor and will continue to collaborate with the CAISO and other stakeholders in these efforts.

- **Run the Grid More Efficiently.** SDG&E's analysis of Smart Grid investments will ensure that new technologies are available in time to meet customer expectations and to ensure that the grid continues to operate efficiently. The frameworks being leveraged to identify the best technologies and Smart Grid projects will ensure that all viable technology solutions are considered.

- **Enable Penetration of Intermittent Power Generation Resources.** Absent the deployment of Smart Grid initiatives, power quality and reliability will deteriorate as additional intermittent power generation resources are deployed. As is discussed above, SDG&E is committed to making those investments necessary to accommodate increased intermittency while preserving power quality and avoiding outages that would otherwise result. The highest priority is placed on ensuring the safety and reliability of service to customers, and this strategy will help ensure that SDG&E is able to integrate growing levels of intermittent resources while maintaining safety and reliability.

- **Create a Platform for a Wide Range of Energy Technologies and Management Resources.** As is discussed above, SDG&E's vision is customer focused and will place a high priority on implementing technologies that empower customers in ways that customers value. Ensuring interoperability within the Smart Grid platform will ensure that a wide range of technologies and services will be available to customers. SDG&E will identify those high value technologies to pursue, for either of these reasons, based on ongoing dialogue with customers and other stakeholders and pursue technology investments where customer value exceeds associated costs or where they are required by state or federal policy.

- **Enable and Support the Sale of Demand Response, Energy Efficiency, Distributed Generation and Storage into Wholesale Energy Markets as a Resource, on Equal Footing with Traditional Generation Resources.** As is discussed above, SDG&E is committed to making those investments necessary to accommodate increased intermittency while preserving power quality and avoiding outages that would otherwise result. Through collaborations with the CAISO and other stakeholders, SDG&E will work to develop interoperable standards and technologies that enable and support the sale of distributed resources including demand response, energy efficiency (if applicable), distributed generation and storage, into wholesale markets.

- **Significantly Reduce the Total Environmental Footprint of the Current Electric Generating and Delivery System in California.** SDG&E's Smart Grid Deployment Plan places a high priority on reducing the total environmental footprint of the current electric generating and delivery system in the San Diego region. This is because the operational and potential reliability impacts of increased intermittent renewable generation and clean transportation resources are a key driver of SDG&E's Smart Grid investments. Therefore, SDG&E will evaluate and implement technologies that increase efficiency and reliability in grid operations where these investments are cost effective. In addition, SDG&E will evaluate and deploy technologies consistent with its vision of working with customers and other stakeholders to create a connected and sustainable smart energy future. This ensures that SDG&E's technology investments create or contribute to a platform for functionality that its customers value and that empowers them to better manage their energy usage. SDG&E's Smart Grid Deployment Plan will significantly reduce the total environmental footprint of the electric system by creating a platform that will integrate technologies and services supporting California's emission reduction and other environmental goals.

4.4.1.2 ADDRESSING THE OBJECTIVES IDENTIFIED IN D.10-06-047

How will SDG&E's decision-making framework specifically address the 11 objectives identified in D.10-06-047?

SDG&E has designed a series of programs to address key Smart Grid drivers and support California policy goals. A basic tenet of the decision-making framework as it applies to SDG&E's Smart Grid Deployment Plan is that the utility will invest in or pilot new technologies only when they are required to support state and federal policy or deliver a capability valued by customers, where the customer value exceeds associated costs or where the investment is necessary to effectively communicate with customers (see Roadmap section for more).

SDG&E's nine current Smart Grid Deployment Plan programs are outlined below. Technology investments in each area are evaluated and deployment decisions made according to the policy/value framework outlined above. Figure 4-1 following this list depicts how each of the policy goals of SB 17 is supported by one or many of these nine programs, with further discussion below:

1. **Customer Empowerment** – SDG&E is investing in an infrastructure to ensure that customers have the necessary information from the utility and third parties as well as the capabilities to make energy management decisions that meet their needs and desires and provide value-added services and offerings;

2. **Renewable Growth** – SDG&E is focused on mitigating the impact of intermittent energy sources;

3. **Electric Vehicle Growth** – SDG&E is deploying new Smart Grid technologies in conjunction with traditional infrastructure to ensure the safe, reliable, and efficient integration of PEV charging load with SDG&E's overall system;

4. **Reliability and Safety** – SDG&E is mitigating the reliability impacts of an aging electric infrastructure by implementing advanced sensors and associated systems;

5. **Security** – SDG&E is investing to address potential security issues across the cyber and physical security arenas;

6. **Operational Efficiency** – Investments are being implemented to maximize SDG&E's operational efficiency;

7. **Smart Grid Research, Development and Demonstration (RD&D)** – SDG&E is planning to create an integrated test facility to research new technologies, integrate emerging technology solutions, test for interoperability, and provide proof-of-concept demonstrations;

8. **Integrated and Cross-cutting Systems** – SDG&E is deploying integrated, cross-cutting systems that support the range of Smart Grid technologies across many functions; and

9. **Workforce Development** – SDG&E is investing to develop its current and transition its future workforce to meet the unique demands of Smart Grid technologies.

Figure 4 1: SB 17 to SDG&E Smart Grid Deployment Plan Program Mapping

SDG&E SGDP Programs***

SB 17 Policy Goals ***

#	SB 17 Policy Goals	Customer Empowerment	Operation al Efficiency	Reliability & Safety	Security	Renew able Growth	Electric Vehicle Growth	Integrated/Cross-cutting Systems	Workforce Development	Smart Grid RD&D	
1	Be self-healing and resilient;		f	f f	f	fl	f f	l f	f	l	f f l
2	Empower consumers to actively participate in the operations of the grid;	ffl	f	f	l f	f	l		f f	l	f f l
3	Resist attack;			ffl	f	f	l	f	f	l	f f l
4	Provide higher quality of power and avoid outages;		f f	lf	f f	l f	f l f	f l	f f l	f	l f f
5	Accommodate all generation and energy storage options;	f f	lf	f fl	f	l	f f	f l	f f l	f	l f f
6	Enable electricity markets to flourish;	ffl	f	f	l f	f	f l f	l	f	f l	
7	Run the grid more efficiently;		f f	lf	f	l f	f	fl f	fl	f fl	f fl f
8	Enable penetration of intermittent power generation sources;	f f	lf	f fl	f	l	f f	f l	f f l	f	l f f
9	Create a platform for deployment of a wide range of energy technologies and management services;	f f	lf	f l	f	f	l	f f	fl	f fl	f fl f
10	Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources; and	f f	lf	f l		f	f	fl f	fl	f l	
11	Significantly reduce the total environmental footprint of the current electric generation and delivery system in California.	ffl	f	f f	l f	l	f f	f l	f l		f f

1. **Empower Consumers to Actively Participate in the Operations of the Grid.**

SDG&E's Customer Empowerment programs will deliver transparency and accessibility to marketplace information so that customers can make energy management decisions that meet their needs and support the effective operation of the grid. Utilizing investments in customer outreach, HAN infrastructure, and dynamic pricing enabled by real and near real time communications, SDG&E will drive energy efficiency, demand response, and more efficient energy management which are key components of the Operational Efficiency program. Investments SDG&E makes in the Security and Integrated Cross cutting Systems programs will ensure the security of customer information as SDG&E investments in data management and analytics allow SDG&E to supply increasing useful information to customers. The Smart Grid RD&D program will ensure new customer empowerment solutions are continually being developed and brought online as appropriate and where the benefits outweigh the costs or improve customer communication.

2. **Be Self healing and Resilient**. SDG&E's Reliability and Safety program improves measurement, control, protection, and optimization to support the resiliency and responsiveness of the grid. SDG&E is investing in equipment monitoring to identify issues before they occur as well as fault identification and management technologies that provide faster isolation and load restoration. In addition, the Operational Efficiency, Security, Renewable Growth, Integrated and Cross cutting Systems and Smart Grid Research Demonstration and Development (RD&D) programs are all designed in various ways to contribute to a self healing and resilient grid.

3. **Resist Attack.** SDG&E's Security program meets increased physical and cyber security requirements with developments to policy and strategy, security infrastructure investment, and Smart Grid risk management. SDG&E's Security program includes investments in security threat, vulnerability, and incident management as well as physical substation hardening, to ensure that risks are well understood and managed effectively. Resisting attack is a key outcome of the Reliability program and SDG&E's ongoing Smart Grid RD&D investments.

4. **Provide Higher Quality of Power and Avoid Outages**. SDG&E's Renewable Growth and Electric Vehicle Growth programs comprise investments that mitigate grid performance issues related to the adoption and impact of new technologies and offerings. These include investments in technologies that will manage intermittency, provide better real time network visibility, and improved dynamic

control. Service reliability is SDG&E's primary goal and of its nine Smart Grid programs, at least seven are directly involved in supporting this SB 17 goal.

5. **Accommodate All Generation and Storage Options**. SDG&E's Reliability and Safety and Renewable Growth programs make investments across the transmission and distribution network to enable the management of generation and storage across the grid. Investments provide increased monitoring and control to support the full range of energy sources, while maintaining the utmost safety around grid operations. In the case of options that are not fully understood, SDG&E's Smart Grid RD&D program invests in the explorations of technologies to facilitate their incorporation in the grid. This SB 17 goal is key to the Customer Empowerment program that gives customers access to information about grid capacity and the option to provide excess capacity stored in their electric vehicle batteries or produced by their rooftop PV systems, for instance, to the grid, which is an area of focus in both the Electric Vehicle and Renewable Growth programs.

6. **Enable Electricity Markets to Flourish**. SDG&E's Customer Empowerment, Renewable Growth and Operational Efficiency programs guide investments that enable a wider set of resources available to the market and their optimized deployment. Investments in these areas allow customers to make decisions based on increased price transparency and increased access to a variety of market participants and their offerings. Its Security program supports secure electricity market communications and Integrated and Cross cutting Systems helps integrate market mechanisms across affected programs and systems.

7. **Run the Grid More Efficiently**. SDG&E's Operational Efficiency program invests in technologies to achieve efficient power flow across the grid while also investing in more efficient maintenance, monitoring, and control capabilities. SDG&E's Workforce Development program provides the support necessary to ensure that the right skills are available to efficiently manage Smart Grid technology and

operations. The Electric Vehicle and Renewable Growth programs are both leveraged to achieve more efficient grid operations, and efficiency is one of the conditions of the Reliability and Safety program. Smart Grid RD&D supports new methods of improving efficiency.

8. **Enable Penetration of Intermittent Power Generation Resources.** SDG&E's Renewable Growth program coupled with programs such as Reliability and Safety provide investments for expanded grid management capabilities that support increased penetrations of renewable resources on the grid while providing for improved planning capabilities to facilitate their rapid deployment. Enabling customers' preferences for distributed generation is a key feature of the Customer Empowerment and Electric Vehicle Growth programs as well.

9. **Create a Platform for a Wide Range of Energy Technologies and Management Resources.** SDG&E's Customer Empowerment and Operational Efficiency programs, supported by Integrated and Cross cutting Systems, provide the infrastructure to provide customers with the information and offerings that they value. Its investments are designed to enable third parties to meet customers' needs, where partners can assist customers to achieve the highest value at the lowest cost. SDG&E's Smart Grid RD&D, Electric Vehicle, Workforce Development and Security programs all contribute to or benefit from its efforts to build a platform for new energy technologies and management resources at SDG&E.

10. **Enable and Support the Sale of Demand Response, Energy Efficiency, Distributed Generation and Storage into Wholesale Energy Markets as a Resource, on Equal Footing with Traditional Generation Resources.** SDG&E's Customer Empowerment and Renewable Growth programs provide the information and control capabilities to improve the reliability and availability of demand response, energy efficiency, and distributed resources. SDG&E's Operational Efficiency program deploys technologies that allows for the optimization and deployment of these different

resources to satisfy demand. SDG&E's Security program strives to ensure that secure market communications are enabled.

11. **Significantly Reduce the Total Environmental Footprint of the Current Electric Generating and Delivery System in California.** SDG&E's Renewable Growth and Electric Vehicle Growth programs support increased renewable generation and alternative fuel vehicles across SDG&E's territory. SDG&E's Customer Empowerment program invests to provide customers with more relevant information and options for customers to act in concert with the environment. Operational Efficiency and the Smart Grid RD&D programs deploy and evaluate technologies, respectively, which support alternative energy resource options. As the environmental footprint of SDG&E's role in the state system is decreased, the Reliability and Safety program seeks to ensure that customers' expectations of reliability, public safety and policy requirements governing reliability are met. SDG&E's Smart Grid Deployment Plan as a whole will support the realization of California's environmental policy goals, including those set forth in the California Global Warming Solutions Act (AB 32), the Renewable Portfolio Standard, and the California Solar Initiative.

4.5 TECHNOLOGY SELECTION

Because many drivers of a smarter grid are more pronounced in SDG&E's service territory than anywhere else in the nation, SDG&E needs to be proactive in technology evaluation. Since many technologies necessary to fulfill policy requirements and maximize customer value are not yet mature, they also require that SDG&E applies a carefully considered technology evaluation process in its overall decision making.

At SDG&E, IT architecture and solutions decisions for existing and new infrastructure must meet business and technical requirements for functionality, including privacy, performance (adequacy and latency), reliability (availability, resilience, and disaster recovery), manageability, scalability, security (cyber and physical), cost effectiveness, safety and regulatory compliance, as well as interoperability, expandability (additional business function), traceability (transactions/events), flexibility/adaptability, and usability. The definitions and specific criteria for each of these terms are derived from the "Non functional Attributes for a Smart Grid Architecture," in chapter six of the *EPRI Public Interest Energy Research (PIER) Program Report: California Utility Vision and Roadmap for the Smart Grid of Year 2020.*[23]

SDG&E will carefully evaluate the reliability and security requirements of each required Smart Grid application and its use cases to determine to what level the existing infrastructure components can meet or be upgraded to meet appropriate performance, reliability, interoperability and security standards for timely and secure Smart Grid information exchange.

SDG&E evaluates technology and vendor roadmaps, product development, R&D investments, manufacturers' capabilities, technology market share, and manufacturer/supplier financial commitments, distribution channels, and stability in determining the risk and value of specific existing infrastructure. In its Technology

[23] *Ibid.*

Reference Model (TRM), SDG&E has categorized its technologies and systems to understand their value and lifecycle for business solutions. The TRM will serve as a guide to prioritize the enhancements and replacements that will enable deployment of the Smart Grid.

The SDG&E IT Product Lifecycle defines the total evolution of an IT product from conception to retirement. This methodology closely adheres to principals and guidance defined by the Project Management Institute; specifically as documented in *A Guide to the Project Management Body of Knowledge* (PMBOK® Guide). At a high level, Table 4 1 below defines phases in this lifecycle.

Table 4-1 IT Product Lifecycle Phases

Phase	Definition
Concept	Description of the business need and potential solutions to be investigated, and cost/benefits associated with each solution. Provides information to justify the business case completion.
Business Case Development	Completion of Scope of work, schedule and total cost of ownership (TCO) for the project/program. Submission of the proposal for funding and approval.
Project Prep	Completion of vendor contracts, and general mobilization of the project team and resources.
Requirements	Development of process models, detailed functional requirements, technical requirements and use cases to document the business need.
Design	Development of high level and detailed designs based on process models and business requirements in preparation for construction/build phase.
Construction/Build	Development, unit test and string test of code per detailed design.
Test	Execution of System, Integration, Regression and Technical (Non-Functional) tests. Defect fixes and migration.
Implementation	Migration of all tested capabilities into production environments.
Production	Production cutover and systems go-live
Post Implementation Review	Review of post implementation performance metrics.

In addition, SDG&E's technology evaluation process incorporates the lessons learned from its experience adopting automation technology, Smart Meter deployment and the OpEx 20/20 program which included Smart Grid foundational projects such as a state of the art outage management and distribution management system (OMS/DMS), geographical information system (GIS), and condition based maintenance (CBM).

SDG&E, through its Research, Demonstration and Development (RD&D) program, is collaborating with universities, government agencies, labs, and established and new companies to forge solutions and better understand technology maturity.

4.6 U.S. DEPARTMENT OF ENERGY (DOE) MODERN GRID ALIGNMENT

The DOE funded the Modern Grid Initiative and utilized stakeholder input from across the nation to develop seven Smart Grid characteristics:

1. Enable active participation by consumers
2. Accommodate all generation and storage options
3. Enable new products, services, and markets
4. Provide power quality for the digital economy
5. Optimize asset utilization and operate efficiently
6. Anticipate and respond to system disturbances (self heal)
7. Operate resiliently against attack and natural disaster

The State of California Legislature through SB 17, and the Commission through its Decision D.10 06 047, took these seven characteristics and modified and expanded them slightly. SDG&E offers a mapping between these two different delineations in Table 4 2.

SDG&E believes that alignment among these different perspectives is crucial to adopting a California view that is consistent with the federal view. Such an alignment allows SDG&E and other California utilities to access solutions on a timelier basis due to consistent requirements nationwide. Absent alignment, vendors will delay product and standards development which will be a detriment to the State of California's aggressive energy policy goals.

Table 4-2 DOE Modern Grid and CPUC Smart Grid Characteristic Alignment

Modern Grid Characteristics	CPUC Smart Grid Characteristics from SB 17
Self-healing from power disturbance events	Be self-healing and resilient
Enabling active participation by consumers in demand response	Empower consumers to actively participate in the operations of the grid; Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources
Operating resiliently against physical and cyber attack	Be self-healing and resilient; Resist attack
Providing power quality for 21st century needs	Provide higher quality of power and avoid outages
Accommodating all generation and storage options	Accommodate all generation and energy storage options; Enable penetration of intermittent power generation sources
Enabling new products, services, and markets	Enable electricity markets to flourish; Create a platform for deployment of a wide range of energy technologies and management services; Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources
Optimizing assets and operating efficiently	Run the grid more efficiently
Accommodating all generation and storage options, enabling active participation by consumers in demand response, and optimizing assets and operating efficiently	Significantly reduce the total environmental footprint of the current electric generation and delivery system in California.

SDG&E's strategy for selecting and making Smart Grid investments includes ensuring that they align with both state policy goals (identified in SB 17 and D.10-06-047) and federal policy goals, as identified by DOE. This will ensure furtherance of both sets of policy goals. SDG&E will also ensure that aligning with both sets of policy goals will foster maximized interoperability and consistency with emerging standards, and not create situations where the policy goals are in opposition.

4.7 GENERAL ORDER 156 ALIGNMENT

What are SDG&E's strategies for meeting GO 156 goals and requirements?

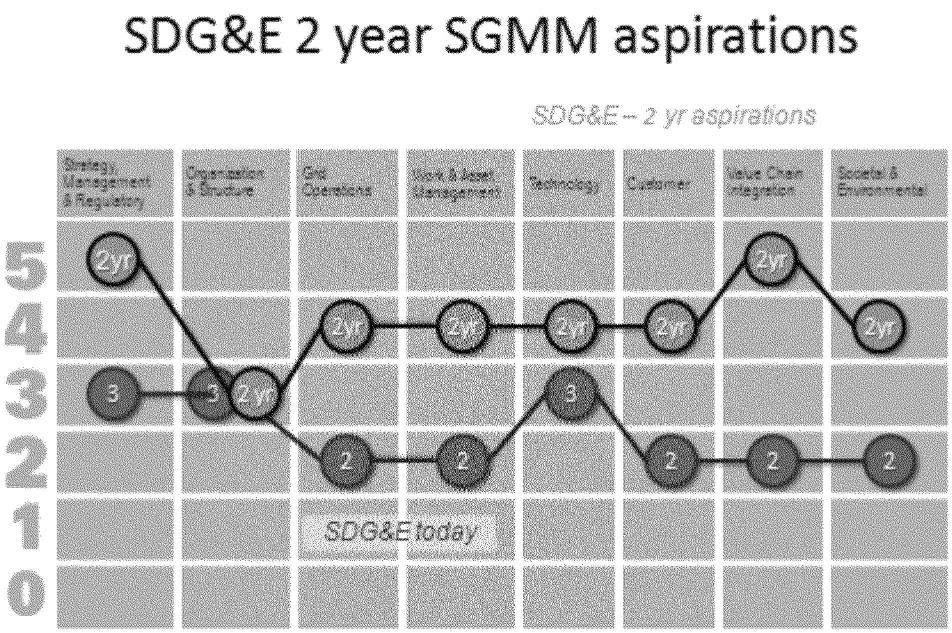
Smart Grid is going to transform the way SDG&E delivers power to customers. There are many components to Smart Grid deployment and this provides a wide range of new opportunities. Diverse Business Enterprises (DBE) can provide value by introducing experienced, qualified and certified suppliers and by helping potential DBEs to expand their technical capabilities and capacity building. SDG&E's strategy is to work closely with current and future companies to achieve its DBE goals. The DBE department has a proven track record of identifying and utilizing cross-functional suppliers that provide cost-effective goods and services to SDG&E. Overall Smart Grid provides an opportunity to introduce the energy industry with innovative technologies while supporting a diverse pool of suppliers.

Supporting General Order 156, in 2010 SDG&E achieved greater than 36 percent Diverse Business Enterprise (DBE) spending / procurement from all SDG&E's goods & services, with $385 million of its procurement dollars going to DBEs. All contracts contain subcontracting language regarding DBE spending: these include spending for Smart Grid projects and DBE is part of SDG&E's evaluation criteria. As an example, Smart Meter achieved 68 percent DBE spending overall in 2010. SDG&E will employ the same procurement strategies that have proven successful in meeting General Order 156 goals in the past in implementing this Smart Grid Deployment Plan in the future. In addition, SDG&E plans to further develop its DBE program by working with DBEs to build their technical capabilities to participate in Smart Grid projects.

4.8 SMART GRID MATURITY MODEL ALIGNMENT

SDG&E was one of the original co-developers of the Smart Grid Maturity Model as part of the IBM Global Intelligent Utility Network Coalition (GIUNC). The DOE is now funding Carnegie Mellon University to expand and maintain this tool. The tool utilizes eight categories and by responding to questions regarding activities in the categories, a utility is able to rank its Smart Grid activities and prioritize areas for future initiatives. The scale varies from zero to five, with zero being business as usual and no Smart Grid activities to five with Smart Grid deployed in the category. SDG&E's existing score and aspirations are shown below.

Figure 4-2: Smart Grid Maturity Model Results



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As a maturity model, the SGMM assists in guiding the organization through the journey of improvement. This model was developed to encompass many aspects of strategy and operations (and not limit itself to just "Smart Grid" aspects). The scope of an SGMM assessment includes everything that an end-to-end intelligently linked network effects within the utility such as assets, end user devices, business processes and customer interaction.

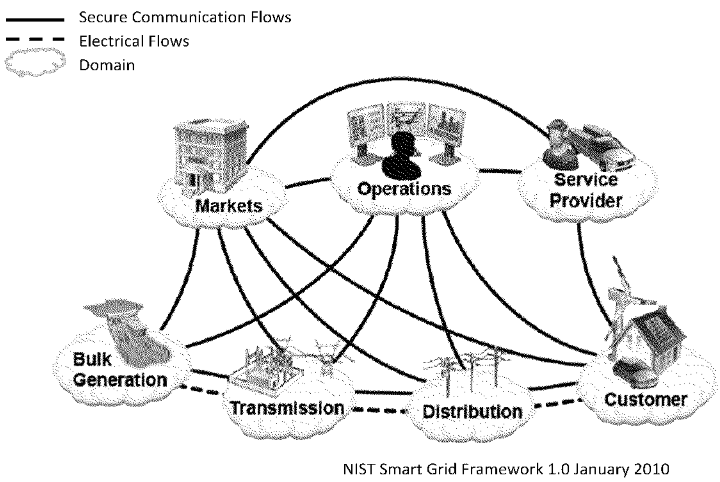
SDG&E has found this tool to be very useful in developing its Smart Grid strategy since many individuals are present in the same room debating the level in each category. The aspirations that SDG&E has established are guides to its initiative planning process.

4.9 NIST MODEL ALIGNMENT

SDG&E's plan development leveraged a framework based on the NIST Smart Grid conceptual model, extended with three additional "cross-cutting" domains as shown in Figure 4-3. The advantage of this model is that it is representative of the electric energy ecosystem and is flexible to accommodate future ecosystem evolution. Teams were assembled for each of the ten domains and they developed strategies that address the implications to technology, people, and business processes.

Figure 4-3: NIST Conceptual Model and Additional Cross-cutting Domains

Domain (NIST Conceptual Model)
Markets
Operations
Service Provider
Customer
Distribution
Transmission
Bulk Generation
Grid & Cyber Security
Info & Comms Technology
HR & Workforce Development
(Cross-cutting domains)



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4.10 PRIVACY CONSIDERATIONS

Privacy strategy or architecture begins with a company security policy, which guides the risk management decision making process. While SDG&E has always respected customer privacy as an important element of its security program, privacy has become a critical and foundational component as the result of new data created by Smart Grid technology.

To that end, SDG&E intends to adapt several aspects of emerging guiding principles into its security and privacy frameworks. For example, SDG&E supports the four dimensions of privacy[24] as described by NIST and the Fair Information Practice (FIP) principles developed by the Federal Trade Commission (FTC) as key components of its security and privacy programs. In addition, from a process and technology design perspective, SDG&E also sees value in other guiding principles such as the Privacy by Design Seven Foundational Principles[25]. This effort will permeate every part of the utility's privacy framework, from policy, guidelines and security requirements, to security architectural principles and design standards, to process and technology implementation. It will positively influence the way SDG&E offers services to its customers by building confidence and trust. After appropriate principles have been applied, SDG&E must consider how customer information is managed from its collection to its destruction.

1. SDG&E will determine if a piece of data about a customer is necessary to collect either for itself, for example to accurately bill a customer, or for a third party, such as regulators or law enforcement.

2. If it is deemed necessary to collect the information, SDG&E will then ensure that adequate controls are in place to protect the information while it is in the utility's possession. These security controls must be regularly tested for potential

[24] From "Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid"
[25] From Privacy by Design : Seven Foundational Principles,
http://www.ipc.on.ca/images/Resources/7foundationalprinciples.pdf

vulnerabilities that could result in the inadvertent loss in the confidentiality, integrity or availability of the information.

3. Next, SDG&E will ensure mechanisms are in place to securely transport information from itself to third parties that have a need to know based on a variety of factors, including applicable law and regulation, and customer desire to share the information with a third party.

4. While in its possession, SDG&E will safeguard the integrity of customer information, ensuring that customer information is accurate, both while SDG&E stores it and during its transport to third parties.

5. Finally, SDG&E will determine the appropriate information retention policy according to all applicable laws and regulations, as well as best practices, and ensure the information is disposed securely and permanently when it is no longer needed.

4.10.1 INTEROPERABILITY AND PRIVACY

How will SDG&E adopt and develop an interoperable architecture designed to protect the privacy of customer data?

SDG&E has named a Chief Customer Privacy Officer and director responsible for customer privacy. These roles include ensuring the completion of a privacy impact assessment and other ongoing efforts, including plans for Grid and Cyber Security Strategy and a robust approach to enterprise architecture and information modeling / standards with privacy related interoperability standards, based on the four dimensions of privacy described by NIST in its security policy framework and the Privacy by Design Seven Foundational Principles.

SDG&E is partnering with the Office of the Information and Privacy Commissioner (IPC) of Ontario, Canada, to put into action the policies, approach, and standards to protect

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the privacy of customer data by working together on a Dynamic Pricing Program. By designing privacy in from the beginning, the project will result in a model that can be leveraged and further improved across the industry.

4.10.2 STANDARDS AND PRIVACY

How will SDG&E evaluate the impact of standards on privacy?

To evaluate the impact of standards on privacy, SDG&E will use a risk management based approach to determine how new standards may impact the confidentiality, integrity and availability of sensitive information based on potential threats, vulnerabilities and impacts. Additionally, because SDG&E recognizes the importance of customer participation in the Smart Grid, it will seek to measure the confidence customers have in the Smart Grid privacy system. Project implementation will leverage privacy and security related standards in order to meet security requirements, regulations, and mandates related to customer information.

4.11 INTEROPERABILITY CONSIDERATIONS

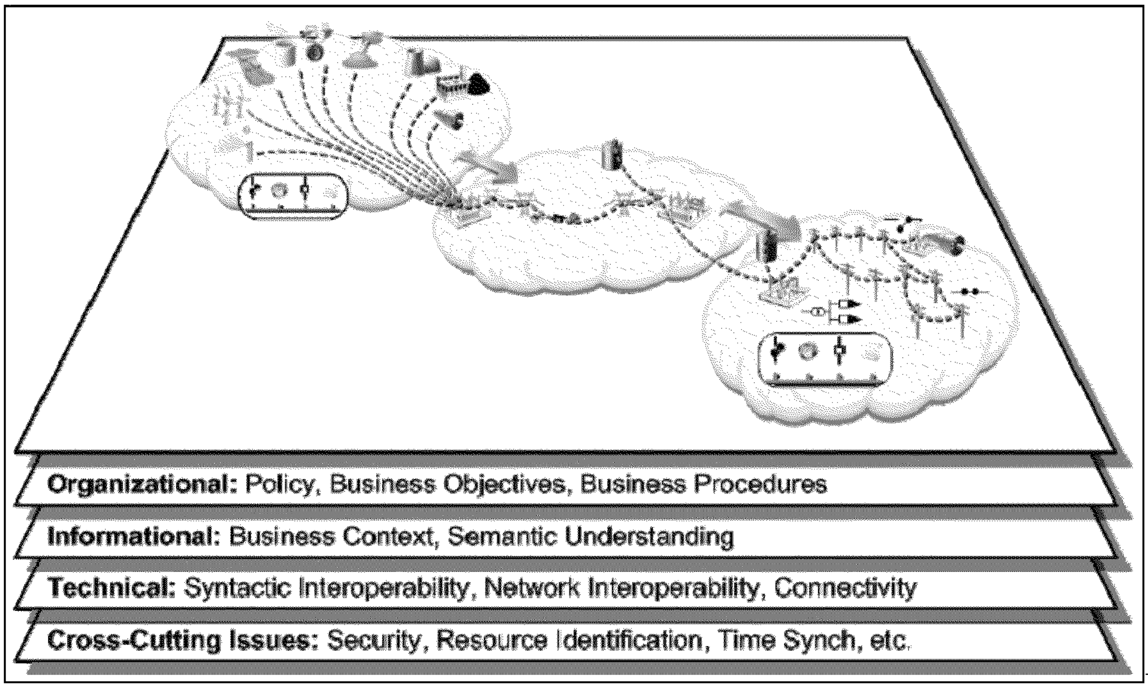
4.11.1 INTEROPERABILITY STANDARDS

How will SDG&E use interoperability standards?

Standards are essential for Smart Grid interoperability to ensure that information can be exchanged between utility systems, applications and customer devices and so that information remains secure.

There are an extraordinary number of potentially applicable standards relating to Smart Grid deployments. A recent NIST report collated existing standards into categories. These categories are structured on the GridWise Architecture Council's layered reference architecture as shown below.

Figure 4 4: GridWise Architecture Council Interoperability Model



The *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0*[26] listed the multitude of potentially applicable standards in each domain. The full analysis is not repeated here, but a selection of key strategic standards of interest to SDG&E is highlighted in the table below.

[26] NIST Special Publication 1108; http://www.nist.gov/public_affairs/releases/upload/smartgrid_interoperability_final.pdf

Table 4-3: NIST Interoperability Standards Roadmap List

NIST Domain	Key standards of interest	Applicability
Operations	IEC 61968, IEC 61970, ICCP (IEC 60870-6/TASE 2), DNP3, IEC 61850	Core standards for exchange of telemetry and reference data within the network operations domain.
Markets	Metering Standards (as developed), aseXML and associated payload standards for market transactions	Smart metering working groups are developing relevant metering data collection and exchange standards. Wholesale, retail and B2B standards are mandatory.
Service Provider	Open ADE/NAESB ESPI	Exchange of customer usage with customer authorized third-party service providers
Bulk Generation		N/A
Distribution	DNP3, IEC 61850-7-2, W3C XML, W3C XSD, W3C SOAP, W3C EXI, W3C WSDL, ANSI C12.22, IEC 60870, IEC 61968, IEEE 1686-2007, NERC-CIP, IEEE C37.111-1999, IEEE 37.118, IP Suite, TCP/IP	Inter-application and industry interoperability standards apply and multiple levels of data exchange (from physical to application). Service oriented architecture standards.
Transmission	As above plus emerging NASPI	As above
Customer	ZigBee, OpenHAN, HomePlug and others	In-home/beyond-the-meter technologies to encourage the uptake of demand response opportunities.
General	ISO 9001	Quality and safety standards to be maintained as for all other SDG&E activities.
Security	ISO27002, NIST 800-53, NERC CIP, IEEE 1402	ISO and NIST provide a broad framework for security in technology, process and governance domains. The Critical Infrastructure Protection (CIP) standards are more specific to grid transmission security. IEEE provides a standard for physical security at substations.

SDG&E incorporates these standards in its decision making process by aligning to standards where it would achieve the greatest benefits for customers (e.g. lowest cost, easiest installation). SDG&E is participating on an ongoing basis with standards and coordination groups such as OpenSG[27], NIST's Smart Grid Interoperability Panel (SGIP), the North American Energy Standards Board (NAESB), and the North American Electric Reliability Corporation (NERC). SDG&E also monitors other areas to ensure the standards are moving in support of customer interests. In areas where standards deliver customer value, SDG&E prioritizes interoperability in its requirements by implementing a preference for suppliers that do not use proprietary technologies or implementations.

SDG&E seeks to design systems for modularity and implement standards at key interfaces, particularly those between the utility and third parties. Standards at these interfaces enable the utility to maintain the flexibility needed to integrate new technology solutions and vendors. It is difficult to predict the evolutionary path of various technologies and, therefore, SDG&E values consistent interfaces that enable the utility to change technologies and vendors as and when needed. SDG&E believes this is a key guiding principle as it explores the many components of Smart Grid solutions.

4.11.2 STANDARDS AND MINIMIZING RISK OF STRANDED COSTS

How will SDG&E minimize the risk of stranded costs in cases where standards are evolving?

To minimize the risk of stranded assets where standards are still evolving, SDG&E will start with pilots of new technologies to ensure they meet its requirements. SDG&E will

[27] The Open Smart Grid subcommittee within the UCA International User's Group, see http://osgug.ucaiug.org

also ensure that field devices are upgradeable over the air, so that as evolving standards firm up, SDG&E's investments can be protected.

Project management practices include evaluation of factors in order to decrease the risk of stranded costs. The SDG&E project lifecycle provides for a review of technology (for adherence to standards both external and internal), service and processes, as well as a vendor evaluation throughout the lifecycle of a project.

SDG&E will also suggest new regulatory structures that will provide the utility with the proper incentives to adopt appropriate Smart Grid technology in a way that responds quickly to market technology changes, and minimizes the risks of stranded costs. As the electric grid and markets are revolutionized by the Smart Grid, SDG&E will need the ability to respond quickly and make decisions that previously might have required direct regulatory approval and lengthy regulatory hearings. Unless this structure is changed, SDG&E and the California utilities will fall behind the best industry practices and will not be able to provide what customers require and demand.

4.11.3 OPENADR AND SMART ENERGY PROFILE COEXISTENCE

What is the feasibility and cost effectiveness of offering OpenADR coexisting with Smart Energy Profile 2.0?

Deploying technologies that are compliant with the OpenADR specification on dedicated servers will become more practical as more vendors enter this arena and begin building products that support the OpenADR specification, including interfaces, demand response automation servers, end devices, and so on. In these early stages, it will be more cost effective to execute initial pilots through software as service offerings from vendors. This approach will reduce the cost impact associated with internal deployment of the technology while also speeding deployment to support initial pilot efforts.

SDG&E has a limited implementation of OpenADR to large commercial customers and will continue to expand it for this class of customers, and will explore its implementation for other customer classes as new products and services are brought to market. SDG&E's advanced metering infrastructure solution includes a ZigBee wireless communications module in the meter and is designed to support the associated Smart Energy Profile. SDG&E's future decisions in this area will be driven by customer adoption, interoperability, and market maturity.

Assuming the technologies built against the OpenADR specification mature and more vendors enter this arena, more cost effective solutions and internal deployment and support of these products will become more feasible. Internal deployments on dedicated servers will provide SDG&E greater flexibility in integrating the OpenADR compliant products with internal systems.

4.12 CUSTOMER BENEFITS DELIVERY

How will SDG&E deliver benefits to customers?

After complying with state and federal policy requirements, delivering benefits and maximizing value for its customers is the primary focus of SDG&E's Smart Grid Deployment Plan and a key element to its decision making process. Even in situations where Smart Grid deployment plans are in response to a policy driven need, such as managing intermittency resulting from increased installation of rooftop photovoltaic energy, SDG&E evaluates the benefits the project will deliver to customers.

SDG&E collaborates internally with cross functional teams and externally with its customers and other stakeholders for ongoing customer input, to ensure its Smart Grid Deployment Plan is delivering customer value and providing benefits. By aligning the Smart Grid Deployment Plan internally, with key stakeholders, and with SDG&E's strategic plan, the utility also ensures that its Smart Grid investments and customer projects receive support across the entire organization. Smart Grid planning and investments, in turn, will inform SDG&E's ongoing strategic and operational planning efforts across the company. This view will support the annual updates and reporting to the Commission which requires centralized portfolio tracking and customer benefits reporting.

SDG&E's strategy to deliver value added services and benefits to customers will continue to be driven by collaboration with customers and other external stakeholders, including ratepayer advocates, government, business, academia, industry, environmental and privacy advocates. This will ensure better alignment with the needs and desires of stakeholders and a more complete understanding of impacts on customers.

By leveraging technology to create a more functional grid, SDG&E customers will become partners in providing energy, managing the grid and ensuring a reliable supply of electricity to the entire San Diego region at minimum costs. SDG&E's deployment plan roadmap is driven by a desire to support customers as they become partners and "prosumers" (those that both produce and consume energy) instead of remaining customers that only consume electricity. For example, Smart Grid Customer Empowerment projects will engage and prepare customers to maximize value by developing rate options, services and programs that customers want while protecting customer privacy and integrating customer owned equipment including distributed energy resources such as photovoltaic systems, smart appliances, home energy management systems, home storage and electric vehicles. SDG&E will also look for opportunities where the utility can play a unique role or fill a gap to satisfy customer energy needs.

SDG&E recognizes that the rate of customer adoption of emerging Smart Grid customer applications and technologies is uncertain. Therefore, SDG&E will continue to collaborate with industry groups, major technology vendors, consumer appliance and equipment providers and retail delivery channels to understand and interoperate with SDG&E's Smart Grid infrastructure to accommodate the rapidly evolving and changing consumer electronic landscape. For example, delivering customer information and customer specific alerts to a customer's mobile device will continue to be a challenge as the proliferation of mobile communications technologies and customer facing application development continue at a rapid pace.

SDG&E will integrate customer renewable resources, storage, and electric vehicles into grid operations while maintaining and/or improving reliability at both the transmission and distribution system. Where appropriate, SDG&E will institute new technologies, such as synchrophasors and dynamic line ratings. Some of this will be done by partnering with CAISO on identifying transmission expansions and technological improvements and requirements and resource characteristics needed in markets. These activities will improve asset management and grid efficiency by leveraging wide area measurement and control capabilities. By performing these activities, SDG&E will create the platform for new products and services from the utility and third parties.

Customer confidence in security is paramount, and SDG&E will ensure security is maintained or improved with the deployment of smart technologies. This will include hardening systems, testing for vulnerabilities, aligning controls to regulation and enterprise capabilities, tracking threats and vulnerabilities, providing appropriate training to operators, and making all Smart Grid participants more aware of security risks. SDG&E will deploy secure, reliable Smart Grid communications capabilities and leverage service based integration to provide maximum flexibility and adaptability between systems.

As technology evolves and becomes increasingly complex to maintain and operate, SDG&E will ensure readiness of its workforce as even higher skill levels are required. The well known workforce challenges from an aging workforce and attrition of experienced workers will also be addressed in any workforce plan. This will ensure that SDG&E is able to provide service that maximizes value of new and emerging technologies for customers.

4.13 EVALUATING THIRD PARTY COMMUNICATIONS NETWORKS

How will SDG&E evaluate whether third party communications networks can provide cost effective communications that meet the security and performance requirements of Smart Grid? How will SDG&E consider both existing and future service provider capabilities (cost effectiveness, security, and performance)?

Secure, reliable network communications are a core requirement for both Smart Grid and traditional utility operations. Network communications solutions for SDG&E's Smart Grid must meet a comprehensive set of functional and technical requirements, and deliver maximum value to the utility and its customers, regardless of whether they are provided by SDG&E's privately operated systems or leverage services provided by network service providers.

Like other technical capabilities and systems, SDG&E will carefully evaluate the feasibility, cost, and technical benefits of using existing communications infrastructure and how they can best be integrated with new technologies to enable Smart Grid deployment. Technologies and systems will be evaluated against business and technical requirements, technology and product maturity and lifecycle, interoperability standards, and fit for purpose value.

SDG&E's communications capabilities have been enabled by a mix of private networks and third party provider services for decades. In its continuous efforts to improve efficiency, functionality, capacity and security; SDG&E constantly monitors the market for available solutions and emerging trends and incorporates promising technologies into its evaluation and analysis process. Through that process, SDG&E has evaluated whether third party communications networks can provide cost effective communications that meet the security and performance (including coverage, capacity, reliability, and survivability during adverse events such as earthquake or wildfire) requirements of the Smart Grid – and found that in some cases, they can. Where those requirements are met, and the solution offered provides the most value, network services from a third party provider may be selected over a private network solution.

4.14 CONCLUSION

SDG&E has developed a robust strategy for its Smart Grid Deployment Plan. Elements of the strategy have been present and successfully utilized for a number of Smart Grid technology deployments to date. The strategy utilizes a decision making framework that prioritizes projects that are driven by requirements of state and federal policy and projects that deliver customer value where the benefits exceed the costs or where the investment is necessary to effectively communicate with customers. Piloting reduces risks such as stranded costs, among others, while the strategy's approach to interoperability standards and the leveraging of existing infrastructure where possible also help keep costs low. This strategy fulfills the requirements of D.10 06 047 and provides for flexibility as technologies evolve over time.

Section 5 GRID SECURITY AND CYBER SECURITY STRATEGY

5 GRID SECURITY AND CYBER SECURITY STRATEGY

5.1 INTRODUCTION

SDG&E intends to build a Smart Grid that is not only reliable and safe, but also secure. SDG&E is not alone in this expectation. The State of California[28] and the Commission agree that security plays a vital role in the state's electric infrastructure by stating "there is an urgent need to ensure that the utilities have appropriate security programs in place for physical and cyber threats and/or attacks."[29] In addition, the Federal Government, through Title XIII of the Energy Independence and Security Act of 2007 states that "it is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth and to achieve each of the following, which together characterize a Smart Grid..."[30] From standards bodies, such as NIST, to utilities, to consumer advocacy groups and private citizens, everyone agrees that for Smart Grid to be successful it must be secure from physical and cyber threats and must protect the privacy of consumer data collected by utilities.

SDG&E sees three important aspects to achieving a secure Smart Grid, including physical security, cyber security and customer privacy. First, **physical security**, which includes preventing or reducing the threat of energy and property theft, vandalism, trespassing, and bomb scares, is a key part of the business of operating a utility. However, physical security becomes even more complex in a Smart Grid where infrastructure components and personnel previously confined to data centers will necessarily migrate out into the field where monitoring is more difficult and physical security intrusions experience longer response times. Second, **cyber security** programs will be challenged by an increasing number of cyber assets dispersed over a broader geographic area, controlling

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[28] California Public Utilities Code, section 8360(a).
[29] D.10-06-047 at p.58[29] D.10-06-047 at p.58
[30] From the Energy Independence and Security Act of 2007, Public Law 110-140

more parts of the grid, and communicating more data than ever before. These assets will require protections against unauthorized access and losses to information confidentiality, integrity and availability that are at least as strong as their counterparts in data centers. Finally, **customer privacy** is a critical aspect to building and operating a secure Smart Grid. Pervasive customer privacy will require a set of robust business rules as well as effective security controls.

Information assets in the field will be hardened against physical tampering, and the grid itself better able to defend against unauthorized access to its systems and networks. Neither a physical nor a cyber threat can be allowed to significantly impact the Smart Grid despite attacking any one or multiple parts of it. As hybrid physical cyber threats emerge, SDG&E will prepare by considering how physical and cyber security programs can and will work together to protect Smart Grid assets and information. Security and privacy will be mandatory requirements that are designed in from the beginning.

5.1.1 SECURITY VISION AND APPROACH

To support SDG&E's larger vision for Smart Grid, the company is further elevating the already important role security, both physical and cyber, will play in this new paradigm. In this security perspective, SDG&E envisions that in the face of more complex systems with exponentially more data and transactions, an increased number of participants (customers consuming and producing energy, service providers, aggregators, regulators, utilities, etc.) will continue to rely on the availability of the system; trust the integrity of the information produced by the system; and be confident that sensitive information is secure from unauthorized access or disclosure. SDG&E's Smart Grid will be resistant to physical and cyber security threats, as well as resilient to attack and natural disasters. It will align with industry standards and best practices. SDG&E's security policies and practices are built on a security program that uses risk management methodologies to maximize its security investments.

To realize this vision, security programs and infrastructure will make Smart Grid participants **aware** of the risks and potential consequences. The utility will have greater visibility into the system state, as well as events taking place on the system; customers will understand how to better protect their privacy; each stakeholder will have more information to help the utility reduce the overall risk of the Smart Grid with an emphasis on creating a culture of security[31]. Security management functions will **converge**, being centrally governed by the utility. This management will allow for company to third party interoperability. Company security processes, such as incident response, will be integrated. For system resistance and resilience, centrally managed security policies will **disaggregate**, distributing into localized islands or communities of infrastructure to allow the system to continue to protect itself in the event it becomes isolated from the total system environment. Finally, SDG&E will continue to focus and enhance its ability to **comply** with Federal, state and local regulations designed to protect the confidentiality, integrity and availability of the Smart Grid. SDG&E risk management methodologies will integrate with business processes and should eventually inform the development of mandatory reliability standards set by regulators. Over time, reliability standards should develop to align with the similar risk management frameworks in order to be agile, effective, and cost efficient.

This vision and approach will benefit all Smart Grid participants by allowing them to be confident that the system is reliable and dependable, its operation predictable and trustworthy, and free from unauthorized information disclosure or modification.

5.2 SECURITY RISKS IN THE SMART GRID

SDG&E evaluates three factors to measure a given risk to the Smart Grid: 1) threats to the system; 2) vulnerabilities in the system, and 3) the impact, or loss, if a threat successfully exploits vulnerability.

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[31] Aligns with the Energy Sector Control System Working Group's "Roadmap to Secure Energy Delivery Systems."

Simply stated, **threats** are anything with the potential to cause harm. Lack of intent does not discount something as a threat. SDG&E classifies threats into three categories: Intentional, Accidental, and Environmental.

Intentional threats are those in which there is intent to adversely impact the confidentiality, integrity or availability of an asset. Common examples include sabotage, theft, cyber attack, and malicious code (malware). In this category of threats, in the their report, *High Impact, Low Frequency Event Risk to the North American Bulk Power System*, the North American Electric Reliability Corporation (NERC) and the Department of Energy (DOE) noted that "on the high impact end of the scale are highly coordinated, well planned attacks against multiple assets designed to disable the system."[32] Intentional threats include not only these external sources, but insider threats such as disgruntled employees or contractors whose knowledge of the system and its vulnerabilities could be used to cause great harm.

Accidental threats include those human caused events that may adversely impact an asset but in which there was no intent to cause harm. Examples include the accidental deletion of critical information, a misconfiguration of a security system that introduces new vulnerabilities, or the unplugging of a device from its power source.

Environmental threats are commonly associated with natural disasters, such as earthquakes, wildfires or flooding, but also include threats such as pandemic events[33] that could impair an organization's ability to provide a critical service. Even solar phenomena such as sun flares represent an environmental threat to Smart Grid.

Threats seek to exploit **vulnerabilities** or weaknesses in the system. Vulnerabilities can also be divided into three categories: technological, process related, and behavioral. There are several places vulnerabilities could potentially develop in a Smart Grid.

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[32] NERC DOE High Impact, Low Frequency Event Risks to the North American Bulk Power System

[33] *Ibid.*

Technological vulnerabilities occur when a flaw in a piece of hardware or software is introduced (intentionally or accidentally). Cyber examples include operating system and application bugs, and system misconfigurations. Physical security examples include coverage gaps in facility video monitoring, weaknesses in physical barriers, or alarms that fail to trigger when a break in occurs.

Process related vulnerabilities are found in organizational processes. A business or organizational process missing critical checks and balances may be exploited by an attacker. Process related vulnerabilities may be influenced by human behavior.

Behavioral vulnerabilities occur in human beings. Attackers will often use social engineering techniques to gain access to a facility or system through human operators rather than attempt to bypass sophisticated or hardened security controls. Users of information assets may attempt to do what is convenient rather than what is necessary to conduct business in a secure fashion. Such vulnerabilities can be particularly challenging to detect or measure.

Finally, the potential **impact** caused by the loss of an asset, whether the loss is related to availability of the asset, or the loss of integrity or confidentiality of information stored, processed or transmitted by the asset, must be considered in risk decision making processes. Assets that are less critical to the operation of the Smart Grid may require fewer protections than assets that are significantly more important to its safety and reliability.

When considering threats and vulnerabilities strategically, the primary role of SDG&E's security program must be to proactively reduce the overall risk to Smart Grid that minimize the quantity and severity of vulnerabilities found in the system, whether they are technological, process related, or behavioral; and to respond quickly to contain threats that do materialize before they can severely impact the system.

5.3 PRIVACY AND SMART GRID

SDG&E understands that the full benefits of Smart Grid cannot be achieved if it does not have the confidence of the users of the system. In particular, it is imperative that the privacy of customers' personal information and usage data be protected from all unauthorized access, disclosure or modification.

SDG&E intends to adapt several aspects of relevant guiding principles into its customer privacy framework. For example, SDG&E supports the four dimensions of privacy as described by NIST and the Fair Information Practice (FIP) principles developed by the Federal Trade Commission as key components of its security and privacy programs. In addition, SDG&E also supports other guiding principles from a process and technology design perspective, such as the Privacy by Design Seven Foundational Principles.

NIST describes four dimensions of privacy that SDG&E will consider how to integrate with its Customer Privacy Program:

"Privacy relates to individuals. Four dimensions of privacy are considered:

(1) Personal information—any information relating to an individual, who can be identified, directly or indirectly, by that information and in particular by reference to an identification number or to one or more factors specific to his or her physical, physiological, mental, economic, cultural, location or social identity;
(2) Personal privacy—the right to control the integrity of one's own body;
(3) Behavioral privacy—the right of individuals to make their own choices about what they do and to keep certain personal behaviors from being shared with others; and

(4) Personal communications privacy—the right to communicate without undue surveillance, monitoring, or censorship."[34]

Further, SDG&E agrees with the seven principles set forth by Privacy by Design, namely:

1. Privacy is Proactive not Reactive; Preventative not Remedial
2. Privacy as the Default
3. Privacy Embedded into Design
4. Full Functionality – Positive-Sum, not Zero-Sum
5. End-to-End Lifecycle Protection
6. Visibility and Transparency
7. Respect for User Privacy

"Customer privacy is becoming an integral part of the business culture within SDG&E."

These characteristics and principles become important as part of a baseline of industry understanding and best practices as SDG&E goes forward in the evolution of its Customer Privacy Program. This effort will permeate every part of SDG&E's customer privacy framework. It will positively influence the way SDG&E offers services to its customers by building confidence and trust.

However, SDG&E recognizes that the challenge of translating these principles into practice in a consistent and cost effective manner. For example, the privacy principle of "data minimization" is a worthy goal to achieve, but how this principle will be consistently applied to ever-changing innovative Smart Grid-enabled service offerings has yet to be fully determined.

[34] From "Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid"

5.3.1 EVOLVING THE CUSTOMER PRIVACY PROGRAM

Customer privacy is becoming an integral part of the business culture within SDG&E. The utility is working to tightly integrate privacy safeguards into relevant business processes and its Security Programs. Customer information privacy impact assessments and analysis of new and pending legislation, as well as maturing best practices regarding privacy will result in changes to company policy, guidelines, processes, procedures—including changes to security requirements, architectural principles and design standards, and system configurations—in order to better support customer privacy throughout end to end business process and technology implementations.

SDG&E will seek to minimize or eliminate the collection of unneeded customer information, share just the required customer information with only those that have a need to know, and ensure appropriate security controls protect customer information through the information's lifecycle.

Automated and pervasive data loss prevention capabilities will allow the company to minimize the risk that sensitive information could be intentionally or accidentally mishandled (i.e., printed, e mailed without encryption, etc.) according to legal, regulatory or company security requirements.

Most importantly, SDG&E will continue to raise the awareness of privacy issues and educate employees and contractors about the necessity of respecting and protecting customers' privacy.

The Customer Privacy Officer will oversee these activities and has overall accountability for insuring the adequacy of all customer privacy controls.

5.4 ALIGNMENT TO SECURITY GUIDANCE DOCUMENTS FROM NIST AND OTHERS

As stated in the Smart Grid Deployment Plan security vision, SDG&E believes it is critical that Smart Grid is aligned with industry standards and best practices. A widely recognized set of security standards that SDG&E uses throughout its security programs is maintained by the National Institute for Standards and Technology (NIST).

NIST represents just one set of standards and best practices that SDG&E must look to for guidance. In addition, several regulatory bodies issue standards and requirements that the company must also comply with, including the North American Electric Reliability Corporation Critical Infrastructure Protection (NERC CIP), the California Privacy Breach Notification Act, Sarbanes Oxley, and others. Some of these standards are duplicative, or rarely, conflicting.

To meet the challenge of complying with this growing list of standards, requirements and best practice guidelines in a sustainable and efficient way, SDG&E's security program is strategically consolidated and articulated in its unified security controls framework. SDG&E manages a master catalog of security requirements and controls that is maintained by this security program. These requirements and controls are normalized or standardized in a language that can be understood by the business as well as auditors and are not intended to be specific to any one regulatory body or set of security standards. Regulatory standards, requirements or industry best practices are incorporated into this catalog by a simple mapping exercise. Adding a new set of regulatory requirements, standards or industry best practices is a matter of mapping them to this normalized catalog of controls. In cases where a new requirement introduces a gap in the catalog, the program engages a process to define, design, test, and implement new controls quickly to ensure the new requirement can be met.

To see an example of how SDG&E uses this framework to align with the Security Profile for Advanced Metering Infrastructure, the Catalog of Control Systems Security, and the Department of Homeland Security (DHS) Cyber Security Procurement Language for Control Systems, see appendix in section 4.11.1.

SDG&E regulatory performs internal self assessments of its compliance with required federal standards regarding security of critical infrastructure as part of its ongoing compliance activity. Internally, the utility's compliance with these standards is reviewed, documentation and other evidence of compliance are examined, and where necessary changes are made to mitigate any areas where security can be improved.

5.5 SDG&E'S GRID AND CYBER SECURITY STRATEGY

SDG&E's security strategy aligns with the company's overall obligation to ensure the safe and reliable delivery of energy to its customers.

In order to realize its security vision, SDG&E will act on a strategy which can be summarized based on five components:

- Adhere to Security Principles
- Broaden Awareness (to Employees, Third Parties and Customers)
- Converge Security Governance
- Disaggregate Security Controls
- Comply with Federal Critical Infrastructure Protection Standards and Requirements

5.5.1 ADHERE TO SECURITY PRINCIPLES

At its highest level, SDG&E's security strategy seeks to apply fundamental security principles to its Smart Grid infrastructure.

- Minimize the attack surface of Smart Grid infrastructure components, rendering them more resistant to attack. Every system and every application must begin in a known and trusted configuration so that in the rare instance that an unauthorized change does occur, it may be quickly identified and acted upon.
- Protect customer privacy by limiting the amount of information collected about customers to that which is necessary to meet service needs while complying with all legal and regulatory obligations. Privacy must be the default, meaning that

customers will opt in or explicitly authorize the utility to share information rather than being required to opt out.

- Separate mission critical duties to minimize the risk of a single individual misusing a system or process to harm the Smart Grid.
- Simplify the management of access to critical systems to minimize the risk of human error in the application of access and to manage accountability of Smart Grid actor actions (i.e. logging critical transactions) by applying the principle of role based access control.
- Minimize the risk that the failure of any one control leads to a compromise or failure of the system by applying defense in depth techniques, in which multiple layers of defense are placed throughout its systems and potential security vulnerabilities are addressed at multiple layers including personnel, technology and operations for the duration of its systems' life cycles.
- Ensure the Smart Grid is aligned with accepted security standards and best practices in order to maximize flexibility in handling the latest threat vectors.
- Separate the application of centrally managed security controls, from security controls which are distributed in the Smart Grid environment.

5.5.2 BROADEN AWARENESS

Beyond the current involvement of utility employees and contractors in security activities, SDG&E considers three different perspectives of awareness in its security strategy.

- *Develop Situational Awareness*

  A resilient Smart Grid is able to self measure and self assess the consistency of its security controls and their effectiveness in near real time. Security personnel monitor for and detect a broad range of physical, cyber and hybrid security events, including incidents and vulnerabilities, responding faster and more efficiently based on the priority of each.

- *Smart Grid Participant Awareness*

  Security is not only embedded into Smart Grid operational processes and technologies, but also in the thoughts and habits of the people that participate in the generation, transmission, distribution and consumption of energy, including utilities, third parties and customers. Risk owners include physical and cyber security risks in their decisions. Utility employees, third parties and customers are informed and understand the shared obligation to protect every individual's privacy and security.

- *Collaborative and Regulatory Awareness*

  Legal and regulatory compliance is more easily managed and verifiable in a complex and rapidly changing regulatory environment where transparency builds trust. The communication of relevant security information, including threats and potential vulnerability mitigations, among a larger collaborative community facilitates finding and resolving potential problems faster.

5.5.3 CONVERGE SECURITY GOVERNANCE

Convergence takes on three perspectives in this deployment plan.

- *Centralized management of company physical and cyber security capabilities.*

  SDG&E centrally enforces its security management functions and reduces the number of unique management interfaces required to monitor and control these capabilities. Security capabilities are policy driven to support the consistent implementation of security controls, large scale enterprise management through the use of automation for enterprise wide configuration management, and remote security management. Company security processes, such as incident response, are integrated so that when an incident occurs, the company responds quickly and effectively.

- *Integration of company and third party security capabilities.*

Security capabilities are federated for company to third party interoperability. Third parties may include customers, vendors, contractors, regulators or law enforcement. This provides relevant actors access to more information in order to make risk decisions. This convergence makes possible the advanced data integrity and non repudiation capabilities required for making such large scale systems trustworthy.

ffi *Leverage standards*

Diverse proposals for standardization regarding the interaction between Smart Grid systems and security capabilities unite into a single well developed and widely accepted library of standards, making interoperability between different entities cost effective, flexible, easy to manage, and secure.

5.5.4 DISAGGREGATE SECURITY CONTROLS

Disaggregated Smart Grid security controls, enforcement mechanisms, and information repositories are physically and logically distributed throughout utility operations. This approach increases the grid's resilience in the face of man made or natural disasters. Risk management decisions sit more closely to the appropriate risk owner and are therefore, based on information provided by the sources closest to the issue. Improved automation also allows for risk decision processing with greater control by risk owners but with less human intervention.

Information security capabilities continue to evolve beyond well known and mature network layer controls into the application layer, increasing reliance on business logic to make near real time security decisions.

Disaggregated security capabilities support distributed security controls, enforcing decisions governed by enterprise policy while taking into account local business needs; are configured to defend local information assets without requiring access to centralized systems; and target specific localized threats.

5.5.5 COMPLY WITH FEDERAL CRITICAL INFRASTRUCTURE PROTECTION STANDARDS AND REQUIREMENTS

SDG&E seeks to maintain compliance with federal Critical Infrastructure Protection (CIP) standards and requirements at all times and continually seeks to enhance its compliance activities. These federal standards are designed to protect those assets that are critical for the reliable operation for the bulk power system.

- Compliance with federal CIP is given high priority with in the company with a senior manager (Vice President Level) designated to as the chief manager responsible for the companies critical infrastructure protection standards compliance across the various business units.
- SDG&E has an internal Reliability Compliance department that works with the business units to maintain compliance. This department also directly reviews documentation of compliance and provides management with an independent view of the compliance activities with each business unit.
- Each business unit with Critical Infrastructure Protection responsibilities, including both cyber and physical security are internally reviewed for compliance as part of the process of self certification of NERC reliability standards compliance.
- SDG&E continually seeks to enhance CIP Standards compliance and to ensure that its employees and contractors are well versed in the importance of compliance with these rules in maintaining the security of the grid.

As deployment develops some Smart Grid assets will be deemed to be critical and fall under the CIP Standards. SDG&E will incorporate these assets into its ongoing compliance activities and ensure that as deployment progresses these assets are afforded, at a minimum, the protections required by these Standards.

5.5.6 SMART GRID SECURITY STRATEGIC EXPECTATIONS

To meet these challenging demands of securing the Smart Grid, SDG&E must set clear security expectations across the utility and with its stakeholders, implement protocols to relentlessly monitor its systems for undesirable behavior, create a culture and technological platform that enables the utility to quickly react to potential incidents before they can cause great impact, and develop communications mechanisms to keep every relevant stakeholder informed. Grid and cyber security should also enable flexibility and extensibility to meet changing business requirements.

Cyber security will continue to use and expand network layer security controls where they provide value, and will aggressively develop application layer controls in order to meet the latest security challenges.

Ensuring data integrity will become increasingly important in a Smart Grid environment where price signals or system commands may be sent, received and acted on in more automated ways. Further, non repudiation (assurance of data authenticity) will become essential to Smart Grid participants in order to be able to trust that other participants cannot deny their role in a given transaction.

From a physical security perspective, SDG&E will further improve its anomaly detection capabilities; including enhanced video capture, storage and retrieval, motion sensing, electronic signal detection, and physical access control technologies further into the field. It will exploit role based and provisioning/de provisioning capabilities in order to improve the accuracy and timeliness of physical access control.

In addition, SDG&E will consider threats related to electromagnetic pulses, and natural events such as solar flares, that could disrupt the availability of the grid.

SDG&E will act in the following ways to execute its security strategy and achieve its security vision for Smart Grid:

- Apply a "secure by design" approach
- Distribute security controls and make them more autonomous
- Develop new security capabilities to support the Smart Grid
  - Information sharing services with collaborative partners
  - Large scale situational awareness capabilities
  - Large scale information integrity and non repudiation services
  - Endpoint protection capabilities
- Evolve existing security capabilities to support the Smart Grid
  - Community centric security awareness capabilities
  - Internal security standards and testing capabilities
  - Software development lifecycle management
  - Enterprise logging services
  - Vulnerability management services
  - Risk and compliance management services
  - System configuration management capabilities
  - Cyber threat detection, alerting and response capabilities
  - Physical threat detection, alerting, and response capabilities
- Unify shared security capabilities
  - Integrate physical and cyber security capabilities
  - Identity and access management services
  - Encryption key management services

5.5.7 APPLY A "SECURE BY DESIGN" APPROACH

Security is more effective and less expensive when it is considered from the beginning of a project, rather than added on after the project is complete. Security controls that are designed alongside system functionality (as part of the IT lifecycle for technology projects) are more effective at protecting information and systems. It is also less expensive in the long run to design security from the beginning rather than attempt to add security features late in the design effort, or worse, after the system or device has been deployed and placed into operations

The success of a "secure by design" approach is as much about the culture of the security within organization developing a solution as it is about the processes or technologies it deploys.

5.5.7.1 DISTRIBUTE SECURITY CONTROLS, AND MAKE THEM MORE AUTONOMOUS

For a variety of performance and reliability reasons, security controls that have traditionally been placed in data and/or control centers will move closer to the field systems that they support or be able to reach such field systems that are closer to the edge, or the consumer's residence or business. Some examples of such controls include, but are not limited to: authentication; authorization; encryption; event logging and correlation; intrusion prevention; and physical access controls such as remote cameras, motion detectors, and facility entry systems.

5.5.7.2 DEVELOP NEW SECURITY CAPABILITIES TO SUPPORT THE SMART GRID

Share information with collaborative partners

A Smart Grid introduces a new set of challenges in large scale cyber security situational awareness. Since no one organization or individual owns, operates, monitors or uses the entire grid, it is incumbent on utilities, third parties and customers that participate in its operation to share information in order to maintain a "big picture" view of system conditions, and in particular, threat activity and security events that could be indicative of a cyber attack.

SDG&E will define the set of actors (i.e., information providers or consumers of information, based on role) with which it will send and/or receive relevant information and ensure individuals in those roles receive the appropriate background checks to handle sensitive information, determine the view or set of information that is required by each actor, develop mechanisms to collect and handle the required information, including systems and facilities that meet government sensitive information requirements, and implement resistant and resilient mechanisms to deliver the information. SDG&E's model will be modular for portability and standardized for more efficient integration with future security threat and event information actors.

Large Scale Situational Awareness Capabilities

Similar to the power system itself, increasing volumes of security event data will be captured and analyzed, so security personnel must have more efficient ways of visualizing and finding patterns, drilling down for more details, and formulating and acting on a response. Especially in physical security, augmented reality will be considered for enhancing real time video to define and visualize security tolerance boundaries. Augmented reality may also prove invaluable by discovering hard to spot patterns in video, such as partially hidden or camouflaged objects.

Large Scale Information Integrity and Non Repudiation Services

Smart Grid will depend on the ability for thousands, tens of thousands and perhaps millions of actors to reliably conduct rapid and frequent automated business transactions. Each actor must be able to consistently trust that the information they use to make energy decisions is being provided by a trustworthy source and that the information itself is free from unauthorized modification through the entire transaction.

Information integrity and non repudiation services will require standardized enrollment interfaces and provisioning mechanisms. These services must seamlessly interoperate with third parties.

Endpoint protection capabilities

Endpoints generally include any device that is at the end of a Smart Grid transaction, such as a smart meter or other smart device. Depending on the role of the endpoint, it may require specific protections around authentication, authorization, least privilege oriented role based access control, data loss prevention, malware prevention, digital rights management, or cryptographic capabilities. Legacy endpoints (i.e. existing devices that are already deployed in the infrastructure) may not be able to support modern authentication, authorization, encryption, or other capabilities. Such endpoints must still be able to securely interoperate with other endpoints on the Smart Grid network. This may require abstracting the security features that cannot be performed by the legacy endpoint to "security layer" technologies that handle these features on behalf of the legacy device.

5.5.8 EVOLVE EXISTING SECURITY CAPABILITIES TO SUPPORT THE SMART GRID

Community Centric Security Awareness Capabilities

Cyber security is an issue about which people are relatively aware and concerned. SDG&E can leverage that awareness and enhance it by collaboratively sharing knowledge, best practices and experiences with its customers, partners, regulators, and employees.

Communicating regularly with this larger community is a priority for SDG&E and includes such topics as threat information and privacy concerns. Awareness programs the utility is developing will be pervasive, deliver a consistent message, multiple times and over a variety of delivery mechanisms, both physical and electronic. SDG&E will also be prepared to receive information about threats and vulnerabilities and distribute this information quickly to the affected parties.

Cyber security cannot be relegated to the back office. Those with a responsibility to secure information must play an active and communicative part in making this larger community aware of the current state of the SDG&E's security posture as well as allowing this larger community to keep the company aware of its ideas and concerns on any planned future state.

Internal Security Standards and Testing

Standards are critical to the development of strong and repeatable security controls, and in the measurement of their effectiveness. Without standards, interoperability becomes increasingly difficult and prohibitively expensive. SDG&E participates in a variety of industry and Smart Grid standards organizations in order to improve security capabilities while ensuring compliance with industry accepted standards.

SDG&E will invest in security testing against new and existing field embedded and wireless systems, and in the performance of regular reassessments of existing systems deployed in the operational environment to quickly find and mitigate vulnerabilities.

Software Development Lifecycle Management Services

Smart Grid will require significantly more software components than the aging infrastructure it will replace. While much of this software will be produced by third parties, SDG&E will evolve its capability to produce and maintain quality software that is free of defects and security vulnerabilities. Existing software management processes will be unified and integrated into a single well managed and authoritative capability.

An enterprise software development lifecycle management capability will include the technology, processes and organizational units required to effectively and repeatedly write software; thoroughly check it for defects; and ensure its integrity through development, unit testing, deployment and while it remains in production.

Further, this management capability will be prepared to incorporate third party software, including source code if available and necessary, that is introduced into company environments.

Lifecycle management capabilities should make it easier for software developers to focus more on software development while meeting relevant software security standards.

Enterprise Logging Services

Enterprising logging is the heart of event collection for actor accountability, anomaly detection and incident response automation. The utility must be able to store much more event data in a scalable fashion and process that data faster for delivery to various monitoring, correlation, and compliance tools.

Vulnerability Management Services

Vulnerability detection and response capabilities must have wider reach across more systems and discover more vulnerabilities in near real time. These capabilities will include traditional vulnerability discovery tools like vulnerability scanners that conduct sweeps of an environment, as well as querying tools that examine system configurations, and passive tools that observe passing network traffic in order to infer potential vulnerabilities.

Vulnerability management will begin examining systems that in the past have had little or no cyber footprint, such as SCADA systems and field equipment, in order to find vulnerabilities in these specialized devices.

Risk and Compliance Management Services

The calculation of physical and cyber security risk must become quantifiable and reliable. Risk owners must be able to depend on risk data for their decisions. Risk data must be available to risk owners via their preferred delivery mechanisms.

SDG&E will be able to measure more frequently and report more quickly to multiple stakeholders, both internal and external.

Compliance Management

Documentation, reporting and visualization of controls objectives, controls and associated risks, surveys and self assessments, testing, and remediation is a necessary feature of compliance management. Compliance management should support various types of compliance, such as ISO 27002; NIST 800 53; and other standards, industry specific regulations such as NERC Critical Infrastructure Protection (CIP); service level agreements; trading partner requirements and compliance with internal policies. Testing, verification, and measurement of control effectiveness are critical to assure continued compliance.

Risk Management

Risk is managed by the documentation, assessment, gap analysis, reporting, visualization, and remediation of risks. The risk management framework should provide a structure of capturing potential issues found during assessment and analysis, reusable controls for remediating risk, and reporting capabilities to ensure the risk owners are aware of their risk posture.

System Configuration Management Capabilities

Any change to a production system should be recognized, authorized and documented. Unauthorized changes should be immediately apparent and operators should have the ability to revert to a trusted state remotely and in a trusted fashion with minimal interaction. Systems should recognize and reject attempts to modify logical components. In some cases, even if software delivery controls are circumvented, the system should be able to recognize an unauthorized change and revert to a previous trusted state without human intervention.

Cyber Threat Detection, Alerting and Response Capabilities

Collecting event data is not enough. Event data must quickly be analyzed for known patterns and anomalous behavior. The company must enhance its monitoring, detection, and response capabilities to provide for more automated defense mechanisms and security personnel augmentation capabilities. Threat analysts and responders must leverage visualization technologies that allow them to visually consume and interact with potentially millions of security events per hour.

From a cyber perspective, this means improving intrusion detection and prevention, and data loss prevention capabilities. Grid computing which harnesses the power of underutilized computer processors to perform process intensive tasks will be considered for threat analysis.

These cyber security threat capabilities must integrate with relevant physical security capabilities in order to gain a better understanding of large scale or blended threats.

Physical Threat Detection, Alerting and Response Capabilities

The company must expand its facility and property surveillance from existing visible light technologies into the thermal, infrared and low visible light spectrums. Capabilities are required to detect and respond to anomalous electronic signals that could indicate potential information gathering or sabotage threats.

Further, the company must be able to monitor increasing numbers of local and remote facilities and equipment, be alerted to anomalous events, recognize physical security threats, and quickly respond.

Finally, these physical security threat capabilities must integrate with their cyber cousins in order to gain a better understanding of large scale or blended threats.

5.5.8.1 UNIFY SHARED SECURITY CAPABILITIES

Company security organizations, technologies and processes, including security risk management, event monitoring, incident handling, provisioning, de provisioning, authentication, authorization and encryption must be able to be managed and monitored from a more centralized security perspective. Specific entities, such as business units or third parties, may have specific requirements for their business areas, but these requirements should integrate cohesively with the larger security directive to minimize risk without sacrificing flexibility. Such capabilities should allow the company to work with third parties, regulatory agencies, or collaborative community driven needs to share information. The following diagram depicts the various levels of maturity in shared security capabilities.

Figure 5 1: Maturity Levels of Shared Security Capabilities

Integrate Physical and Cyber Security Capabilities

The threats that face a Smart Grid are relentless, having the luxury of time and unlimited cumulative resources on their side. As these threats already operate both in the physical and cyber worlds simultaneously, so must the company's security program combine its physical and cyber security capabilities in order to detect, prevent, and when necessary, respond to, such threats in a coordinated and well practiced fashion. SDG&E will manage these capabilities under a centralized joint security operations center (JSOC).

Identity and Access Management Services

All actors, including user, systems, and some applications, must have unique identities in order to conduct secure transactions on a Smart Grid. This capability must incorporate externalized authorization, coarse and fine grained role based access control, and federation with internal as well as third party systems, and with cryptographic key management systems. Multi factor authentication will be required for users of the system in specific roles, circumstances, or threat conditions. Further, authentication, authorization and access control mechanisms must become more centralized for more consistent management and support multiple levels of granularity.

Encryption Key Management Services

Strong information integrity and non repudiation services will require a centralized and unified key management system in order to protect valid encryption keys and revoke those that have expired or become compromised.

5.6 SDG&E'S INFORMATION SECURITY PROGRAM

This section of the Smart Grid Cyber Security Deployment Plan describes the Information Security Program for the company. The security program addresses information security in the broadest scope and determines SDG&E's methodology for following its security strategies.

As part of implementing its Smart Grid security strategy, the company will apply its Information Security Program, including the following elements.

- Information Security Governance
- Information Management
- Compliance Program
- Security Awareness and Training
- Security Strategy and Architecture
- Security Principles in Contracts
- Information Security Engineering in the System Development Lifecycle
- Operational Security

5.6.1 INFORMATION SECURITY GOVERNANCE

Company information security governance practices support the effective operation of the company in carrying out its role as a public utility with the verifiable assurance that information assets are handled in a manner that protects the business and is consistent with applicable laws and regulations.

Management of any complex system such as those required to deploy SDG&E's Smart Grid vision requires well documented and understood accountability and responsibility of a system's "users" and owners of the system. The company's Security Governance Program includes the following elements.

- Leadership: Define roles that are accountable and responsible for protecting information and information assets. These roles provide the appropriate level of authority necessary to execute their responsibilities.
- Requirements in a comprehensive security policy framework.

- Partnerships: Partnerships with external stakeholders, including law enforcement and regulatory entities, to facilitate reporting and escalation of important security incidents and information securely and efficiently.
- Risk Management: No organization can protect everything with the same level of security, nor should it. Risk based management of security includes a value and impact based methodology to ensure protections are commensurate with the value of the asset being protected.

5.6.1.1 INFORMATION SECURITY LEADERSHIP

The company's Information Security Program defines leadership roles and responsibilities to fulfill key activities and decision making within the program. The key roles are those of information and system owners, security professionals, and operations and system administration staff. Smart Grid technology deployments will be subjected to this program element as part of SDG&E's ongoing best practices in security leadership and decision making.

The corporate structure consists of Officers, Directors, Managers, and Staff.

For example, specific Information Security Program roles include:

- The Chief Information Officer has overall accountability for the information security posture of the company and its information assets.
- The Director of Information Security and IS Compliance has the overall responsibility for company Information Security department activities.
- Managers address aspects of strategy, architecture, compliance, risk, governance, engineering, and operations.
- Various staff positions provide multiple support functions to company projects, assisting in design, implementation, operation, management, and compliance activities.

- A Computer Incident Response Team (CIRT) is responsible for detecting, responding to, and assisting in the recovery from computer security incidents that impair the company's ability to conduct normal business operations.
- Information Security Advocates (ISA) participate in a cross functional team comprised of business, IT and security team members. ISA's are a practical extension of the enterprise security program into the business.

5.6.1.2 COMPANY INFORMATION SECURITY ROLES AND RESPONSIBILITIES

An individual may be assigned to one or more of the following roles. Each role has specific responsibilities with respect to information security and protecting company assets. Table 5 1 lists those roles & responsibilities:

Table 5-1: Security Roles & Responsibilities

Role	Description
User	An individual who accesses or attempts to access Company Information and/or Information Systems.
Risk Owner	Company officer or executive that is ultimately accountable for risk and has the ability to assume financial impact of an accepted risk or the residual risk related to the outcome of a risk treatment. In many cases, the Risk Owner can also be the Information Owner.
Risk Manager	Company executive or director that has been delegated a limited level of responsibility for making risk decisions on behalf of the Risk Owner.
Control Owner	Directors or managers ultimately accountable for security controls. Control Owners report to Risk Managers any deficiency of controls related to the protection of company information and information systems. Control Owners don't necessarily need to organizationally report directly to a Risk Manager.
Control Manager	Individuals responsible for implementing and maintaining operational controls. A secondary responsibility exists to ensure controls are operating effectively and performing as expected. Control Managers are assigned by and report deficiencies to Control Owners.

5.6.1.3 POLICY FRAMEWORK

Company security policy documents are organized by artifact type. Company security policy artifacts include:

- Policies: The set of business rules and practices that regulate how an organization manages and protects sensitive information.
- Guidelines: Provide practical direction for what people need to do in order to comply with security policy.
- Standards: A specification of agreed security features and controls that are established for use within the company.
- Procedures: Detailed step by step instructions that define how to perform information protection processes and activities.
- Requirements: The specifications of the security features and controls necessary to satisfy security policy.

Company Information Security policies are based on accepted standards and guidelines, including ISO 27002 and the NIST 800 series standards, and cover regulation important to SDG&E, such as NERC CIP Standards and Requirements and many others. The policy framework applies to the Sempra Energy Utilities (SEU), including SDG&E and the Sempra Energy Corporate Center (CC).

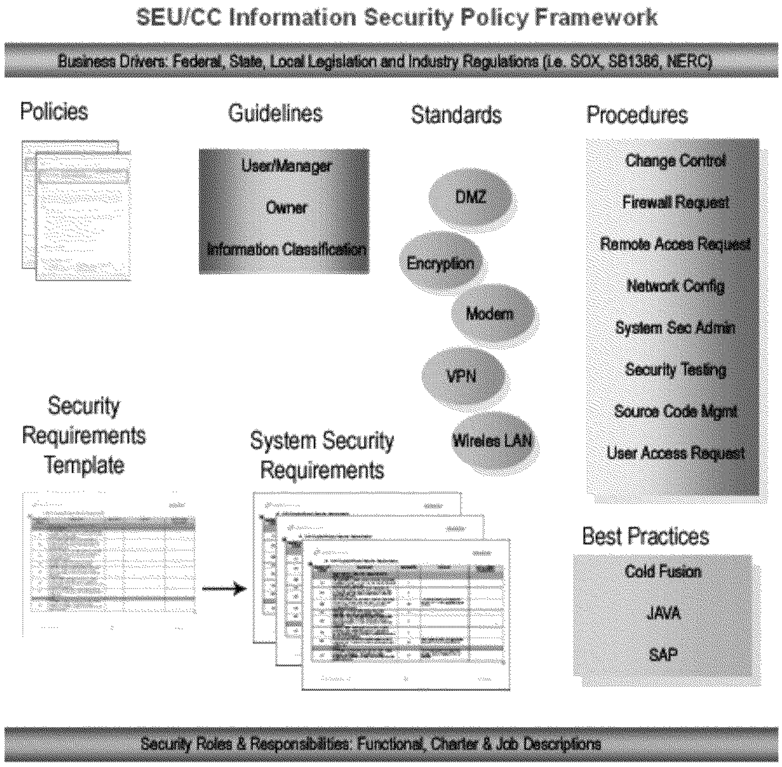


Figure 5 2: SDG&E (SEU/CC) Information Security Policy Framework

5.6.1.4 EXTERNAL PARTNERSHIPS

The Information Security team maintains a number of partnerships outside of the company. The partnerships include industry groups, community organizations, and state and federal organizations. Best practices in Smart Grid cyber security, physical security and privacy will be shared with these groups by SDG&E where appropriate and SDG&E expects to work collaboratively with these external partners to accelerate best practices throughout the industry as it implements its Smart Grid vision.

Some of the industry groups include:

- UCAIug/Open Smart Grid User Group
- GridWise Alliance/Interoperability and Cyber Security Working Group
- ZigBee Alliance

- EPRI
- International Information Systems Security Certification Consortium, Inc. $(ISC)^2$
- Information Systems Audit and Control Association (ISACA)
- Information Systems Security Association (ISSA)
- UTC (Utilities Telecom Council)

Activities with community, State, and Federal organizations include:

- DOE/NIST Smart Grid Cyber Security Working Group
- DHS Homeland Infrastructure Threat and Risk Analysis Center (HITRAC) security briefings
- Federal Bureau of Investigation (FBI)
- Western Electricity Coordinating Council (WECC) Critical Infrastructure Protection User Group
- Electricity Sector Information Sharing and Analysis Center (ES ISAC)

Partnership with other industry experts:

- Active participation and information sharing with local companies in the financial, healthcare and other industries;
- Active participation with various industry peer groups – CISO, CSO Round table, etc.

5.6.1.5 RISK MANAGEMENT & ASSESSMENT

Enterprise Information Risk Management is an ongoing process to proactively manage risk related to information assets. Its objectives will be applied to new Smart Grid deployments to manage risk, make information risk decisions, drive awareness of potential risk impact and ensure continual assessment, measurement and process improvement:

- Provide the company with a standard framework for managing information risk;

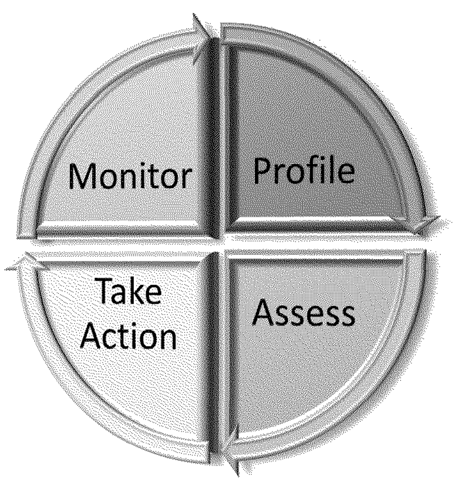
- Provide the ability for the business to make informed information risk decisions;
- Make the company aware of the potential risk impact to its information;
- Continual assessment, measurement and process improvement.

These objectives are accomplished using an Enterprise Information Risk Management (EIRM) framework and information assurance process that is aligned with the company's core values and risk tolerance, in order to assess and manage information risk.

5.6.1.6 EIRM FRAMEWORK DEFINITION

The four key phases of the EIRM Framework are depicted graphically, as well as described below:

Figure 5-3: Enterprise Information Risk Management Phases



- ***Profile***: identifies company information assets and their value.
- ***Assess***: provides threat classification and security vulnerability information, along with potential business impact, to suggest possible responses to different categories of information risk.
- ***Take Action***: empower business managers to make informed decisions to prioritize risks and implement appropriate controls.

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- *Monitor*: ensures that current and future risks can be minimized through ongoing maintenance and monitoring activities.

5.6.2 INFORMATION MANAGEMENT

Information Management consists of creating, handling, and when necessary, securely destroying data throughout its lifecycle as required by the company records retention policy and applicable law or regulation, as well as appropriate handling and disclosure required by information sensitivity, legal and regulatory requirements. Information is classified based on its value and sensitivity combined with the impact of its loss, modification, or unintended disclosure. Company records are a specific type of information with additional handling requirements.

5.6.2.1 INFORMATION CLASSIFICATION

Company information is categorized into one of four classification levels. The classification levels do not affect any privilege status or preclude the use of more stringent need to know restrictions for the dissemination, protection, and use of the information.

The four categories are "Public," "Internal," "Confidential," and "Restricted." These categories are applied to Information or data, commands, and controls for all forms of systems. Roles and responsibilities are defined for information to determine the appropriate classification and handling of specific pieces of data.

- **Public Information** – Public Information is any non privileged information prepared, owned, used, or retained by the company and that is required or intended to be disclosed or made available to the public. Public information must be authorized for release prior to being released to the public domain.

- **Internal Information** – Internal information is generally releasable to Company employees and contractors designated by an authorized employee to receive such information, subject to privilege and/or need to know restrictions. It requires a degree of protection because unauthorized acquisition, modification or destruction of internal information could result in loss of productivity, disruption of Company operations or negatively impact the company's reputation. When a handler is unsure of a piece of information's classification, it should be assumed to be, at a minimum, Company Internal information.

The external release of internal information regardless of the transmission media must be authorized by the information owner.

Unauthorized release of Company Internal information could:

- Reduce Company competitive business advantage;
- Increase the risk profile of the company due to attacks;
- Tarnish the reputation of the company;
- Negatively impact service availability and/or reliability.

- **Confidential Information** – Confidential Information is any information that if disclosed or corrupted in an unauthorized manner could cause *great* harm to an individual or the company. It requires reasonable control because unauthorized access or improper security measures could cause a violation of applicable law or could harm the company's reputation, credibility, competitive advantage, revenue generating potential or employee morale.

Dissemination of Confidential Information regardless of the transmission media must be authorized by the Information Owner.

Unauthorized release of Company Confidential information may significantly:

- Compromise the company business reputation and credibility;
- Increase the risk profile of the company due to attack;
- Decrease Company competitive business advantage;

- Reduce Company revenue generating potential;
- Destroy employee morale.

- **Restricted Information** – Restricted Information is any information that if disclosed or corrupted in an unauthorized manner could cause *extremely grave* harm to an individual or the company. It requires maximum control because unauthorized access or improper security measures could cause an impairment of business activities or significant economic damage and/or significantly damage the health and well being of individuals, and may also cause a violation of applicable law.

  Restricted information requires explicit written approval dissemination by the information owner, including off site records retention.

  Unauthorized release of Company Restricted information would significantly:

  - Impair the ability to generate, transmit or distribute energy;
  - Harm the economic well being of the communities served;
  - Inflict irreparable harm on the general public.

5.6.2.2 NEED TO KNOW

The hierarchical classification may not always be sufficient to adequately determine the appropriate protection measures for information. Reasonable security features and controls should be used to protect information from misuse, unauthorized access, unauthorized acquisition, destruction or disclosure. Access to information may be further limited based on business considerations and an individual's "need to know." Generally, information should be limited to the fewest number of individuals to reduce the risk of compromise or misuse.

"Need to know" categories are often dictated by customer/employee privacy, legal, regulatory and business considerations, and typically include:

- Affiliate Compliance;

- Client Attorney privileged Information;
- Procurement contracts during the Request for Proposal and/or preparation process;
- All personal Information protected from disclosure by applicable law.

Information which is privileged, pursuant to the Attorney/Client privilege or otherwise shall remain privileged irrespective of its classification above.

5.6.2.3 INFORMATION LABELING

Marking or labeling is the process of designating the value of information based on its hierarchical classification, any associated need to know restrictions and in some cases, any associated need to know privileges. All Company information may be marked with one of the four classifications as an advisable means of communicating such status to recipients. Company information should also be marked with need to know restrictions as an advisable means of communicating such restrictions to recipients. Privileged Company information shall remain to the applicable privilege irrespective of whether it is marked, but the discloser may wish to mark it as such for clarity. If the classification or need to know restrictions/privileges of the information are unknown, employees are trained to check with their manager/supervisor, the associated information owner or the applicable records retention schedule.

Information, depending on its media, may be labeled in some of the following ways:

- Within electronic files and/or documents;
- On the media containing the Information;
- On printed or hard copy Information.

Trade Secret Marking Guidelines – Intellectual Property law recognizes patents, trademarks, copyrights and trade secrets. Trade secrets require special protection measures. The term "trade secret" under the California Uniform Trade Secrets Act means information, including a formula, pattern, compilation, program, device, method, technique, or process, as well as contractual non disclosure protections that:

1. Derives independent economic value, actual or potential, from not being generally known to the public or to other persons who can obtain economic value from its disclosure or use; and

2. Is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

Accordingly, Trade Secret Information shall be appropriately safeguarded based on its classification – Internal, Confidential or Restricted, such status can be communicated effectively by marking.

5.6.2.4 INFORMATION AND SYSTEM APPROPRIATE USAGE

Company policy defines appropriate business use in the Information Security Acceptable Use Policy to address such impacts as privacy but also guidelines for usage of information on portable devices, legal considerations and password management which will be applied to SDG&E's information produced in association with Smart Grid deployments to ensure proper usage.

- Privacy rights and employee expectations;
- User Guidelines with respect to;
- Authorized Business Use;
- Protecting Information and Information Systems;
- Password Management;
- Information Transfer;
- Legal Considerations;
- Portable devices;
- Information Retention.

5.6.2.5 RECORDS MANAGEMENT POLICY

The company retains only those records and non records that are necessary for complying with legal, regulatory or financial requirements and for conducting business. All business units involved with Smart Grid deployments are subject to and will comply with and implement this policy. Each employee is responsible for understanding this policy and maintaining and disposing of records and non records, regardless of media, within their possession or control in compliance with this policy.

5.6.2.6 INFORMATION DESTRUCTION

It is important information is kept (which includes company records) for as long as required to meet company policy and regulatory requirements. When any piece of Smart Grid related information is no longer needed, it's equally important that it is destroyed according to its level of sensitivity.

Information stored in hard copy, or on electronic media, that has been classified as confidential or restricted should be shredded or its media physically destroyed when it is no longer needed.

5.6.3 COMPLIANCE PROCESS

The Company Information Security Compliance Program oversees compliance with external requirements, internal policies and business processes. It also defines IT departmental responsibilities and monitors, measures and reports on compliance status via exception engagement / issue tracking.

The Information Security Compliance Program assists the business with compliance with the Information Security aspects in a number of business areas. SDG&E's Information Security Compliance Program ensures that all Smart Grid information security is in compliance with the regulations and statutes such as:

- Electric Reliability Standards as required by FERC (such as, NERC CIP, NERC Communications/COM);
- FERC Order 717 (Affiliate Compliance Code of Conduct);
- CPUC Affiliate Transactions Compliance (Shared V.C., D.97-12-088/D.97-12-029);
- Consumer Information Privacy (Gramm-Leach-Bliley Act [GLBA], SB 1386);
- Breach Notification (SB 1386, California Database Breach Notification Act [CDBNA]);
- Identity Theft detection (Red Flag Rules);
- Financial Integrity (Securities and Exchange Commission [SEC], Sarbanes-Oxley Act [SOX]);
- Retention and eDiscovery (such as, Federal Rules of Civil Procedure [FRCP], CA's AB 5);
- Medical Information Protection (Health Insurance Portability and Accountability Act [HIPAA], California Civil Code 1798);
- Credit Card and Checking Account transactions (The Electronic Payments Association [NACHA], Payment Card Industry [PCI]);
- California specific (California Highway Patrol, Department of Motor Vehicles).

Roles and Responsibilities

Responsibility for the Compliance Program on a day-to-day basis resides with a variety of business and IT operating groups, particularly those areas and departments of the company affecting the confidentiality, integrity and availability of information assets. Senior Management or their delegate(s) in these departments, or areas, are responsible for communicating its compliance responsibilities to affected employees within the department and monitoring compliance with applicable standards, policies and regulatory requirements. The Senior Management or their delegate(s) will be responsible for activities, procedures and changes necessary to ensure their department, function or area is in full compliance with external requirements, internal policies and business processes.

Information Security Compliance Tools and Processes include capabilities such as:

- Controls and Policy Mapping;
- Policy Distribution and Attestation;
- IT Control Self Assessment and Measurement;
- Governance, Risk and Compliance Asset Repository;
- Automated General Computer Controls Collection;
- Remediation and Exception Management;
- Basic Compliance Reporting;
- IT Compliance Dashboards; and
- IT Risk Assessment.

Information Security Compliance Internal Controls and Monitoring

The Compliance Program proactively monitors and self–assesses its compliance with all applicable standards, policies and external requirements as well as its processes intended to ensure its compliance. SDG&E undertakes numerous compliance activities which differ in scope and activity depending on the compliance requirement, including:

- Control effectiveness review/ verification, attestation and certification;
- Periodic internal audits by Audit Services (in Sempra Energy Corporate Center) of one or more control areas;
- Periodic external audits by qualified third parties of one or more control areas;
- Ongoing monitoring of regulatory environments for development of necessary changes;
- Ongoing monitoring for compliance, control effectiveness and program effectiveness;
- Regular compliance meetings;
- Prompt and thorough assessment of compliance questions;

- Coordination and facilitation of compliance inquiries with appropriate resources within IT;
- Regular evaluation of documents, procedures and resources associated with applicable standards, policies and regulatory requirements;
- Timely investigation, assessment, risk mitigation and remediation of compliance events and issues to ensure continued compliance and to prevent reoccurrence.

5.6.3.1 RISK TREATMENT

Once the risk is understood, a Risk Owner has four options. He or she can

- Avoid the risk,
- Mitigate it,
- Transfer it, or
- Accept it.

Risk **avoidance** means the Risk Owner can opt not to continue with the source of the risk. For example, the service may not be offered, or a vulnerable system may be removed from the network.

Risk **mitigation** provides the Risk Owner great flexibility. The service may be offered, but security controls must be put in place to reduce risk to more manageable levels. For example, a vulnerable system may be patched to reduce the risk of getting a computer virus. There may be several options for risk mitigation of varying costs for the Risk Owner to consider. In the same example, the vulnerable system may also be placed behind a firewall or other network-based security control to further reduce the risk of virus infection.

Risk **transfer,** or risk sharing**,** is for situations where it may be more cost-effective to allow another entity to adopt the risk rather than for the Risk Owner to pay to mitigate or accept risk. For example, a third party hosting service may be contracted with to provide a web server if the Risk Owner has reason to believe the third party can more effectively manage the risk of computer virus infection on its web servers. Risk transfer may also include the purchase of insurance in order to offset cost if a risk condition is realized.

Risk **acceptance** is a process in which a Risk Owner makes a decision to accept a specific security risk because the overall cost of addressing residual risk through avoidance, mitigation and/or transfer outweighs the value of the information asset(s) being protected. Risk Acceptance provides the Risk Owner an opportunity to understand and document a known Information Security Risk Situation. A Risk Owner can only accept risk for information assets they own. Only a Senior Executive responsible for the business unit at risk may assume risk on behalf of the subject enterprise environment.

Risk Acceptance is used if a company security policy, procedure, standard, or requirement cannot be met because:

- It is physically infeasible to do so (i.e., physical attribute prevents implementation of security controls);
- Logically infeasible to do so (i.e., significant impact to business process, service and or financials, or regulatory requirements);
- The cost of implementing a specific security control outweighs the value of the information asset(s) being protected.

Risk Acceptance is not permanent. The business unit and or organization must satisfy the necessary requirements and come into compliance with Information Security Policy within a designated period of time described in the Risk Acceptance.

It is the purpose of the Risk Acceptance to define the issue(s), develop a plan, and begin the path to remediation, not to become comfortable or complacent with the known risk. The Risk Acceptance process requires that a plan be submitted that identifies what corrective action(s) will be taken, when those actions will be accomplished, and who is responsible for doing them. There is a maximum duration for a risk acceptance, at which point it will have to be renewed through the same process, or the risk is demonstrated to be remediated, or circumstances that created the risk have ended, or the acceptance has been renewed. After exceeding the period of risk acceptance, and failing remediation, or the end of the risk situation, Information Security may take steps to minimize the risk, either by adding compensating security controls, or removing the risk (i.e., shutting down a risky application or server).

When vulnerability is discovered in a third party product or service, a risk assessment is performed to assist the business in determining an appropriate course of action. Where vulnerabilities can be exploited, the business may elect to postpone implementation of the vulnerable system or proceed with implementation in acceptance of the residual risk. In both cases, vendors or service providers are informed of the vulnerabilities and asked to remediate them. Also in both cases, the conditions are tracked to remediation by the company risk acceptance process.

5.6.4 SECURITY AWARENESS & TRAINING

Security awareness and training is critical to preserving a secure Smart Grid environment. The company uses several methods used to promote awareness with a focus on role based audiences, diverse delivery mechanisms, and relevant messages. The Company Information Security Program makes training available to employees regarding acceptable use and other aspects of the security program. Specific regulations and laws which apply to certain segments of the business provide targeted security training in those focused areas.

Security awareness and training is offered to all employees through a variety of diverse communications mechanisms in topical areas such as social engineering, password handling, managing information in their work areas, locking and securing workstations, reporting possible security issues, and facility security and safety.

Physical and Cyber security personnel receive ongoing training to maintain and expand knowledge in their fields of expertise. Training consists of security certifications, specialized skill training, technical training on specific systems and platforms, and information security awareness.

As part of the continual improvement of the company's overall security posture, the Information Security department has established an Information Security Advocates (ISA) Program. This program helps to align business and security strategy goals by developing and maintaining a team of business focused personnel that help establish a foundation for key business drivers, processes, requirements and impacts while distributing responsibility for select information security tasks across business domains.

Candidates are leaders within groups at the manager level or below that have an interest and willingness to learn more about Information Security and how it impacts their core business area. Participants are given a two day training course followed by a company specific certification test. After passing the test, the ISA team meets periodically to share knowledge and experiences.

5.6.5 SECURITY STRATEGY AND ENTERPRISE RISK ARCHITECTURE

The company's Information Security Program includes the following architectural and strategic elements which will be applied to protecting the physical and cyber security needs of the Smart Grid.

- Adopt a Comprehensive View. System security design should look beyond traditional organizational boundaries, demarcation points (such as those between transmission and distribution systems) and areas of responsibility in order to work with interconnected systems and other authorized "users" to ensure security is maintained when information is exchanged between different systems or entities.
- Improve Interoperability. System components should be designed in such a way as to show how they maximize resilience, reusability and interoperability with

adjacent systems, allowing authorized interfaces to "plug and play" in trusted and predictable ways with centralized services.

- Manage Standards. Security solutions should be developed via consensus driven security standards and development methodologies, such as those described in the NIST interagency report in order to minimize the risk that proprietary technologies will be exploited by threats while improving cost effectiveness and reliability.
- Balance Redundancy. Systems should be designed in a cost effective way to minimize the chance of a single point of failure causing adverse impact to the overall system.

5.6.6 SECURITY REQUIREMENTS IN CONTRACTS

Key security requirements are embedded in contracts with vendors and service providers. The general contract areas, below, are augmented with specific requirements based on the specific product or service addressed by the agreement. The contract language requires verifiable accomplishment of security goals and adherence to security standards and best practices, and that verification may be performed by the company or a trusted third party. Contract language is intended to instill in third parties a necessary sense of urgency in protecting information assets and customer privacy. It describes third party obligations to protect information in alignment with industry accepted oversight and audit procedures. It further describes third party liability if they are the cause of a security breach.

The contracts have language regarding:

- Role Based Security Controls;
- Shared Application Architecture;
- Account Management;
- Application Interface Controls;
- Encryption;

- Password and Logon Standards;
- Data Security;
- Logging and Errors Details;
- Operational Support and Administration;
- Source Code Review;
- Vulnerabilities and Defects;
- Security Assessments and Testing;
- Right to Report.

5.6.7 SOLUTIONS DEVELOPMENT AND IMPLEMENTATION LIFECYCLE

The mission of Information Security Engineering is to provide Information Security guidance and consulting services to the Information Technology (IT) department and its clients during the preproduction phases of the system development lifecycle. This approach to information security during preproduction will assist in the "secure by design" approach SDG&E envisions for all Smart Grid technology deployments.

5.6.7.1 SECURITY ENGINEERING PROCESS TOOLS

The Information Security Engineering team uses several process tools in the course of an engagement. These tools are the Risk Triage Process, the Security Assessment Methodology, the Key Concerns for Information Security Document, the Information Security Requirements Document, the ITPL Documentation Required for Phase Review document, and the Security Evaluation Methodology.

5.6.7.2 IT SYSTEM LIFECYCLE SECURITY CHECKPOINTS

Information Security includes sign off checkpoints at the Requirements and Design phases, and "go/no go" authority at the Test phase of the IT System Lifecycle. Approvals are requested from Information Security by the project team, and establish assurance throughout the System Development Lifecycle (SDLC) that Information Security Requirements are met.

5.6.7.3 SECURITY ENGINEERING PRODUCTS

While supporting the IT System Lifecycle, various artifacts are produced to communicate the developing and measured security posture of the information asset being developed.

During Project Preparation phase, the project team identifies the types of information that an asset will handle; the information owner and custodians of that information; the sensitivity of the information, and the environments in which the information will be handled and accessed. Information Security uses this information in conjunction with interviews of the project team and the various stakeholders to develop a Preliminary Risk Assessment for the information asset. This risk assessment identifies generalized risks that the asset may pose to the enterprise and the information that the asset handles, and provides recommendations on the types of controls that should be employed in protecting the information.

At Requirements phase review, the Preliminary Risk Assessment is reviewed along with the Requirements documentation to verify that the recommended controls are required as part of the project. Direct feedback is provided to the project team in order to facilitate any necessary changes to the Requirements that support necessary Information Security controls.

At Design phase review, the Design document is examined to identify if the design appears to effectively implement the required controls, and to identify any risk conditions or deficient controls that may not have been previously apparent. Direct feedback is provided to the project team in order to facilitate any necessary changes to the Design that support necessary Information Security controls.

During Build phase, the assigned Security Engineer provides direct support for implementation of security controls by the project teams. In addition, the assigned Security Engineer performs some preliminary security testing on baseline configurations of products, usually before customization and integration happen. This provides a means of identifying vulnerabilities in software or integration products that the vendors will be expected to remediate before the asset enters production. The findings from the detailed technical testing at this stage include specific identification of vulnerable conditions or material defects that lead to security risks, and are usually identified by the Common Vulnerabilities and Exposures (CVE) references maintained by MITRE Corporation.

At Test phase, the asset is tested for compliance with technical and administrative security controls. The depth and detail of this testing varies according to assessed risks, with more detailed and comprehensive testing being afforded to those assets that are assessed with the highest risk levels. The result of the Test phase review of an asset is a Security Evaluation Report that describes its overall security posture and specific steps to remediate any vulnerability findings. Information assets must be determined to be compliant with Information Security Requirements before Information Security will grant approval for an asset to enter production through Change Management processes.

Upon successful completion of Test phase, Security Engineering transitions tracking of the asset to the Information Assurance team for follow on compliance work. The asset is tracked as a matter of course by Security Operations processes.

5.6.7.4 SECURITY ENGINEERING PRODUCTS FOR PARTNER PRODUCTS AND SERVICES

Increasingly, hardware and software solutions are outsourced to third parties that are not under the direct management of SDG&E. Often, this situation makes it impractical to apply the company lifecycle approach. To address potential differences, additional or alternative controls are leveraged. For example, external third parties may be evaluated as accomplishing company control objectives either using direct examination by company Information Security personnel or by an independent third party.

In both cases, the subject third party is measured for compliance with commonly used standards like International Organization for Standardization (ISO) 27001, ISO 27002, ISO 15408, or NIST SP 800-53. Additionally, a previously performed comprehensive Statement on Auditing Standards (SAS) 70 type II audit may be used to collect information about the security posture of a third party.

Contract terms and clauses in the Statement of Work or Master Services Agreement provide the mechanism for enforcement of the security-related requirements and the right to measure accomplishment of control objectives.

5.6.8 OPERATIONAL SECURITY

The goal of operational security is to ensure that information and information systems are continually monitored for threats attempting to access, damage or otherwise disrupt them, and for the vulnerabilities those threats are trying to exploit. The company's Information Security Program includes the following operational security elements.

- Event Collection and Logging. Information systems forward logs and events to centralized environments for the collection and analysis of events.
- Event Management. A 7x24 Security Operations Center monitors events and logging systems for suspicious events that are detected and initiates an incident response team, as necessary.
- Incident Response. If a security event occurs, an incident response may be initiated. Suspicious events that escalate into incidents are recognized quickly, and contained in order to minimize adverse impact to the system, so recovery of the system can begin. Incident responders are readied for such activities through

training, procedural development, testing and continuous improvement. Criminal incidents are reported through the internal Corporate Security department to appropriate law enforcement agencies.

- Vulnerability Management. Vulnerabilities are identified and evaluated before they can be exploited by a threat, and to ensure timely mitigation of those vulnerabilities.
- Penetration Testing. Testing is performed in an effort to discover and mitigate vulnerabilities. Internal and third parties are used to simulate "attacks" on the system from the perspective of an outside threat in order to find backdoors or other weaknesses that are not readily apparent in the system.

5.6.8.1 VULNERABILITY MANAGEMENT

The most common security exploitations leverage known vulnerabilities. Vulnerability Management minimizes risk associated with known vulnerabilities by seeking to discover and remove the number of vulnerabilities in the company's business operations and infrastructure. This approach will be applied to known vulnerabilities in Smart Grid technologies prior to deployment and monitored throughout their lifecycle.

The Vulnerability Management Program tracks reporting and remediation of known vulnerabilities across multiple information resources by monitoring vendors which provide and support enterprise information and controls systems, a number of public and limited distribution vulnerability reporting lists, and tracking and reporting vulnerabilities discovered during internal testing activities. The program ensures systems maintain current, supported patches and upgrade levels.

Functions of the Vulnerability Management program include:

- Penetration Testing: Evaluating the security of a computer system or network by simulating attacks from a malicious source.

- Application Scans: Attempts to identify vulnerabilities in the application and/or web layers.
- Validation Scans: Attempts to identify vulnerabilities in the host operating systems, like Windows, Linux, UNIX, etc.
- Reports: Request results from a monthly scheduled scan or one of the above service requests.

Vulnerability Management activities also uses the company risk acceptance process. Under some circumstances it is necessary to document the acceptance of business risk resulting from a gap between the applicable security requirement(s) and the implemented security features and controls.

5.6.8.2 INCIDENT RESPONSE & RECOVERY

While the goal of the company's Information Security Program is to proactively avoid incidents which threaten to compromise company data, systems or related assets using proactive means, it also governs SDG&E's response to incidents. A disorganized reaction to an Information Security incident can be as damaging to the company as the incident itself. Therefore, it is important to follow a well defined process in response, with clear coordination responsibilities. The following describes the Incident Response and Recovery process followed in the event of an Information Security incident which puts company assets at risk.

5.6.8.3 COMPUTER INCIDENT RESPONSE TEAM (CIRT)

The Computer Incident Response Team (CIRT) team is responsible for detecting, responding to, and assisting in the recovery from computer security incidents that impair the company's ability to:

- Generate, transmit or distribute energy;
- Conduct normal business operations;
- Operate in a secure computing environment;

- Threaten the privacy of customers.

5.6.8.4 INCIDENT RESPONSE PROCESS

The Incident Response process is initiated when the Security Operations Center (SOC), a 7x24 team dedicated to monitoring enterprise security, detects or receives a report of a security event. The team collects and evaluates the information in order to assess whether the event is an incident. If the event is an incident, the CIRT team, with appropriate predefined members based on the nature of the incident, is activated.

The CIRT Team manages the incident response, recovery and post incident notification and reporting by:

- Performing a triage to determine the best course of action, gathering information on how to resolve the incident, how to contain the effects, and consult with the appropriate corporate management representative before actions are taken;
- Taking actions to halt and contain immediate damage due to an incident;
- Remediating the affected systems to "fix" the damage caused by an incident;
- Observing the assets behavior in order to gain information as to the nature of the incident, and potentially identify a larger issue;
- Determining whether or not the formal Forensics Process needs to be initiated, given the information about the incident available. If the Forensics Process is initiated, the results are reported back to the CIRT;
- Performing or requesting a Root Cause Analysis (RCA) to determine the basic reason for the incident, and suggest a course of action to prevent the incident from re occurring;
- Determining the final actions and activities needed to return the company system and network to a "known secure state," and to prevent the incident from re occurring; which may involve policy alteration, security training, component

upgrades, patch application, or other remediation actions. Specifically, the Risk Management process may (and likely will) be called from these final actions;

- Collecting, documenting and protecting all event and situation data in the Security Event repository;
- Reporting to appropriate parties about the Incident.

5.6.8.5 INCIDENT RECOVERY PROCESS

If there has been a service impact, the CIRT Team Lead activates and coordinates with the Service Restoration Team (SRT) to respond to the outage by restoring service, while addressing the potential need for Forensics data maintenance, and Root Cause Analysis to be performed after the incident.

5.6.8.6 NOTIFICATION AND REPORTING

Depending on the system or Information involved in an incident, as well as regulatory requirements, different internal and external organizations will need to be informed regarding the incident. These organizations potentially include, but are not limited to, FERC, NERC, the Commission, ES-ISAC, the DHS, the FBI, other law enforcement agencies, and impacted customers.

5.7 SDG&E'S PHYSICAL SECURITY PROGRAM

Utilities have long recognized physical security threats as significant. As SDG&E moves more assets of increasing value further out into the field, including information assets, existing physical security threats will be exacerbated and new ones introduced. Having physical access to an information asset increases the likelihood the asset can be exploited. The company's Physical Security Program recognizes that as more information assets move out of well-protected data centers and into the field, more robust and faster responding physical security controls must also be applied.

5.7.1 INVESTIGATIONS

Physical security investigative capabilities extend over a service territory covering much of Southern California and part of Mexico in order to support Smart Grid physical security.

5.7.2 SITE SECURITY REVIEWS AND VULNERABILITY ASSESSMENTS

Critical sites must be reviewed by corporate security representatives that have been trained in assessing physical security of facilities and properties for threats and vulnerabilities. Discovered vulnerabilities are prioritized and communicated to risk owners to make decisions about how to avoid, mitigate, transfer or accept these risks. Appropriate mitigations must be applied to reduce the risk to safety, as well as asset loss or damage.

5.7.3 PHYSICAL SECURITY MANAGEMENT

Physical security services must be effectively managed and expanded to incorporate Smart Grid infrastructure considerations. Such management services include:

- Guard Services – including management of employee or contractor guard forces;
- Technical Security Services – including facility clearing, and counter surveillance measures; Video surveillance includes local and remote monitoring of activity at gates and other strategic locations. Live monitoring at guard stations and recorded video for incident investigation.
- Alarm Monitoring and Response

5.7.4 SECURITY COMPLIANCE

As with cyber security, facilities that support Smart Grid infrastructure and activities must comply with all legal, regulatory and company driven standards and policies. Compliance must be easily verified and reportable.

Physical security capabilities for mission critical facilities are periodically reviewed by the DHS, NERC, and the Transportation Security Administration (TSA).

5.7.5 ACCESS ADMINISTRATION

Effective access administration includes facility access management capabilities, including the company's enterprise wide badge access system. Employees, vendors, contractors are required to have photo ID/access badge displayed while on site. Access is in accordance with all applicable law and regulation, including to FERC requirements.

5.7.6 SECURITY AWARENESS AND TRAINING

Employee and third party awareness and training of physical security threats and vulnerabilities are a core part of the security program and incorporate relevant sabotage awareness, threat detection and reporting mechanisms.

5.7.7 THREAT MONITORING, GLOBAL EVENT NOTIFICATION AND ALERTS

Threat information sharing must be integrated and flow easily not only between company physical and cyber security programs but also between these programs and relevant law enforcement and intelligence agencies.

5.8 SDG&E RESPONSES TO COMMISSION QUESTIONS REGARDING PRIVACY

This section contains SDG&E's responses to the questions posed to the California Investor Owned Utilities by the Commission in Ordering Paragraph 10 of D.10-06-047 concerning the security of customer information.

5.8.1 INFORMATION COLLECTED VIA SMART METERS, PURPOSES, MINIMIZATION

What types of information about customers are or will be collected via the smart meters, and what are the purposes of the information collection? Could the information collection be minimized without failing to meet the specified purposes?

SDG&E's smart meters are capable of storing many types of energy related data. However, smart meters do not store customer data other than energy measurement data. SDG&E's smart meters are programmed to store energy measurement data that is required for billing. Additionally, SDG&E's smart meters collect different energy measurement data depending on the electric rate or tariff associated with the customer's account. Generally, SDG&E's smart meters collect register reads and interval reads for electric meters and register reads for gas meters. In addition to the energy measurement data SDG&E also collects information related to 'events' from the meter, such as a tamper alarm, and other information that allows the company to validate the accuracy of the data collected and transmitted back to SDG&E. In order to be assured of accurate billing information and ascertain the status of tampering, outages and other events, the data collected is necessary and cannot be minimized.

Below is a listing of the information being collected by SDG&E's smart meters by customer class. As stated, SDG&E's smart meters are capable of being programmed to collect many types of information; examples of these additional capabilities are included in Appendix 5.10.2.

Basic Residential

1. Delivered Register Read
2. Received Register Read
3. Total Register – Delivered plus Received
4. Delivered hourly intervals
5. Event information such as tamper alarms or outage information

Basic Commercial

1. Delivered Register Read
2. Received Register Read
3. Net Register – Delivered minus Received
4. Delivered 15 minute intervals
5. Event information such as tamper alarms or outage information

Advanced Residential & Commercial (e.g. co generation, bi directional)

1. Delivered Register Read
2. Received Register Read
3. Net Register – Delivered minus Received
4. Delivered 15 minute intervals
5. Received 15 minute intervals
6. Event information such as tamper alarms or outage information

Notes:

1. Delivered means energy delivered from utility to the customer.
2. Received means energy delivered from customer to the utility (e.g., from a roof top solar installation).

5.8.2 EXPECTED DEVICES AND ASSOCIATED INFORMATION

Does SDG&E have or expect to have other types of devices, such as programmable communicating thermostats, which can collect information about customers? If so, what types of information are collected, and what are the purposes of the information collection? Could the information collection be minimized without interfering with the specified purposes?

SDG&E is piloting new technologies that enable devices inside the home, such as in home displays, programmable communicating thermostats and other "smart" communicating devices, to be commissioned to the customer's smart meter (collectively, Home Area Network or HAN devices). These devices will present information, such as consumption or price, and will be capable of receiving signals controlling end use devices based on established preferences set by SDG&E customers.

Information collected by these HAN devices is manufacturer and device dependent. SDG&E's smart meters are equipped with ZigBee transceivers and the ZigBee Smart Energy Profile (SEP). The ZigBee SEP protocol provides for customer acknowledgements, such as acknowledging that a message was received, or a choice to opt out from a demand response event. Devices that use profiles other than ZigBee SEP may collect device state information, such as the current thermostat set point, mode (cooling or heating) and/or current temperature sensed by the thermostat. Certain end use metering devices may collect interval consumption data of the end use appliance. Other, more capable devices, may record all information input by the user similar to the capabilities of a personal computer (e.g., tablet computers used as in home displays or ZigBee USB dongles that would use a customer's computer as the user interface for their HAN).

Minimizing information collection must be balanced with the information needed for a meaningful customer experience and realization of customer, utility and societal benefits. HAN devices exchange information with customers and the utility to enable valued added services. Features that make devices desirable to customers may not be the same features that make them desirable for utilities. For example, utilities generally strive for operational, energy efficiency, demand response, and societal benefits. However, customers desire technologies that provide lower cost and greater choice, convenience, control, and comfort, as well as other tangible and intangible benefits. Customer requirements for information exchange may differ from that of utilities. Utilities may minimize device information collection to achieve utility operational and demand response benefits. However, minimizing data collection may result in lower adoption rates because some customers value greater amounts and frequency of information and customization of the experience. SDG&E intends for devices and systems to collect only the minimal information necessary to perform their functions and provide customers with features and options that provide value.

5.8.3 EXPECTED INFORMATION FROM SMART METERS AND HAN GATEWAY

What types of information, if any, does SDG&E plan to collect from the smart meter and Home Area Network gateway?

Details regarding smart meter data collection and capabilities are discussed in the response to question a, above. Regarding the Home Area Network gateway, this type of device serves as a communications conduit for securely commissioning various in home devices to the smart meter (such as a programmable communicating thermostat or an in home display). The data collected includes Media Access Control (MAC) identification numbers, device type, serial number, and other similar data. The gateway maybe a conduit for data collected at the device level.

5.8.4 FREQUENCY OF INFORMATION COLLECTION FROM SMART METERS

How frequently will SDG&E take readings from the smart meter? Is this frequency subject to change? Will customers control this frequency?

As stated above, smart meters collect hourly or 15 minute interval data depending on the type of customer and the tariff associated with the customer account. In general and under normal circumstances, this data is transmitted to the utility twice each day. Energy usage intervals recorded at the meter can be changed, as can the frequency with which SDG&E collects this data from its Smart Meter system. The effective frequency of utility meter reads is based on the relevant tariffed rate being billed, information to be presented to customers, and system performance characteristics. SDG&E does not envision opening these systems' operational characteristics to customer control.

5.8.5 INFORMATION USAGE / PURPOSES

For each type of information identified above, for what purposes will the information be used? The purposes must be articulated with specificity, e.g., "targeted marketing" instead of "promoting energy efficiency."

As stated above, the information collected from SDG&E's smart meters and HAN system are used for billing and consumption information presentation purposes and to allow end use devices to be commissioned to a particular customer's meter. Additionally, this information will be used to effectively manage the HAN system, allow verification of energy and capacity savings (demand response measurement and evaluation), possibly provide additional functionality to customers as the market continues its growth and more functionality is enabled by the Smart Grid, and possibly make customers aware of energy services they may find of value subject to affiliate compliance restrictions.

5.8.6 INFORMATION RETENTION PERIODS / PURPOSE OF RETENTION

For each type of information collected, for how long will the information be retained, and what is the purpose of the retention? Could the retention period be shortened without failing to meet the specified purpose?

Regarding data collected by home or premise area network devices, SDG&E is in the early stages of piloting systems to ascertain customer acceptance and satisfaction with these systems as well as to evaluate system, technology and device performance. Retention policies for the information associated with these systems have not been formally established, however SDG&E intends to retain this information for only as long as is necessary to meet these evaluation purposes. As these devices and systems become more widely deployed, data retention will also depend on the requirements associated with the verification of energy and capacity savings (demand response measurement and evaluation) and other demand response or price signal event acknowledgement purposes.

Regarding the data collected from SDG&E's smart meters, retention is driven by factors such as Electric Rule 18 (that states, in part, that if either a residential or nonresidential customer is found to have been overcharged due to billing error, the calculation of the amount of the overcharge for refund to the customer is for up to a period of three years), credit, meter revenue protection, load research, rate design, and system planning requirements. For credit purposes, the retention requirement for data is seven years which is tied to credit reporting requirements. This period of retention is also required by law if a customer disputes an item on their credit report, and thus, such retention is necessary. For meter revenue protection, legal requirements for reports and investigations are for a minimum of seven years plus the current year. However, for unauthorized use (which includes, but is not limited to, meter tampering, unauthorized connection or reconnection, theft or fraud) there is no limitation regarding the rebilling period and ideally, enough past information would be available to re bill for the entire period of the unauthorized use, which would benefit all other customers (these provisions are also found in Electric Rule 18).

In addition to the above requirements for customer / account specific meter data, there are also requirements to keep meter data for longer periods, however for these purposes the data does not necessarily need to be tied to a particular customer, but rather to general categories of customers (i.e.: residential / small commercial / large commercial or inland/desert/mountain/coastal climate zone or other customer groupings). These requirements are tied to such things as rate design and system planning. Additionally, load impact analysis associated with demand response or energy efficiency programs are required over periods extending up to 10 years as are price elasticity studies that require a substantial amount of pre and post rate treatment usage information (up to 10 years). This data is retained up to 15 years.

SDG&E's records retention policies evolve over time and with the deployment of the Smart Meter system, these policies are being reviewed in detail to determine necessary changes. The above noted requirements will be the drivers in determining updated retention requirements for the types of data discussed.

5.8.7 DATA SHARING AND ASSOCIATED ISSUES

(1) With whom does SDG&E share customer information and energy data currently?

SDG&E currently provides customers with access to their usage data via various online applications and is planning to provide additional channels in the future.

For large commercial and industrial (C&I) customers who currently have interval data meters with telecommunication (generally 200 kW or greater), usage data at the 15 minute interval is provided on line via the kWickView application. The C&I customer accesses the kWickView application through SDG&Es website at www.sdge.com. The kWickView application has been available online to large C&I customers since 2001. In addition to energy usage data (kWh), kWickView provides customer specific monthly demand (kW) for the billing month.

Residential customer access to SDG&E smart meter hourly consumption data is available via Google's PowerMeter gadget. SDG&E customers who choose to access their consumption data via Google's PowerMeter must register with SDG&E as a My Account customer and must provide explicit consent[35] for the transfer of their interval usage data to Google during the Google PowerMeter enrollment process.

SDG&E shares customer information and energy data with various third parties with whom it contracts for such purposes as on-line energy data presentment, credit checks, collection agencies, administration of demand response and energy efficiency programs, facilitation of meter installations, SDG&E brochure or other mailings, e-mail contacts concerning their gas or electric service, to facilitate on-line payment of bills, and administration of low income programs (such as California Alternate Rates for Energy or CARE) among other reasons. In cases when SDG&E does share customer data with a third party, contractual terms and conditions are included to protect such data and, if necessary, hold the third parties accountable if such data is not handled properly.

(2) With whom does SDG&E reasonably foresee sharing data in the future?

SDG&E plans to continue to offer a variety of on-line energy management tools to customers in the future so that customers can track their usage, identify the estimated bill-to-date, bill forecast data, projected month-end tiered rate, a rate calculator, and notifications to customers as they cross rate tiers.

SDG&E's future plans include mobile applications for customers and new experimental pilots on home energy management technologies that will likely involve third parties.

[35] The customer's consent may be made either by a manual signature or by electronic means; as set forth in SDG&E Advice Letter 2100-E, dated July 31, 2009.

SDG&E also envisions sharing certain kinds of data with third parties, such as aggregators, in accordance with its privacy policies and regulatory requirements in order to facilitate customer participation in such things as ancillary services market (leveraging their PEV or roof top solar systems, for example) and perhaps other parties that the customer may designate (i.e., service providers).

In cases where data sharing is associated with secondary purposes (as defined in the CPUC proposed decision mailed May 6, 2011 adopting privacy rules), prior customer authorization will be obtained prior to gathering or sharing such data.

(3) What does SDG&E anticipate is or will be the purpose for which the third party will use the data?

Third parties such as aggregators may facilitate customer participation in such things as ancillary services markets (leveraging their PEV or roof top solar systems, for example) and perhaps customers may designate release of data to other parties that will provide various energy management services, including rate analysis or appliance maintenance.

(4) What measures are or will be employed by SDG&E to protect the security and privacy of information shared with other entities?

SDG&E's internal policies regarding privacy protections and data exchange rules are based in part on the Commission's direction, federal and state statutes and Commission orders applicable to Commission regulated companies. Numerous Commission decisions make clear that the California regulated utilities must keep sensitive customer information confidential (e.g., D. 01 07 032). Additionally, SDG&E places significant importance on protecting its customers' privacy as part a measure of good business practices for companies entrusted with such sensitive and confidential customer information.

Customer specific usage data as well as customer personally identifiable information (PII) are considered and treated by SDG&E as sensitive and confidential information.

PII includes any personal identification such as name, service/billing address, phone number, email address, and social security number. It also includes consumption information such as usage amounts and patterns and credit history such as records of customers' payment histories.

As the general rule, SDG&E does not release PII to a third party (e.g. data presentment or energy service providers) without obtaining the customer's prior explicit consent and authorization. There are, however, certain limited exceptions to the general rule. On limited occasion, SDG&E may be compelled or required by law to provide PII to law enforcement agencies upon receipt of a subpoena or other legally enforceable document demanding the information (e.g. a court order). SDG&E's policies pertaining to legal requests or demands for disclosures of PII data made pursuant to a subpoena or court order are discussed in more detail below. Depending upon the specific customer request received by SDG&E to release PII to a third party, SDG&E evaluates the specific type of customer usage data and intended purpose under the following general guidelines.

All requirements for data transfer, (e.g. Google's PowerMeter) is assessed against SDG&E's Information Security Requirements. Security requirements comport with efforts to adhere to a law, regulation, SDG&E security policy or best practice. Regulations and laws that apply to customer usage data transfer include:

- Sarbanes Oxley
- California Privacy Breach Notification Act
- HIPAA
- California Information Protection Laws
- Best practices which drive SDG&E requirements include:
- NIST 800/53 (Currently Rev 2; Rev 3 in development)
- NIST Interagency Report (IR) 7628
- BS 17799 (ISO 27002)

- Control Objectives for Information and Related Technology (COBIT)

SDG&E has several specific policies that govern proper access to customer energy usage data, such as:

- Password Policies
- Acceptable Use Policies
- Service Account Policies

Each of SDG&E security requirements are the result of and can be traced to a policy, law, regulation and/or best practices. Because of changes to regulations and laws over time, SDG&E reviews policies governing data security and privacy protection, at a minimum, on an annual basis.

Although the Smart Grid decision does not explicitly request that utilities address consumer protection issues that may arise as a result of third party energy management and information service providers, SDG&E believes statewide certification of third parties may be prudent to provide minimum protection and oversight of third parties. The Commission currently certifies energy service providers (ESPs) that provide Direct Access services to customers. A similar process could potentially be used to certify third parties requesting access to customer data.

The proposed decision of the Commission mailed on May 6 regarding privacy rules indicates that the Commission may not implement such a certification process for third parties[36]. If this direction is adopted, SDG&E will continue to work with the Commission on a legally acceptable process (due process) to cease transfer of customer data to bad actors.

[36] Finding of Fact 58 of the PD states "Because of the privacy protections adopted in this decision, because a residential customer may withdraw access to his or her consumption data at any time, and because the Commission can find a third party ineligible to receive data either via tariff or by refusing to interconnect a device that automatically transfers usage data to the third party, it is not necessary to create a registration process to certify third parties as eligible to receive usage data."

Additionally, for SDG&E contracted third parties, the legally binding contractual terms and conditions will protect customer information. SDG&E's standard confidentiality language includes the following provisions designed to protect customers' information:

- SDG&E uses a broad definition of "Confidential Information" to protect a wide range of information related to customers;
- SDG&E limits vendors' use of such Confidential Information to be solely for purposes of performing services under its agreements (i.e., vendors cannot use Confidential Information for their own benefit or commercial purposes);
- SDG&E requires vendors to use reasonable security procedures and practices to protect the Confidential Information from unauthorized access, destruction, use, modification or disclosure;
- SDG&E requires vendors to deliver or destroy any Confidential Information upon request; and
- SDG&E now specifies that its confidentiality provisions related to customer Confidential Information remain in effect perpetually.

(5) What limitations and restrictions will SDG&E place on third party use and retention of data and on downstream sharing?

Non disclosure agreements (NDAs) are required for all consultants or contractors retained by SDG&E that are provided access to SDG&E customer data. The NDA provides contractual protection from unauthorized use or release of customer energy usage data or PII.

Each vendor is required to ensure each of its agents, representatives, subcontractors and suppliers become familiar with, and abide by, the customer confidentiality provisions in SDG&E's agreements as more fully described in the response to question 5.8.7 (4), above. Generally speaking, these customer confidentiality provisions prohibit the use or sharing of customers' confidential information for any purpose other than performing services for the utility under its agreements. Additionally, these provisions include requirements to protect customer information using reasonable security measures and allow SDG&E to seek the return or destruction of any confidential information.

(6) How will SDG&E enforce those limitations and restrictions?

SDG&E has several options to enforce the customer confidentiality provisions in its agreements. In the event of a breach or a threatened breach of the customer confidentiality provisions of an SDG&E contract with a third party with whom it has shared data, SDG&E can generally:

- Obtain injunctive relief preventing a breach of customers' confidential information;
- Request the return or destruction of all or any part of customers' confidential information; or
- Seek monetary damages and other legal and equitable remedies.

5.8.8 AUDIT AND SECURITY PRACTICES

What measures are or will be employed by SDG&E to protect the security of customer information?

SDG&E has designated a Chief Privacy Officer whose responsibility it is to ensure the privacy of customer information that is in the custody of the utility.

In addition, SDG&E employs a robust information security program that focuses on the three core competencies that operate together to protect the security of customer information: Governance, Engineering and Operations.

The Security Governance organization is tasked with company security policy and policy compliance, which includes the drafting and maintenance of policy artifacts, and assurance that the company is in compliance with all required legal and regulatory cyber security requirements; security awareness, which ensures every employee understands and executes their role in protecting company information; security strategy and architecture, which oversees the future direction of security controls across the company; and its security program office, which leads projects that implement new security controls. The Governance organization also maintains security contractual language that is used during negotiations with third parties to ensure that if the relationship calls for the sharing of company information, that the information is adequately protected.

The Security Engineering organization is responsible for developing and maintaining company security standards and requirements, and ensures that every new project adheres to such standards and requirements.

Finally, SDG&E's Security Operations organization is responsible for monitoring company networks and systems for potential cyber threats and vulnerabilities, ensuring that vulnerabilities are quickly remediated, and if threats materialize, they are contained quickly so the damage caused is minimized.

Has the utility audited or will it audit its security and privacy practices, both internally and by independent outside entities? If so, how often will there be audits? What are the audit results to date, if any?

As a supplement to system owner driven control processes, Sempra Energy's Audit Services department performs risk based audits based on an annual audit plan. Confidentiality of customer data and security practices are considered when developing annual audit plans. The frequency of internal audits of customer information and privacy controls are dependent on the outcome of the annual risk assessment process. On occasion, the company also engages independent outside entities to perform targeted assessments of SDG&E security practices and controls.

The company considers audit reports and the associated findings, if any, to be confidential. The company's security and privacy practices protect confidential information from public disclosure.

5.9 CONCLUSION

The Commission and the public are concerned about the potential physical and cyber security risks posed by Smart Grid. It is incumbent on all of Smart Grid participants, including utilities, regulators, service providers and consumers, to do their part to ensure that the system all participants rely on to deliver safe and reliable energy to our homes and businesses is resistant to threats and resilient to disaster.

SDG&E believes that if Smart Grid is implemented according to its security strategy, its advantages to customers and the communities it serves will far outweigh its potential risk.

5.10 APPENDIX

5.10.1 SAMPLE MATRIX OF UNIFIED SECURITY CONTROLS FRAMEWORK TO VARIOUS SECURITY GUIDELINES

The sample Common or "Unified" control framework below is provided for illustrative purposes only. It is not intended to show SDG&E's entire library of security controls and control activities, nor does it represent the complete list of standards and regulatory requirements SDG&E is obligated to comply with.

Table 5-2: Sample Matrix of Unified Security Controls Framework to Various Security Guidelines

Sample Common or "Unified" Control Activity	ISO 17799 (2000)	NERC CIP	CObIT	NIST 800-53	AMI Security Profile	DHS Catalog of Control Systems	DHS Procurement Language	"..."
Access to administration utilities shall be strictly controlled and maintained separately from application functions.	9.5.5.B			AC-3(1)	DHS-2.8.3.1	2.8.3.1		x
Access to administration utilities shall be limited to the minimum practical number of authorized users.	9.5.5.C							x
Activities performed using administration utilities shall be logged.	9.5.5.F				DHS-2.16.2.1	2.16.2.1	4.4	x
Persons and processes that have access to administration utilities shall be documented.	9.5.5.G				DHS-2.10.8.1	2.10.8.1		x
Unnecessary utilities and system software shall be removed from Sempra information assets.	9.5.5.H			CM-7(1)	DHS-2.15.7.3	2.14.3.2	2.1.3	x
Sensitive information shall not be transmitted to output devices (e.g. printers, web sites, unencrypted email) where they cannot be protected in accordance with their sensitivity.	9.6.1.D		DS13.4	PE-5				x
Information assets shall be monitored to detect deviation from access control policies.	9.7	CIP-007 R6, R6.1, R6.2	PO8.6, DS3.5, DS5.5, DS13.3	CA-7				x
Users and automated processes shall be identified by unique User IDs and authenticated by cryptographic mechanisms or passwords compliant with the Sempra Password Standard.	9.2.1.A		DS5.3	IA-1 IA-2(1) IA-5	DHS-2.15.16.3	2.15.5.2 2.15.16.2	4.3.3	x
"..."	x	x	x	x	x	x	x	x

5.10.2 LISTING OF POSSIBLE SMART METER DATA ELEMENTS

The following table, Table 5-3, lists the data elements available on smart meters.

Table 5-3: Smart Meter Data Elements

Examples of SDG&E Smart Meter Capabilities

Selected Categories / Elements that can be recorded (Commercial and/or Residential meters)

Measurements
Energy Reading
Forward Energy Kwh
Reverse Energy Kwh
Net Energy (Fwd + Rev)
Net Energy (Fwd - Rev)
Demand KW
Demand KVAR
Demand KVA
TOU Data
Critical Peak Period Data (TOU)
Date
Time
Meter Status & Errors
RAM bit error
Hard EEPROM error
Configuration error
Clock Error
Low battery
Load Profile Overflow
Meter Alarms and status
Service Condition Status
Power failure
Reverse power
Out of Socket alarm

Meter Info
voltage
max amps (class)
Hardware Version
Firmware Version
Comm Info
Firmware Version
AMI SN
Module Status & Erros
RAM ROM fail
History overflow
Remote Communications Inactive
Controls
Demand Threshold Alert
Set and update time
reset error codes
Reset momentary outage counts
Power Quality - Voltage Measurements
Max Voltage
Min Voltage
Current Voltage (Inst)
Power Quality - Current Measurements
Instantaneous RMS current A
Instantaneous RMS current B
Instanteneous RMS current C
Status / Alarms
Meter Tamper
Outages
Momentary date and time
Outage date & time
Restoral date & time
Security
Invalid Password
Radio Performance
Transmit Power

5.11 REFERENCE MATERIALS

- *NISTIR 7628: Guidelines for Smart Grid Cyber Security: Vol. 1, Smart Grid Cyber Security Strategy, Architecture, and High Level Requirements,* http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol1.pdf
- *NISTIR 7628: Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid,* http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol2.pdf
- *NISTIR 7628: Guidelines for Smart Grid Cyber Security: Vol. 3, Supportive Analysis and References,* http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol3.pdf
- *Security Profile for Advanced Metering Infrastructure, v 1.0, Advanced Security Acceleration Project – Smart Grid,* December 10, 2009
- *Catalog of Control Systems Security: Recommendations for Standards Developers,* U.S. DHS, National Cyber Security Division, September 2009
- *DHS Cyber Security Procurement Language for Control Systems*
- *SGIP Smart Grid Conceptual Model, Version 1,* April 2010
- *NIST High Impact, Low Frequency Event Risk to the North American Bulk Power System,* http://www.nerc.com/files/HILF.pdf
- *Privacy by Design: Achieving the Gold Standard in Data Protection for the Smart Grid*
- *Privacy by Design: Seven Foundational Principles,* http://www.ipc.on.ca/images/Resources/7foundationalprinciples.pdf
- *SmartPrivacy for the Smart Grid: Embedding Privacy into the Design of Electricity Conservation*

Section 6 – ROADMAP

6 ROADMAP

6.1 INTRODUCTION

In the Deployment Baseline section, SDG&E described historical and current Smart Grid technology deployments either completed or ongoing. These projects have laid the foundation for a larger, more comprehensive Smart Grid deployment to enhance customer value as well as meet state and federal energy policy goals as described in this document's Strategy section.

While the Roadmap section lays out SDG&E's Smart Grid projects on a forward looking 10 year timeline, energy industry changes cannot be expected to proceed on such a predictable path. Rather, SDG&E expects a combination of technology breakthroughs, policy changes, and unanticipated events to impact both the project list and the timeline. Even without significant external impacts; lessons learned, project delays, and Commission application approvals, modifications, and denials will result in changes to SDG&E's Smart Grid deployment roadmap.

Given these real world conditions, SDG&E will use this roadmap as a tool for adaptive management and leverage it to gain directional alignment with customers and other regional stakeholders; ensure a common understanding within SDG&E; create a dialogue with regulators and legislators; advance discussions with other utilities, vendors, and industry stakeholders; and establish a baseline to move forward with, track against and update as the utility implements solutions to enable its Smart Grid vision.

In this Roadmap section, SDG&E presents its plan to facilitate achievement of each of the following policies, specifically: the *Global Warming Solutions Act of 2006* (AB 32); *California Long Term Energy Efficiency Strategic Plan*; achievement of state mandated energy efficiency and demand response goals; achievement of the renewable portfolio standard program (RPS); and full solar photovoltaic deployment under the California

Solar Initiative. The SDG&E Smart Grid roadmap also includes infrastructure steps SDG&E must take to empower customers with access to energy consumption and pricing data.

SDG&E is committed to meeting California's policy goals for promoting increased levels of renewable energy resources and electric vehicle deployment to meet greenhouse gas GHG reduction targets. However, such advancements in environmentally friendly technologies like solar and wind generation, PEVs, and energy storage as well as the deployment of new customer empowering smart meter technology are placing significant new demands on the electric system. SDG&E recognizes the need to leverage advanced information and communication technologies to ensure the continued safety, reliability, security and efficiency of the electric grid as utilization of intermittent energy resources and demand for PEVs increases.

In addition, environmental policy and legislation encouraging customer empowerment over energy management and renewable integration are accelerating the need to create a smarter grid. The public policy objectives of California and the situation faced in San Diego create an urgent need to move forward with the implementation of such advanced technology.

To build the capabilities required to realize Smart Grid benefits for customers and to meet the state's ambitious energy policy goals, SDG&E's portfolio of Smart Grid projects is structured around nine specific program areas:

1. **Customer Empowerment** – SDG&E is investing to ensure customers have the knowledge and necessary information to make informed energy management decisions to maximize their energy value and to support their access to third party value added services and offerings while protecting their privacy.

2. **Renewable Growth** – SDG&E is making Smart Grid investments that will mitigate the impact of distributed and other intermittent energy sources by increasing measurement, control, and management capabilities.

3. **Electric Vehicle Growth** – SDG&E is deploying new Smart Grid technologies in conjunction with traditional infrastructure upgrades to ensure the safe, reliable, and efficient integration of PEVs.

4. **Reliability and Safety** – SDG&E is maintaining and/or improving reliability by mitigating the challenges that intermittent resources and electric vehicles present to an aging electric infrastructure through implementation of advanced sensors and associated systems, and other capabilities that will improve employee and public safety.

5. **Security** – SDG&E is investing to address the increased physical and cyber security risks and threats associated with Smart Grid system design, development, implementation, and operations.

6. **Operational Efficiency** – SDG&E is leveraging existing and developing new capabilities to improve the efficiency of planning processes and system operations through remote monitoring and real-time responsiveness enabled by the deployment of advanced sensors and management systems.

7. **Smart Grid Research, Development and Demonstration (RD&D)** – SDG&E is improving its capabilities by researching new technologies, integrating emerging technology solutions, testing for interoperability and providing proof-of-concept demonstrations.

8. **Integrated and Cross-cutting Systems** – SDG&E is deploying systems in areas such as application platform development, data management and analytics and communications that support Smart Grid functionalities across multiple business units.

9. **Workforce Development** – SDG&E is investing to develop its current workforce and to transition to a future workforce that will meet the unique requirements of Smart Grid through implementation of effective organizational change management and workforce planning.

6.2 STATUTORY AND POLICY ALIGNMENT[37]

The State of California has a significant number of energy policy goals as shown in Figure 6-1. A brief description of each policy goal is given below. SDG&E believes that Smart Grid is essential to meeting these goals at the least cost and with the greatest possible benefit to consumers. SDG&E's Smart Grid Deployment Plan will achieve regulatory and policy requirements, as shown in Figure 6-1, by accommodating increasing levels of renewable generation; improving customer education and outreach regarding usage, pricing and energy options; and leveraging new customer loads (i.e. PEVs and smart appliances).

[37] Portions of this section, including Figure 6-1, are adapted from the EPRI *Defining the Pathway to a Smart Grid in 2020* report. Public availability of the report is expected in the second half of 2011.

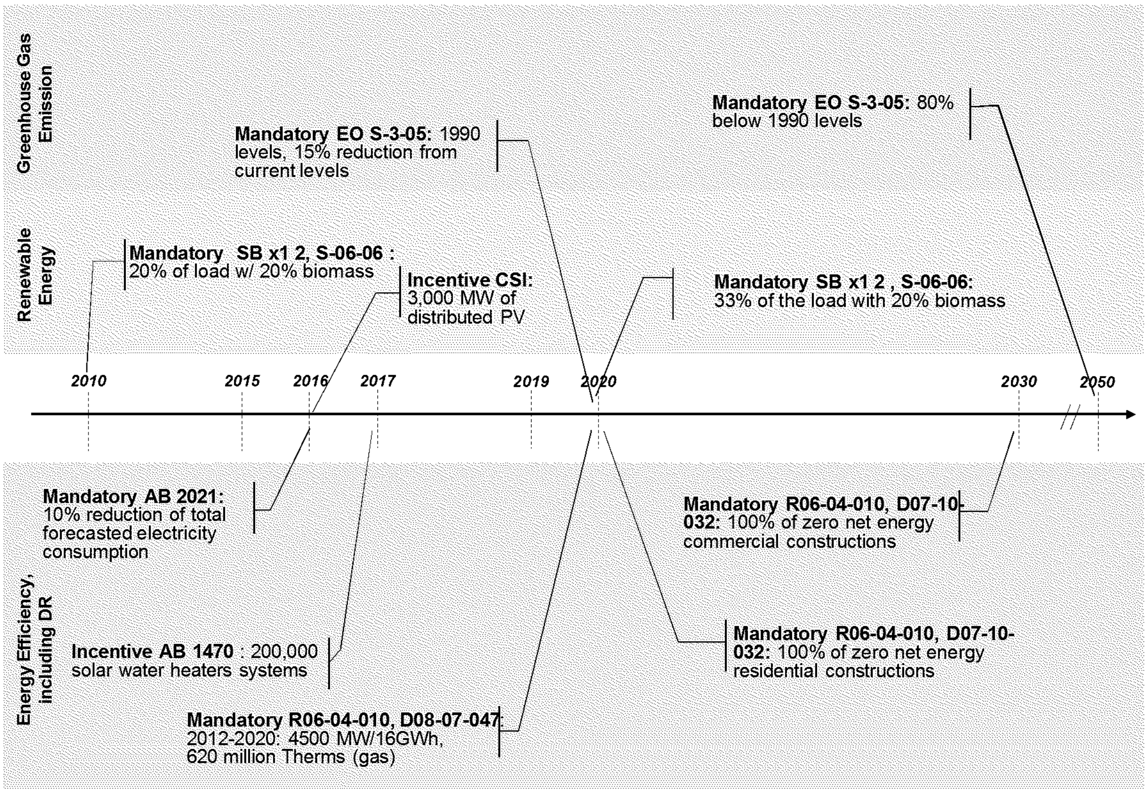


Figure 6-1: California Energy Policy Elements

6.2.1 GREENHOUSE GASES EMISSIONS REDUCTION

AB 32, the *California Global Warming Solutions Act, 2006* establishes a comprehensive program of regulatory and market mechanisms to achieve real, quantifiable, cost-effective reductions of greenhouse gases (GHG). AB 32 makes the Air Resources Board (ARB) responsible for monitoring and reducing GHG emissions.

Executive Order S-3-05 (2005) calls for a greenhouse gas reduction goal of 1990 levels by 2020 (30 percent reduction from projected levels by 2020, 15 percent reduction from current levels), with a target of 80 percent below 1990 emissions levels by 2050.

6.2.2 RENEWABLE PORTFOLIO STANDARD (RPS)

SB x1 2 requires California's retail sellers of electricity to serve 20 percent of their load with renewable energy by 2013, 25 percent by 2016 and 33 percent by 2020.

SB x1 2 also sets rules for the use of Renewable Energy Credits (RECs) by establishing a cap of no more than 25 percent unbundled RECs going towards the RPS between 2011 and 2013, 15 percent from 2014 to 2016, and 10 percent thereafter.

Executive Order S 06 06 (2006) promotes the use of bioenergy, and calls for the state to meet a 20 percent target for the use of biomass for electricity generation within the established state goals for renewable generation for 2010 and 2020.

6.2.3 DISTRIBUTED ENERGY RESOURCES

California Solar Initiative SB 1 (2006) aka Million Solar Roofs Program: the goal of this program is to install 3,000 MW of distributed solar PV electricity generation in California by the end of 2016. SDG&E's portion of this program is 180.3 MW.

Renewable Auction Mechanism (RAM): The Commission enacted RAM FIT (Renewable Auction Feed in Tariff Mechanism) which will require SDG&E to acquire 81 MW of additional distributed renewable generation resources.

SDG&E Solar Energy Project (SEP): approved by the Commission in September 2009, will add an additional 100 MWs of PV to SDG&E's renewable generation resources. The SEP will consist of 26 MWs of SDG&E owned PV and as an additional 74 MWs of Power Purchase Agreements.

Feed in Tariffs (FiTs): AB 1969 (2006) and SB 380 (2008) provide a standard contract and tariff price for renewable generators up to 1.5 MW at a set price. SDG&E's combined allocation under these programs is 41.1 MW. SB 32 (2009) expands the existing FiTs to eligible renewable facilities up to 3 MW. Implementation of SB 32 is still underway at the Commission.

Combined heat and power (CHP): the California Air Resource Board in its Scoping Plan[38] set a target of an additional 4,000 MW of installed CHP capacity by 2020, enough to displace approximately 30,000 gigawatt hours (GWh) of demand from other power generation sources.

AB 2514 Skinner would require the Commission, by March 1, 2012, to open a proceeding to establish procurement targets for each electrical corporation for viable and cost effective energy storage systems and, by October 1, 2013, to adopt an appropriate energy storage system procurement target, if any, to be achieved by each electrical corporation by December 31, 2016, and a second target to be achieved by December 31, 2021.

6.2.4 ENERGY EFFICIENCY

AB 1470 – Solar Water Heating and Efficiency Act: Authorized a 10 year, $250 million incentive program for solar water heaters with a goal of promoting the installation of 200,000 systems in California by 2017.

AB 2021 – Public utilities: energy efficiency: Sets a state wide goal of reducing total forecasted electricity consumption by 10 percent over the next 10 years (starting 2006).

Rulemaking 06 04 010 Decision 08 07 047: First, this decision sets interim energy efficiency savings goals for 2012 through 2020 for electricity and natural gas on a total gross market basis. For 2012 through 2020, total energy savings are expected to reach over 4,500 MW, the equivalent of nine major power plants. Further, the decision

[38] The California Air Resource Board was mandated to develop a Scoping Plan outlining the State's strategy to achieve the 2020 greenhouse gas emissions limit. The Scoping Plan, developed by CARB in coordination with the Climate Action Team (CAT), proposes a comprehensive set of actions designed to reduce overall greenhouse gas emissions in California, improve the environment, reduce dependence on oil, diversify energy sources, save energy, create new jobs, and enhance public health. The "Approved Scoping Plan" was adopted by the Board at its December 11, 2008 meeting. The measures in the Scoping Plan will be developed over the next two years and be in place by 2012.

expects savings of over 16,000 GWh of electricity and 620 million therms over that period. The decision also confirms existing energy savings goals for 2009 through 2011 that shall be gross goals, not net of free riders (D.04-09-060 goals over the 2009-2011 period: 7,516 GWh, 1,584 MW and 162 million therms).

Rulemaking 06-04-010 Decision 07-10-032: All new residential construction in California will be zero net energy by 2020. All new commercial construction in California will be zero net energy by 2030.

CARB Scoping Plan: The plan would set new targets for state wide annual energy demand reductions of 32,000 GWh and 800 million therms from business as usual – enough to power more than 5 million homes, or replace the need to build about 10 new large power plants (500 MWs each). These targets represent a higher goal than existing efficiency targets established by the Commission for the investor-owned utilities due to the inclusion of innovative strategies above traditional utility programs.

6.2.5 RELIABILITY

Annual Reliability Reports (D.96-09-045): The major California electric utilities must comply with a number of reliability guidelines for the duration and frequency of sustained and momentary outages using SAIDI, SAIFI, and MAIFI, with and without excludable major events for the past 10 years; the top 10 power outage events based on customer-minutes, excluding events such as weather, declared emergencies, or disasters affecting over 10 percent of the utility's customers; and the number of circuits in which customers have experienced greater than 12 sustained outages in a reporting year.

Emergency Standards: In 1998, the Commission signed D.98-07-097, adopting General Order 166, which comprises standards for operation, reliability, and safety during emergencies and disasters. Subsequently, in the year 2000, the Commission adopted D.00-05-022 adding Standards 12 and 13 to GO 166, pertaining to the Restoration

Performance Benchmark for
a Measured Event.

Electric Emergency Action Plan: During the power crisis (2000-01) the Commission revisited programs of distribution utilities to preserve electric service to the greatest number of customers by opening Rulemaking R.00-10-002.

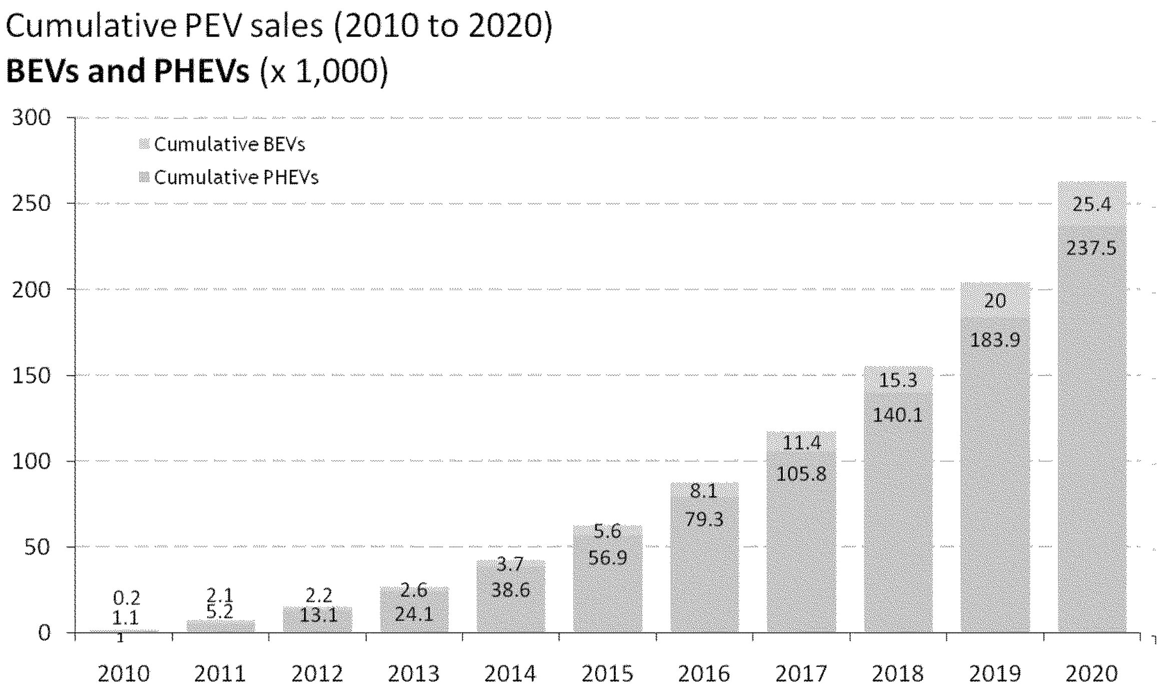
Inspection and Maintenance Standards: Decisions 96-11-021 and 97-03-070 establish inspection cycles and record-keeping requirements for utility distribution equipment, which are contained in General Order 165. Decision 97-01-044 of Investigation 94-06-012 establishes standards for trimming trees near power lines, issued as a revision to Rule 35 of General Order 95-A.

6.2.6 ELECTRIC TRANSPORTATION

AB 1007, Pavley Air Quality: alternative fuels: The bill requires the State Energy Resources Conservation and Development Commission, in partnership with the state board, and in consultation with specified state agencies, to develop and adopt a state plan to increase the use of alternative fuels to achieve a goal of 20 percent non-petroleum fuel use in the year 2020 and 30 percent in the year 2030. As required, the CEC released in December 2007 its State Alternative Fuel Plan, providing strategies, actions and recommendations to meet the state goals to reduce petroleum consumption in the transportation sector.

SDG&E adapted external forecasts of light duty electric transportation deployment and developed its forecast for the SDG&E service territory, shown in Figure 6-2.

Figure 6‑2: Assessment of SDG&E Electric Vehicle Market Population



6.2.7 WATER USE: ONCE‑THROUGH COOLING

The State Water Resources Board's *Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* calls for coastal power plants to phase out once‑through cooling systems. The policy aims to provide standards and consistency in implementing the Federal Clean Water Act, which requires the use of best technology available for protecting marine life. The power plants in SDG&E's service area would have until 2017 to phase out their once‑through cooling systems. Plants in the Los Angeles area would have until 2020 owing to the city's more complex power needs. The San Onofre and Diablo Canyon nuclear plants would have until 2022 and 2024, respectively.

SB_GT&S_0376115

6.3 POLICY ACHIEVEMENT

SDG&E's Smart Grid Deployment Plan will facilitate achievement of the state's energy policy goals and in particular each of the following policies:

- *Global Warming Solutions Act of 2006* (AB 32), which requires California to reduce its GHG emissions to 1990 levels by 2020;
- The *California Long Term Energy Efficiency Strategic Plan*;
- Achievement of the energy efficiency and demand response goals as required by Sections 454.5 and 454.55 of the *California Public Utilities Code*;
- Achievement of the RPS goal; and
- Full solar PV deployment under the California Solar Initiative.

In addition, the deployment plan will support essential infrastructure steps that must be taken to provide customers with access to consumption and pricing data pursuant to D.09-12-046.

6.3.1 GLOBAL WARMING SOLUTIONS ACT OF 2006 (AB 32)

The Global Warming Solutions Act of 2006 (AB 32) requires California to reduce its GHG emissions to 1990 levels by 2020.

SDG&E is reducing GHG by accommodating increased levels of renewable generation and installing energy storage to more efficiently use generating resources as well as other technology to promote energy efficiency.

Projects in SDG&E's Customer Empowerment, Renewable Growth and Electric Vehicle Growth program areas, in particular, will help the state meet this policy goal.

6.3.2 THE CALIFORNIA LONG TERM ENERGY EFFICIENCY STRATEGIC PLAN

The California Long Term Energy Efficiency Strategic Plan ("Strategic Plan") encourages programs that integrate the full range of demand side management (DSM) options to achieve "Big, Bold Energy Efficiency Strategies," which include:

1. All new residential construction in California will be zero net energy by 2020.
2. All new commercial construction in California will be zero net energy by 2030.
3. The Heating Ventilation and Air Conditioning (HVAC) industry and market will be transformed to ensure that its energy performance is optimal for California's climate.
4. All eligible low income customers will be given the opportunity to participate in low income energy efficiency programs by 2020.

The full range of DSM options includes energy efficiency (EE), low income EE (referred to as Energy Assistance Programs), demand response (DR), California Solar Initiative and distributed generation are fundamental to achieving California's strategic energy goals. The Strategic Plan provides for three levels of integration for DSM programs:

1) Comprehensive and Coordinated Marketing—This includes comprehensive customer outreach and education through which offerings from various DSM programs can be presented in a unified portfolio of services.

2) Program Delivery Coordination—This allows for various audits to be combined with a comprehensive set of DSM recommendations that customers can consider and implement.

3) Technology and Systems Integration—This includes equipment and information systems that allow customers to manage their energy usage (e.g., energy management systems, dimmable ballasts, etc.).

Projects in SDG&E's Customer Empowerment, Renewable Growth, Reliability and Safety, Operational Efficiency and Integrated and Cross cutting Systems program areas in particular will help the state meet this policy goal.

6.3.3 ACHIEVEMENT OF THE ENERGY EFFICIENCY AND DEMAND RESPONSE GOALS AS REQUIRED BY SECTIONS 454.5 AND 454.55 OF THE CALIFORNIA PUBLIC UTILITIES CODE

6.3.3.1 ENERGY EFFICIENCY

SDG&E promotes achievement of meeting energy efficiency goals through optimization of voltages and operation of the system to minimize losses and also by providing tools and communications that provide more information to the customer and options for operating their equipment more efficiently.

Projects in SDG&E's Customer Empowerment, Reliability and Safety, Operational Efficiency and Integrated and Cross cutting Systems program areas, in particular, will help the state meet this policy goal.

6.3.3.2 DEMAND RESPONSE

One of SDG&E's key goals is to enable demand response. SDG&E's technology investments will provide increasing options for customers to participate in managing their energy consumption during peak usage periods, in some cases electing to choose options that allow for automated device control which will support grid operations while maintaining customer convenience, or setting smart appliances and smart devices to react based on price and event signals. In all cases, choice remains with SDG&E customers.

Projects in SDG&E's Customer Empowerment and Integrated and Cross cutting Systems program areas in particular will help the state meet this policy goal.

6.3.3.3 ACHIEVEMENT OF THE RPS

SDG&E is working aggressively to meet California's RPS targets. SDG&E is utilizing a number of existing and developing programs to meet the state's mandated 33 percent RPS goal by 2020. These programs include the Renewable Auction Mechanism (RAM) program designed to facilitate renewable projects under 20 MW, annual RPS solicitations, and the Solar Energy Project, covering purchase agreements and utility owned generation.

Projects in the SDG&E program areas of Renewable Growth and Reliability and Safety in particular will help the state meet this policy goal.

6.3.3.4 FULL SOLAR PHOTOVOLTAIC DEPLOYMENT UNDER THE CALIFORNIA SOLAR INITIATIVE

SDG&E is committed to enabling distributed energy resources to connect to the grid and potentially participate in markets. SDG&E believes that coupling a number of key investments will address the intermittency issues resulting from photovoltaic penetration.

Projects in the SDG&E program areas of Customer Empowerment, Renewable Growth and Reliability and Safety in particular will help the state meet this policy goal.

6.3.4 ESSENTIAL INFRASTRUCTURE STEPS TO PROVIDE CUSTOMERS WITH ACCESS TO CONSUMPTION AND PRICING DATA PURSUANT TO D.09-12-046

SDG&E is committed to provide timely and actionable energy information to customers and is investing in data collection, management, and presentment capabilities. SDG&E is also working with utility and customer-authorized third parties to meet customers' needs that may provide customers with even greater value-added energy management services. SDG&E is developing capabilities that will provide customer energy usage data to customer-authorized third parties with standard industry data transfer interfaces.

These capabilities will provide customers more choice, convenience and control over their energy use.

On May 6, 2011 Commission President Michael Peevey issued a proposed decision (PD) adopting, among other requirements, rules regarding the electricity usage data of customers. This PD also includes a requirement to commence a pilot study within six months of the final adoption of the decision to "provide price information to customers in real time or near-real time."[39] Additionally, the PD requires that SDG&E "file a Tier 3 advice letter including tariff changes to make price, usage and cost information available to its customers online and updated at least on a daily basis..."[40] Additionally, the PD discusses what type of pricing information must be provided to customers[41] and clarifies access to usage data to be provided to third parties.[42]

In order to fulfill these requirements, SDG&E will have to deploy infrastructure such as HAN with messaging functionality to present the information to customers.

Under SDG&E's Customer Empowerment program area, a HAN infrastructure and lab, dynamic pricing project and the Customer Energy Network (CEN) are planned and will enable compliance with the PD (for more, see section 6.4.1 below).

Additionally, the Integrated and Cross-cutting Systems program area will also help SDG&E meet this policy goal.

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[39] See ordering paragraph 10 of the Proposed Decision of President Peevey, mailed 5/6/2011 titled "Decision Adopting Rules to Protect the Privacy and Security of the Electricity Usage Data of the Customers of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company, at page 138.
[40] See ordering paragraph 6 of the Proposed Decision of President Peevey, mailed 5/6/2011 titled "Decision Adopting Rules to Protect the Privacy and Security of the Electricity Usage Data of the Customers of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company, at page 137.
[41] See price discussion from p.88 to p.96 the Proposed Decision of President Peevey, mailed 5/6/2011 titled "Decision Adopting Rules to Protect the Privacy and Security of the Electricity Usage Data of the Customers of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company.
[42] See ordering paragraph 8 of the Proposed Decision of President Peevey, mailed 5/6/2011 titled "Decision Adopting Rules to Protect the Privacy and Security of the Electricity Usage Data of the Customers of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company at page 137.

6.4 FUNCTIONALITY AND TECHNOLOGY ROADMAP

The SDG&E Smart Grid Deployment Plan Roadmap is comprised of nine program areas which will deliver the capabilities required to meet the demands of customers and California's policy goals. The programs are designed to respond to policy and market drivers which are impacting SDG&E's grid and customers.

Figure 6 3: Alignment between SDG&E Programs and SB 17 Policy Goals

SDG&E SGDP Programs**: Customer Empowerment, Operational Efficiency, Reliability & Safety, Security, Renewable Growth, Electric Vehicle Growth, Integrated/Cross-cutting Systems, Workforce Development, Smart Grid RD&D

	SB 17 Policy Goals ***	SDG&E SGDP Programs**
1	Be self-healing and resilient;	f f f f f l f f l f fl l f f l
2	Empower consumers to actively participate in the operations of the grid;	ffl f f l f f l f f l f f l
3	Resist attack;	ffl f f l f f l f f l
4	Provide higher quality of power and avoid outages;	f f f f f l f f l f f l f f l f f f
5	Accommodate all generation and energy storage options;	ffl f f f l f l f f l f f f l f f
6	Enable electricity markets to flourish;	ffl f f l f f f l f l f f
7	Run the grid more efficiently;	f f f f l f f f l f f l f f l f f l f
8	Enable penetration of intermittent power generation sources;	ffl f f f l f l f f l f f f l f f
9	Create a platform for deployment of a wide range of energy technologies and management services;	f f f f f f l f f l f f l f f l f
10	Enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources; and	f f f f f f f l f f l f l
11	Significantly reduce the total environmental footprint of the current electric generation and delivery system in California.	ffl f f f l f l f f l f f f

The nine programs include a high degree of flexibility understanding that, while Smart Grid drivers will remain, the array of solutions will evolve as technology and market requirements mature. SDG&E incorporates a large number of pilots across these programs and dedicates an entire program to Smart Grid Research, Development and

Demonstration. SDG&E's technology focused projects incorporate milestones to monitor progress against benefit expectations. Collectively, these investments and this approach ensure that SDG&E is pursuing solutions that deliver the capabilities that its programs require.

Many investments that SDG&E is undertaking or plans to undertake to meet the broader needs of its business are related to the Smart Grid but not exclusively. However, these "enterprise project" investments complement the utility's ability to meet policy objectives, empower its customers, incorporate advancing technologies, and develop its workforce to meet the needs of SDG&E's Smart Grid capabilities and as such, they are important contributors to the portfolio of Smart Grid investments and are included in SDG&E's roadmap.

Note: "Enterprise" projects – those that meet the broader needs of SDG&E's business but that are also related to Smart Grid – are designated with an (E) after the project title in the below project listings.

6.4.1 CUSTOMER EMPOWERMENT

Empowered customers must have readily accessible and reliable information regarding their energy usage. In addition, customers must understand the basic units of energy measure and the energy consumed among their common uses. SDG&E has been empowering its customers with this information for many years, including recent emphasis during SDG&E's Smart Meter deployment where energy usage information, appliance energy requirements and energy efficiency measures, including peak period consumption, were provided. To further empower customers, price signals must flow to them in a timely and meaningful manner and be easily integrated into customer energy management and HAN systems all while respecting customers' privacy.

SDG&E is providing and continuing to develop information systems, communication infrastructure, and energy management services along with customer facing tools, services and significant outreach capabilities to raise customers' awareness of their energy usage, relevant market conditions, and to gather feedback. SDG&E will also endeavor to work through customer authorized third parties to disseminate important information and educate its customers, recognizing that often other sources of information are also needed to be most effective.

SDG&E recognizes that many of today's customers have an ever increasing number of communications and media capabilities from smart phones to tablets to whatever comes next. Through these tools, customers are 'plugged in' to social networks and engaged in peer communications at an unprecedented level. To ensure customers' new communications preferences and expectations are met, SDG&E will support various tools and provide relevant information to customers (including price signals) that will result in greater customer awareness of energy impacts, related behavioral changes in energy usage, and informed appliance and equipment choices leading to reductions in overall peak demand, total usage and associated emissions. SDG&E will ensure secure customer access to usage information via the Internet and access to near real time usage data via HAN connected devices. A critical component to empowering customers is deployment of tools and applications that present customer specific energy related data.

SDG&E's Customer Empowerment program area also delivers the information, services, and control sought by customers with projects providing enhanced demand response, dynamic pricing, distributed energy options and HAN capabilities. Key and substantive information, knowledge, and understanding will be provided by the results of several pilot projects including the microgrid and HAN pilots.

SDG&E customer related investments and projects are designed to provide customers with transparent and relevant price signals. These efforts enable utility and non utility service providers to offer competitive products and services that provide customers value.

Investments in key technologies are required to achieve these capabilities. For example, for security and privacy reasons, SDG&E will deploy a centralized Demand Response Control Application (DRCA) that will manage customer authorized HAN devices provisioned to a customer's smart meter.

Like many of the technologies across the SDG&E Smart Grid Deployment Plan, the exact timing and degree of technology maturity, as well as customer adoption of new service offerings is unknown. SDG&E believes that an SDG&E infrastructure roadmap to support customer empowerment must remain flexible and adaptable so that utility and third party energy management and information service providers can be incorporated. SDG&E has sequenced its investments to allow for flexibility while also preparing for capabilities that SDG&E believes are critical to achieving customer empowerment.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Customer Empowerment program includes the following:

Contact and Campaign Management (CCM) Enhancements (E) – This project will expand and enhance SDG&E's customer communications and notification system and allow customers to be notified by operations or other events, price thresholds or related items (i.e. bill triggers, moving into next pricing tier, rates / market signals and related). The communications and notifications will be based on each customer's preferred channel given a specific event or area of interest. CCM will save customers time and provide them with information for better energy use decisions.

Single View of the Customer (SVOC) (E) – This project expands tailored treatment options and provides automation for extracting and presenting customer specific data for customer web access and interactive voice recording (IVR) systems, therefore, resolving customer issues more effectively and efficiently.

Home Area Network (HAN) Infrastructure – This project will provide HAN device commissioning and decommissioning capabilities, manage and distribute firmware updates, demand response event signals, pricing signals and short messages to HAN devices. This project will implement the required hardware infrastructure to support the Demand Response Control Application (DRCA) deployment. Security review and penetration testing are also included to ensure that security threats are mitigated. Future implementations will support growth of the system, additional infrastructure required for a customer device management portal, and security testing of new HAN.

HAN Lab – The HAN laboratory supports the compatibility verification of HAN devices with SDG&E systems ensuring that the devices perform the functionality as designed and described by the device provider and interoperate with other HAN devices.

Digital Roadmap (E) – The Digital Roadmap provides for six initiatives that provide customers with greater accessibility to information and easier navigation for more effective communications and time savings in addressing customer energy-related information needs: (a) Re-architecting SDG&E.com website; (b) eServices; (c) digital research; (d) including social media into two-way communications; (e) digital advertising; and (f) mobile applications.

Demand Response Programs – Demand Response programs in this context refer to the Smart Grid related Demand Response Program costs/benefits filed March 2011 in SDG&E's 2012-2014 DR Application (A.11-03-002[43]) including peak time rebate (PTR), residential and non-residential new construction programs and the small customer technology deployment (SCTD) efforts.

Electric Clean Transportation (Customer Outreach) – Electric Clean Transportation (ECT) provides customer support outreach, education and information to SDG&E customers purchasing or considering purchasing a PEV and charging facilities (home, commercial and public). This effort is needed to support the rapid growth in the use of electricity as

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43 http://www.sdge.com/regulatory/A11-03-002.shtml

a transportation fuel in the San Diego region due to the influx of PEVs and charging facilities in the market.

Energy Innovation Center (EIC) (E) – The Energy Information Center (EIC) will be a 27,000 square foot facility where customers will receive demonstrations of various technologies, learn energy efficiency concepts, principles and equipment measures, alternative fuel transportation, clean generation and Smart Grid features. A portion of the facility will focus on Smart Grid technologies (i.e. home technologies, electric vehicles and renewable(s), etc.) and the facility is planned to function as a "smart building" with grid interoperability. The EIC will provide customers access to a demonstration facility to test energy utilization ideas.

Smart Meters – The SDG&E Smart Meter project was approved by the Commission in D.07-04-043 in April 2007 and has resulted in a project to install smart electric meters and gas modules for all SDG&E customers. As of May 2011, the deployment is more than 95 percent complete. Smart meters are digital devices that collect energy-use data and, unlike traditional meters, transmit and receive data. Electric energy use is recorded every hour for residential customers and every 15 minutes for commercial customers and natural gas information is read on a daily basis.

New Development Smart Community – This is a pilot project to test distributed energy resources—such as solar PV, fuel cells and energy storage—and demand-response-enabling technology in a new community. The pilot is directed at residential and a few small commercial customers. In addition, the community will provide employment opportunities to local residents. The community will be designed to be highly energy-efficient in both the residential and commercial sectors. The goal of the pilot project is to provide enough distributed energy resources to meet the critical energy needs of the community. The requirements for such a pilot are the ability to shed non-critical load through demand response programs and to utilize automatic switches that would reroute power from distributed energy resources to the community, allowing customers to ride through outages.

Dynamic Pricing Project (DPP) – DPP reflects dynamic pricing and time-of-use rates proposed in the 2010 Dynamic Pricing Application (A.10-07-009) filed on July 6, 2010, along with IT, billing system enhancements and customer outreach to assist customers in dynamic pricing participation and employees in supporting dynamic pricing/time-of-use rate business processes.

Customer Energy Network (CEN) phase 3 – The Customer Energy Network (CEN) will provide a standard interface (OpenADE/NAESB ESPI compliant) for authorized third parties to access customer energy usage data on a batch and real-time basis thereby allowing them to present usage information to customers via their own platform / application.

Emerging Technologies RD&D – Emerging Technologies Research, Development and Demonstration (ET RD&D) funds multiple pilots to evaluate promising customer premise technologies.

Customer & Other Stakeholder Engagement Campaign (E) – Provide campaign level coordination / overarching connections between the programmatic outreach and education efforts existing throughout other projects such as Dynamic Pricing Application and the outreach / education for Electric Clean Transportation (PEVs).

The timeline of SDG&E's Customer Empowerment program is shown in Figure 6-4 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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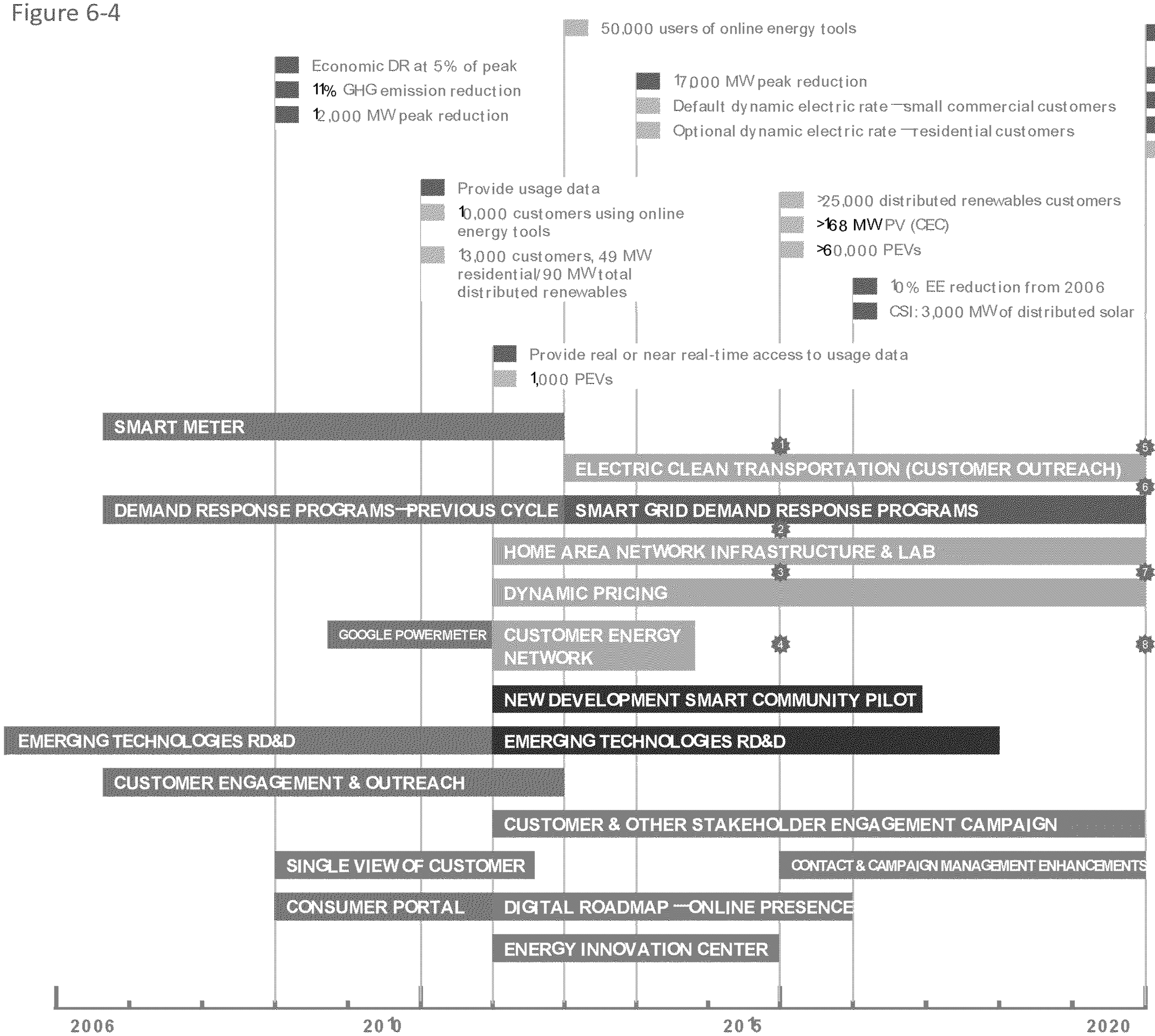
1 2 3 4 5 6 7 8 9 **2011 Smart Grid Roadmap**

CUSTOMER EMPOWERMENT

Key
- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-4



SDG&E Smart Grid Vision: by 2015

1. Customer education and outreach programs are proactively engaging customers through multiple channels
2. SDG&E and third parties are providing HANs and other customer premise network capabilities, providing customers real time feedback on power consumption and energy pricing
3. Standardized/reliable customer specific interval usage information and time differentiated price signals are available, enabling customers to make informed and cost-based energy use decisions
4. Customers can choose among multiple energy information services and providers

SDG&E Smart Grid Vision: by 2020

5. Customers are provided near-real time signals via price and event triggers enabling a balance of supply and demand
6. Widely adopted standards create a ubiquitous market of plug-and-play network devices in businesses and homes, including multi-unit dwellings
7. SDG&E is providing options and tariffs for customers to sell generation using distributed energy resources, electric vehicle to grid, or energy storage discharge
8. Microgrid and other technologies give customers more reliability options

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6.4.2 RENEWABLE GROWTH

SDG&E customers continue to install significant numbers and capacities of solar photovoltaic and other intermittent electric generation resources at residential and non-residential premises. To support distribution-level renewable resources, SDG&E plans investments that increase measurement, control, and management capabilities.

SDG&E is planning Renewable Growth investments to enable real-time, monitoring and situational awareness. These investments will help mitigate the intermittency issues associated with renewable generation by employing high-speed, time-synchronized measurement devices installed in substations and at key points on the distribution system. This data can equip system operators with better real-time information about actual operating margins so that they can better understand and manage the risk of operating closer to system limits.

For use in conjunction with improved monitoring capability, SDG&E is increasing control capabilities. When combined with the increased monitoring, these investments will assist in addressing intermittency issues created by the variable power output of renewable energy resources.

As an additional grid management mechanism, SDG&E is planning distributed energy storage systems on circuits with high penetration of customer PV systems. Additionally, energy storage systems will be strategically located in substations to mitigate the impact of multiple circuits with PV.

To further extend SDG&E grid control capabilities, SDG&E plans to implement SCADA control of all capacitors on SDG&E's distribution system. SCADA controlled capacitor banks will provide local and remote control, failure prediction and detection, reduced operating cost, and should enhance distribution system performance through improved voltage and reactive power control.

These investments in increased measurement, control, protections, management and optimization enabled by technology investments will accommodate the increased variability that will result from intermittent renewable resources as they help run the grid in the most efficient manner.

To inform the timing of these investments and identify further needs, SDG&E has or is closely conducting and/or monitoring a number of studies underway. A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Renewable Growth program includes the following:

Phasor Measurement Units – Installation of high speed time synchronized measurement devices in substations and on distribution lines. This information will be utilized to provide an indication of grid conditions that can drive mitigation measures.

Dynamic Line Ratings – Installation of sensors on distribution lines to monitor tension and temperature conditions in order to develop real time dynamic conductor ratings. With this technology as part of a portfolio of projects, increased amounts of renewable generation may be integrated into the grid.

Advanced Energy Storage – Investigation and deployment of various types of storage and other fast acting technologies to help improve the reliability of the distribution system.

SCADA Expansion – Installation of 1.5 SCADA switches at every distribution circuit (mid points and ties). With the completion of this project, automation of a significant portion of system restoration after a system fault can occur.

Capacitor SCADA – Installation of SCADA control on all existing distribution line capacitors. This will allow additional visibility into grid conditions, more optimal volt/VAr management and identification of capacitors with blown fuses that need to be replaced.

Community Solar – Community Solar Program is an in-basin community-scale solar project developed by SDG&E to provide all customers an opportunity to experience the benefits of solar. SDG&E will secure the solar energy system on behalf of customers and act as the program manager. Customers will voluntarily participate in the cost and benefits of the system – helping to build the community's power future.

The timeline of SDG&E's Renewable Growth program is shown in Figure 6-5 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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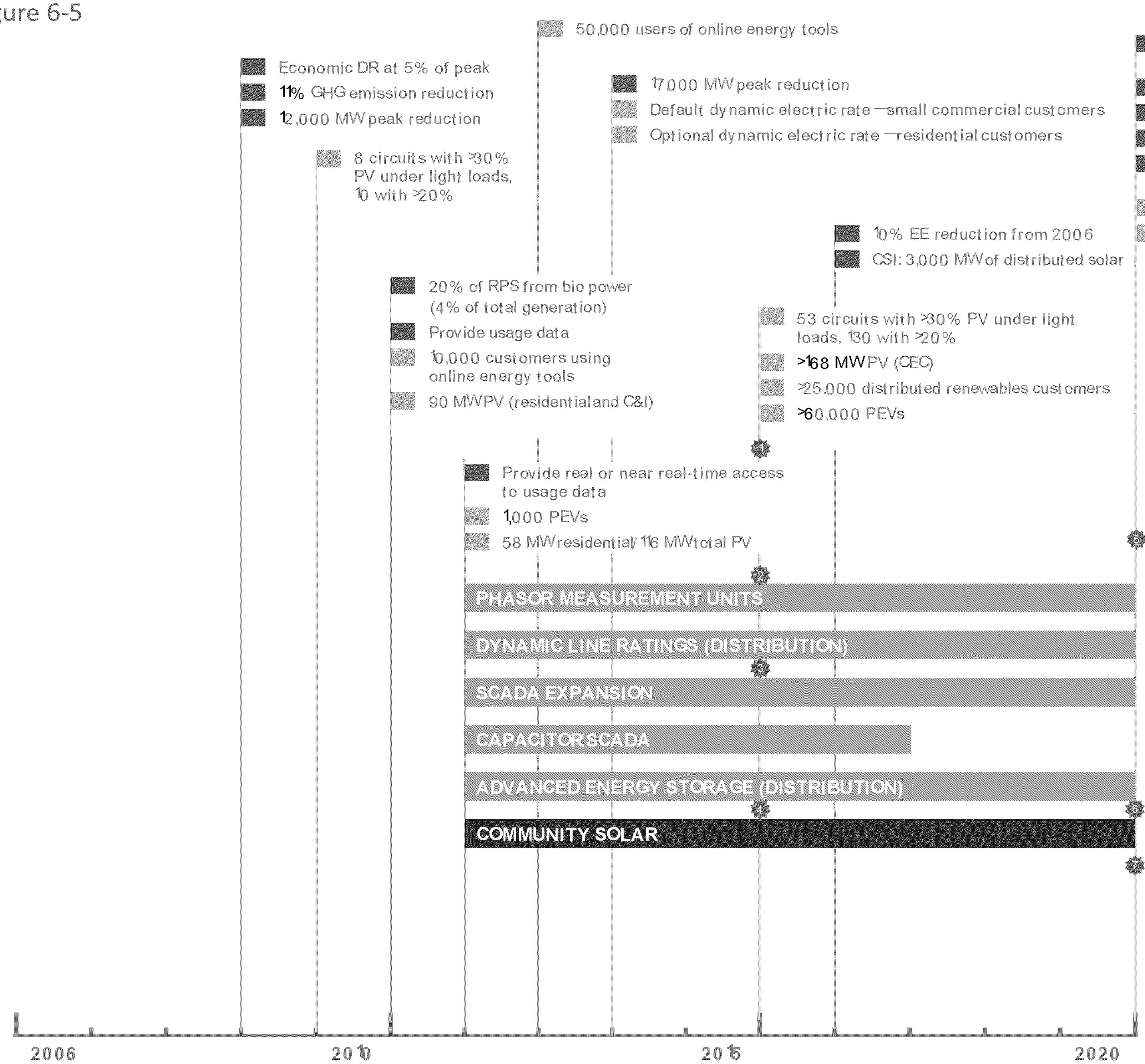
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

RENEWABLE GROWTH

Key

- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-5



SDG&E Smart Grid Vision: by 2015

1. SDG&E, customers and other third parties continue to install energy storage to enable more efficient use of renewable resources and to reduce overall base load generation requirements
2. SDG&E is relieving congestion by utilizing dynamic line ratings and synchrophasor data to operate the grid more efficiently
3. Cost-effective energy storage—either utility, customer, or third party owned—is helping to resolve voltage regulation, voltage flicker, and intermittency of renewable resources
4. Residential distributed generation output has metering and control options enabled by HANs

SDG&E Smart Grid Vision: by 2020

5. Synchrophasor data is being used to assess the condition of the grid and respond to changes before they become problems
6. Advanced inverter controls (for both distributed and central station renewables) are utilized for the smoothing of intermittency issues associated with solar photovoltaics and wind resources
7. SDG&E is providing options for customers to sell output from their electric vehicle, PV system or storage device to optimize overall system efficiency and costs

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6.4.3 ELECTRIC VEHICLE GROWTH

SDG&E is preparing for electric vehicle growth by addressing these critical areas:

Charging Technology & Infrastructure – Support widespread and convenient PEV charging opportunities including third party, customer and utility charging stations.

Rates/Pricing/Incentives – Develop and promote attractive cost based off peak charging rates that encourage PEV customers to charge vehicles during off peak hours, when there is sufficient system capacity.

Efficient Utility System Integration – Expand utility charging infrastructure in a manner that enables the safe, reliable and efficient integration of PEV charging loads with the utility grid, including separate, as well as large charging station networks.

Support for Market Development – Support the growth of the PEV market with customer focused sensitivities, while providing support services to electric vehicle services providers (EVSP) and related industries. Provide support for a variety of PEV customers and stakeholders with services (e.g., metering, billing, back office, field support), as well as education and outreach for home and non home charging: public, private, commercial, multi unit dwellings, single family, contractors, EVSPs, municipalities, OEM / dealerships, trade allies, media and fleet.

To prepare for the efficient integration of PEV charging loads, SDG&E is monitoring PEV EVSP installations in the event that these loads require service transformer upgrades, including the use of transformer sensors and other monitoring technologies. These capabilities will provide information to engineers and operators about the state of the grid including distributed resources and loads at the location of these targeted transformers. These sensors have the potential to allow increased transformer capacity utilization and accommodate future loads including, but not limited, to PEVs.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Electric Vehicle Growth program includes the following:

Public Access Charging Stations – Installation of utility owned, public access charging facilities for EVs. Projection: 129 Level 2 stations and 13 Fast Charge stations in 2012.

Smart Transformers – Installation of sensors on distribution transformers plus ancillary communication technology to monitor and report loading, and transformer condition. This will impact the number of transformers replaced and overloaded by PEVs and heat storms.

Plug In Electric Vehicles – Infrastructure Upgrades – Upgrades to the electric distribution system to accommodate increased numbers of PEVs. Upgrades include facilitating customer panel upgrades, upgrades of residential distribution transformers and upgrades of primary distribution feeders.

Vehicle to Grid (V2G) Pilot – This pilot results in integrating stationary batteries with fast public and private charging facilities and includes implementation of sites/units with communication and controls protocol, testing of a micro network of PEV charging units with EVSP and technology partners, micro network testing, protocol refinement with automotive manufacturers and PEV integration testing.

EV Study – Rates (E) – SDG&E is studying up to 1,000 PEV owners' charging patterns using experimental rates designed to encourage off peak charging. The results of the study will be used to design future EV charging rates.

The timeline of SDG&E's Electric Vehicle Growth program is shown in Figure 6 6 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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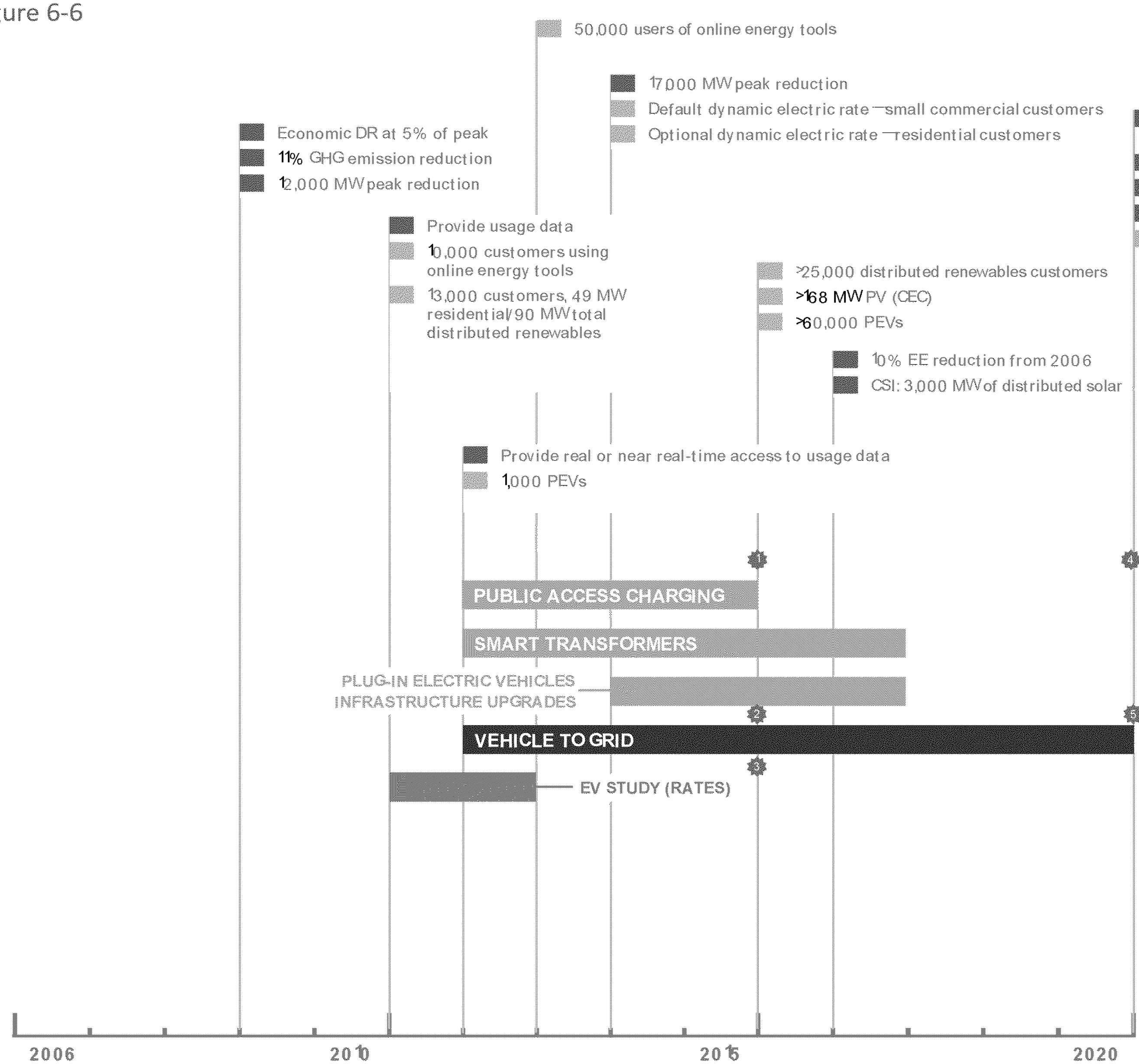
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

ELECTRIC VEHICLE GROWTH

Key
- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-6



SDG&E Smart Grid Vision: by 2015

1. PEV growth is supported and encouraged through the application of new technologies to manage customer load and facilitate EV charging to minimize impacts to the grid
2. SDG&E is providing options for customers to prioritize and control load to accommodate distributed intermittents and efficiently integrate plug-in electric vehicles
3. SDG&E, through metering and related measures, is tracking electricity used for transportation in order to earn Low Carbon Fuel Standard credits on behalf of customers

SDG&E Smart Grid Vision: by 2020

4. SDG&E is providing options for customers to sell energy from their electric vehicle, PV system, or storage device to optimize overall system efficiency and costs
5. The market continues to integrate the aggregation of distributed resources, plug-in electric vehicles, and energy storage

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6.4.4 RELIABILITY AND SAFETY

SDG&E's Reliability and Safety program goals are to maintain and/or improve reliability and safety in response to the challenges associated with renewable generation and PEVs. SDG&E will accomplish this goal by improving measurement, control, protection, data recording, and management and optimization capabilities. Initially, SDG&E will focus on increasing the measurement and recording across its grid, providing the basis for an increased understanding of grid performance and the ability to perform detailed analysis on past events. In the future this will enable SDG&E to implement control and protection projects that will improve the ability of SDG&E and the CAISO to anticipate problems and respond to them automatically and manually. The data will also allow for programs that will stabilize and optimize the grid, also improving its resilience.

SDG&E's technology investments will combine with investments it is making to expand its control capabilities and further its goal of providing faster isolation of faulted electric distribution circuits and branches, resulting in faster load restoration and isolation of system disturbances.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Reliability and Safety program includes the following:

Advanced Ground Fault Detection – Development of algorithms that will utilize available data and perform analytic evaluations to determine optimal actions. Purchase or develop existing protection equipment to support improved analytic and control functionality.

Advanced Weather Station Integration and Forecasting Capabilities – Optimization of advanced weather monitoring information to develop environmental forecasting tools that facilitate and enhance deployment strategies during inclement weather conditions, including Red Flag events. This information can be further leveraged for renewable generation forecasting.

Wireless Faulted Circuit Indicators – Implementation of wireless faulted circuit indicators to provide rapid identification and location of faulted distribution circuits resulting in reduced outage time by expediting patrol and restoration activities.

Condition Based Maintenance Expansion – Expansion of CBM to selected 4 kV substation transformer banks to leverage actual transformer conditions to optimize operations.

Phase Identification (E) – Identification of the phase of each conductor on a three-phase feeder, as well as single phase branches on all circuits by 2013. This will improve the distribution system models and allow for future system efficiency improvements.

Smart Isolation and Reclosing – Application of off-the-shelf pulse closing technology at additional points on the system. SDG&E has already applied this technology which limits the amount of energy that SDG&E re-closes back into faulted circuits, improving public safety.

ARC Detection – Development of capabilities for arc detection in 230 kV underground vaults and overhead conductors. This system provides radio frequency indication to an inspector at street level and helps locate faults.

Automated Fault Location – Development of automated fault location for transmission events, using relay events from all line terminals to improve accuracy. This will assist in service restoration and outage duration.

Composite Core Conductor – Demonstration of composite core conductor installation. This technology has the potential to increase capacity ratings of existing and new transmission corridors.

Advanced System Planning Tools – Development of improved models for new types of generation, such as solar thermal and solar PV, and the use of better weather forecasting for improved generation forecasting, improving grid performance with renewable generation.

Dynamic Voltage and VAR Control – Installation of three synchronous condensers at Mission, Penasquitos and Talega 230 kV substations to mitigate the loss of system inertia and assist in maintaining voltage within tolerances.

Energy Storage for Transmission Reliability – Installation of various types of storage and other fast acting technologies to maintain and/or improve the reliability of the transmission system.

Real Time Voltage Stability Program – Usage of new applications and models to allow for variations in dispatch and better utilization of import capabilities.

Synchrophasors (Transmission) – Deployment of multiple PMUs across SDG&E's service territory that will enable wide area situational awareness capabilities.

Convert Manual Line Switches to Remote SCADA Operations – Expansion of SCADA to additional points on the transmission system to allow for more automated grid operations.

Fiber Optic Communications Systems (E) – Expansion of the fiber optic network to all transmission substations. This system will be primarily to enable system protection capabilities but can be leveraged for other Smart Grid communication needs.

The timeline of SDG&E's Reliability and Safety program is shown in Figure 6-7 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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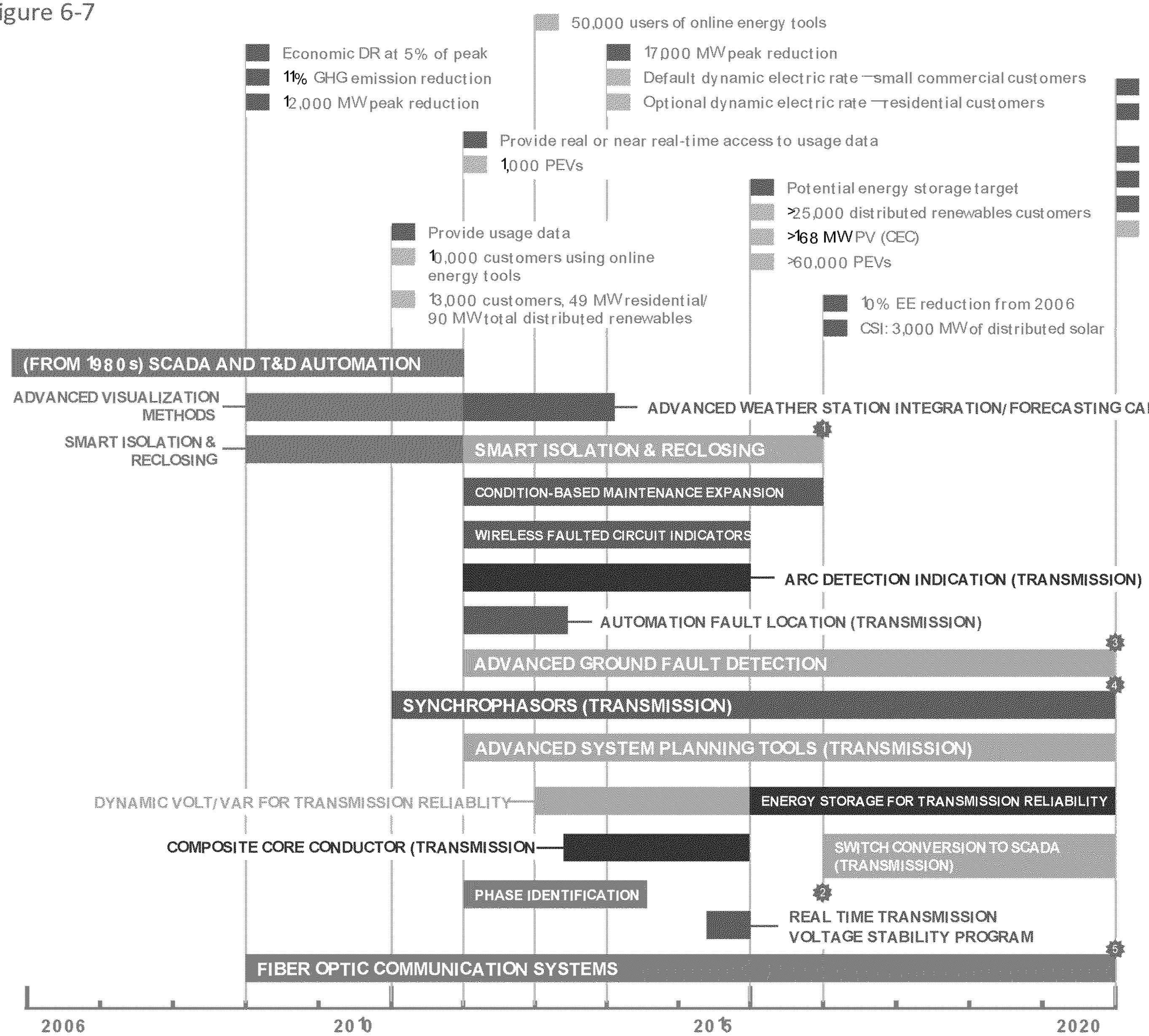
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

RELIABILITY AND SAFETY

Key

- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-7



SDG&E Smart Grid Vision: by 2015

1. Automatic fault detection, isolation, and service restoration capabilities are being enabled, requiring minimal human intervention and leading to improvement in outage restoration
2. Cost-effective energy storage—either utility, customer, or third party owned—is helping to resolve voltage regulation, voltage flicker, and intermittency of renewable resources

SDG&E Smart Grid Vision: by 2020

3. SDG&E is enabling differing levels of reliability, based on customer needs/preferences for self sufficiency (particularly for C&I customers)
4. Synchrophasor data is being used to assess the condition of the grid and respond to changes before they become problems
5. Highly reliable network services are deployed to targeted areas to ensure continued availability for mission critical applications

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6.4.5 SECURITY

SDG&E's Security program guides a comprehensive set of capabilities to address the increased physical and cyber security requirements associated with the development, implementation, and operation of the Smart Grid's systems. The Security program will focus on developing policy and strategy, upgrading the security infrastructure, managing Smart Grid risk, and extending security daily operations. The program is designed to support the tenets of SDG&E's security strategy:

- Adherence to Security Principles
- Broaden Awareness
- Converge Security Governance
- Distribute Security Controls

The program supports SDG&E's security principles by incorporating them across projects. For example, key principles, such as alignment to role based access control with separation of critical duties, are incorporated in configuration change control projects SDG&E plans within security compliance management.

SDG&E's Security program broadens awareness internally and externally. Activities are dedicated to real time situational awareness of security controls. Project objectives include enhancing current policies, informing participants, such as employees, third parties, and customers; of the shared obligation to protect every individual's privacy and security. Additionally, planned investments drive mechanisms to communicate relevant security information among a collaborative community to facilitate finding and resolving potential problems faster.

SDG&E achieves converged security governance by incorporating standards and interoperability into security management projects so that security management can be centrally managed. Security capabilities are policy driven to support course grained security controls, and security projects define central, integrated security processes to enable SDG&E to respond effectively as a single unit.

Finally, SDG&E's Security program places and executes security throughout the network to resist attack, distribute risk management decisions, and support application level security. This distributed security control allows decisions to reflect local business needs, while they are governed by enterprise policy. Pilots are defined to expand SDG&E's capabilities around distributed network protocols supporting this distributed security control.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Security program includes the following:

Security Event & Incident Management (SEIM) Refresh Installation of SEIM technology to replace SDG&E's current SEIM infrastructure. The project will design and implement a SEIM service that supports current production and regulatory requirements and a foundation for strategic utility programs. This capability will streamline and enhance management, trend analysis, alert reporting and escalation processes.

Substation Physical Security Hardening – Installation of physical access control and monitoring for substations, and enhanced capabilities for network monitoring of alarm systems.

Security Metrics, Report and Awareness (Cyber) — This project will enhance internal and external security awareness, collaboration and training, as well as security and compliance metrics, and risk reporting.

Security Compliance Management (Cyber) —Implementation of a compliance control framework, security features and control baselines and configurations, as well as compliance control unification, attestation and testing automation for security and compliance requirements.

Security Threat and Vulnerability Management (Cyber)—Enhancements to the hardware/software security testing and vulnerability management program; testing and monitoring of Smart Grid security controls; operational compliance monitoring (SOX & NERC/CIP); data labeling and tagging; compliance management solution; cyber security testing & assessment program; CIS standards; audit and records retention.

Security Incident Management (Cyber)—Implementation of solutions for vulnerability assessment and management; hardware and firmware security assessment and code review. Implementation of processes and procedures for data classification, handling, marking and disposal. These capabilities will help ensure configuration and assurance verification and testing; threat and vulnerability collaboration.

Secure Distributed Network Protocol (DNP) Pilot—This project will develop SDG&E standards/guidelines for the implementation and use of secure SCADA technology for electric transmission and distribution. The technology will have proven reliability, security, robustness; meet latency and real-time applications requirements; and provide robust two-way communications.

Information Security Research (E)—Security research activities supporting Smart Grid technologies and projects. Monitor standards development and other best practices to ensure external alignment.

The timeline of SDG&E's Security program is shown in Figure 6.8 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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2011 Smart Grid Roadmap

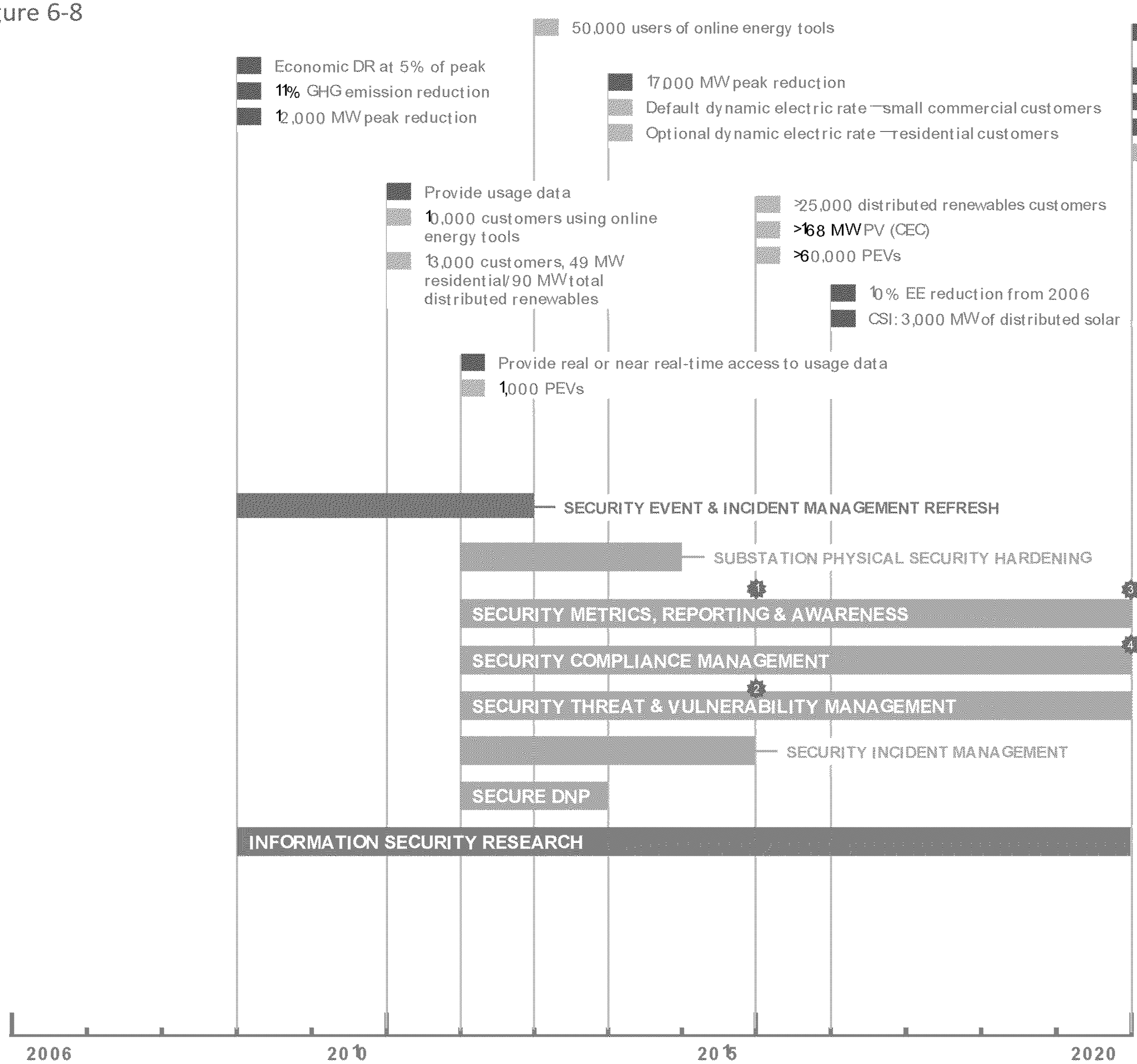
1 2 3 4 5 6 7 8 9

SECURITY

Key

- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-8



SDG&E Smart Grid Vision: by 2015

1. SDG&E continues to ensure that secure Smart Grid technologies are being applied to the electric distribution system that are highly resistant to outside intrusion or other unauthorized uses
2. Smart Grid network security continues to improve, further preventing unauthorized access and incorporating responsive intrusion detection and prevention measures

SDG&E Smart Grid Vision: by 2020

3. SDG&E continues to work with technology providers to develop new control systems that automatically detect attacks and reconfigure to resist attack
4. Smart Grid applications provide detailed logging of events enabling tracing and correlation for improved security, problem resolution, and performance monitoring

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6.4.6 OPERATIONAL EFFICIENCY

SDG&E has designed the Operational Efficiency program to advance SDG&E's network monitoring, operating and optimizing capabilities to achieve more efficient grid operations. Investments are planned to improve monitoring and measurement with technologies that assist in the detection of anomalies with greater efficiency and effectiveness. SDG&E plans investments that facilitate the availability and use of key network information, such as modeling tools to improve the efficiency of network planning processes. Several projects facilitate the optimized operation of the grid utilizing remote monitoring and real time responsiveness, such as the Outage Management System/Distribution Management System (OMS/DMS) and dynamic transmission line ratings.

SDG&E's investments optimizing grid operation address opportunities to improve power flow as well as generation coordination. Investments in dynamic line and facility ratings will allow operators to make real time determinations of a grid element's ability to carry load based on electrical and environmental conditions. In conjunction with SDG&E investments in grid operational control such as the distribution management system implementation, operators will be able to conduct real time load transfer through real time feeder reconfiguration and optimize to relieve load on equipment, improve asset utilization, improve system efficiency, and enhance system performance.

Collectively, SDG&E's investments in operational efficiency will improve its ability to plan and operate the grid while delivering key environmental benefits by enabling alternative resources and more efficiently delivering power. Additionally, some of these investments will play a key role in empowering consumers.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Operational Efficiency program includes the following:

Weather Station Network (E) – Expansion of the fourth largest weather network in the nation to support improved operational decision making during adverse weather conditions. The expansion of the weather network will also enhance its management of current and future renewable energy generation. The collection of real-time wind, solar radiation, barometric pressure, and satellite irradiance data will be used to forecast solar PV and wind generation energy production. Modeling and forecasting the micro-weather climate of SDG&E's service territory will enhance its ability to predict PV and wind energy generation peaks and expected lows that occur from the natural variations in weather patterns. This will enable SDG&E to manage the transmission and distribution grid at a high level of efficiency and help to manage the dispatch of resources. Finally, this real-time weather data can be used to support dynamic line ratings by factoring in temperature and wind for maximum line ratings.

Micro Pile (Distribution) – Micro piles (also called minipiles) are high-performance, high-capacity drilled and grouted piles with diameters typically 5" – 12". Generally, micro piles are applicable when there are problems with using conventional deep foundation systems. While not a traditional Smart Grid technology project, this project leverages innovative materials and construction technologies and helps minimize environmental impacts of the electric system.

ARC Detection – Distribution – Evaluation and deployment of this technology will assist in fire prevention activities through SDG&E backcountry areas.

3D Modeling Using PLS-CADD/LIDAR – This project will apply state-of-the-art computer modeling technology to existing utility infrastructure, using conventional or LIDAR survey data. This technology will provide SDG&E with better information regarding critical spans and ground clearance that can impact system reliability.

Distributed Energy Resource Management System (DERMS) – This project will optimize resource utilization in response to system operational events, environmental and equipment conditions (collectively reliability events), and market price conditions.

DERMS includes several different, but integrated, software components that incorporate advanced optimization algorithms to dispatch demand and supply side resources, including DR, storage, and PEV Charging (monitoring and control of batteries at public charging stations).

Condition Based Maintenance – Transmission and Distribution Condition based maintenance will use technology to assess the condition and performance of substation transformers and breakers to make better maintenance decisions and optimize assets.

IR Inspection for Distribution Apply a structured infra red inspection program to the distribution system to reduce equipment failures, leveraging ground and/or aircraft based methods.

Geographic Information System (GIS) Implementation of an enterprise geographic information system that will maintain, analyze and map data entered in electronic format and integrate with the OMS/DMS to ensure up to date network models are used in system operations.

Outage Management System/Distribution Management System (OMS/DMS) – Replacement of an existing OMS and installation of a new DMS to improve outage restoration and response and identify potential grid issues. This system will provide operators with improved capabilities, particularly in storm conditions and reduce manual processes.

Automated Facility Rating System This project will create a new database to automate development of facility ratings and allow equipment rating owners to enter data directly. This will provide updated information to Operations and Engineering as well as provide an audit trail for NERC reliability standards compliance.

Smart Substations (E) – Upgrades of old electro mechanical relays to solid state relays to allow for improved protection schemes and functionality.

Mobile Field Force Deployment (E) – This project includes field scheduling and dispatch (FSD), wider utilization of mobile data terminals (MDTs) for such initiatives as Supervisor Enablement (SE), improved work management systems and the Construction Planning and Design (CPD) initiative. Together, these projects will improve the efficiency of SDG&E's field forces through improved communications and automation.

Dynamic Line Ratings – This project will develop criteria for applications on the transmission system, and initiate a pilot program with the CAISO to use Dynamic Transmission Line ratings in generation dispatch. Sensors will be installed on lines to monitor tension and temperature conditions in order to develop real time dynamic conductor ratings.

The timeline of SDG&E's Operational Efficiency program is shown in Figure 6.9 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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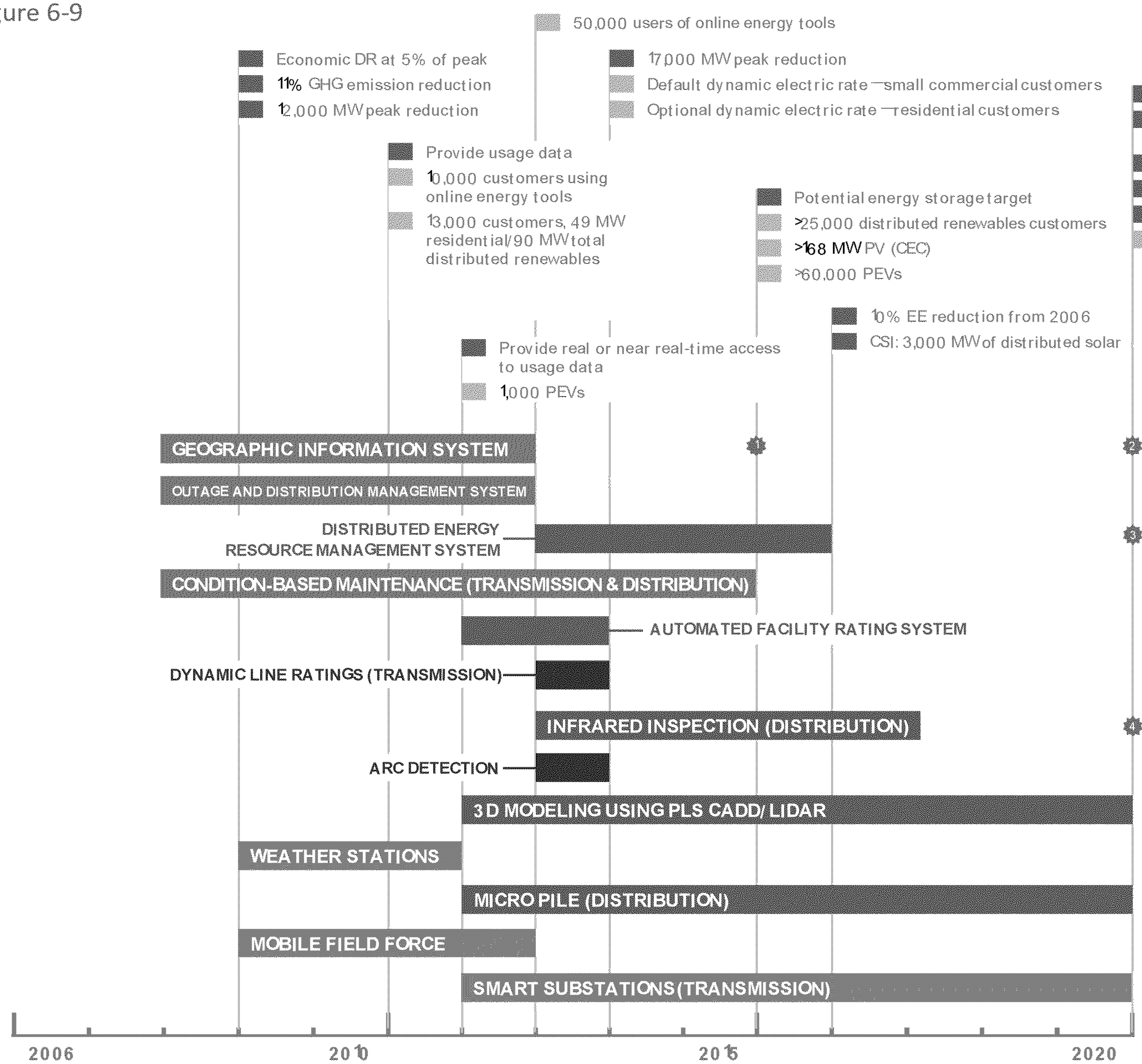
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

OPERATIONAL EFFICIENCY

Key
Policy Goal
Forecast
SDG&E Smart Grid Vision
In Flight Project
New Project - Policy
New Project - Value
New Project - Pilot
Enterprise Project

Figure 6-9



SDG&E Smart Grid Vision: by 2015

1. Improved distribution system voltage regulation through energy storage, automated capacitor switching, and other devices results in lower system losses

SDG&E Smart Grid Vision: by 2020

2. Ancillary service markets allow use of distribution level resources supporting the transmission system and resulting in improved system performance
3. SDG&E's Distributed Energy Resource Management System is fully functional and interfacing with customer loads and resources, supporting efficient utilization of distributed energy resources
4. SDG&E is utilizing time series data and event correlations to provide predictive capabilities that improve asset management, system operating performance, and health

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6.4.7 SMART GRID RESEARCH, DEVELOPMENT AND DEMONSTRATION (RD&D)

Many Smart Grid tools and technologies anticipated to be available in the future are nascent or still in the conceptual stage. The technical requirements and functionality are not defined and the impact on SDG&E's operations is not fully understood. SDG&E Smart Grid Research, Development and Demonstration (RD&D) program incorporates pilots and the development of an Integrated Test Facility to address these areas of uncertainty.

SDG&E plans to implement an Integrated Test Facility as a test bed for Smart Grid technologies. As part of the effort to integrate technologies to improve the electric power systems' reliability and efficiency; facilities, systems, and personnel will be required to test interoperability, functionality and effectiveness in meeting requirements. The Integrated Test Facility will allow integration testing of multiple complex hardware and software systems comprising Smart Grid technologies. Leveraging space at an existing SDG&E building, the project will implement necessary upgrades and equipment to create these capabilities.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Smart Grid RD&D program includes the following:

Microgrid SDG&E's Borrego Springs Microgrid demonstration project uses Smart Grid technologies to integrate and manage distributed resources, and will enable the demonstration of islanding of an entire distribution circuit from the utility grid.

Integrated Test Facility This project will construct facility upgrades and purchase and install equipment to create a Smart Grid integrated test facility as described above.

Flexible Demand Pilot This project is designed to work with the CAISO to aggregate many small batteries on the distribution system into one larger entity that can bid into the CAISO markets.

RD&D Smart Grid Related Projects – These RD&D projects are organized into multiple program areas of RD&D (operations, customer applications, clean generation, clean transportation, renewable generation and program management and related) and include (among others) standards and protocols, customer DER integration, next generation DER and next generation energy storage systems.

The timeline of SDG&E's RD&D program is shown in Figure 6-10 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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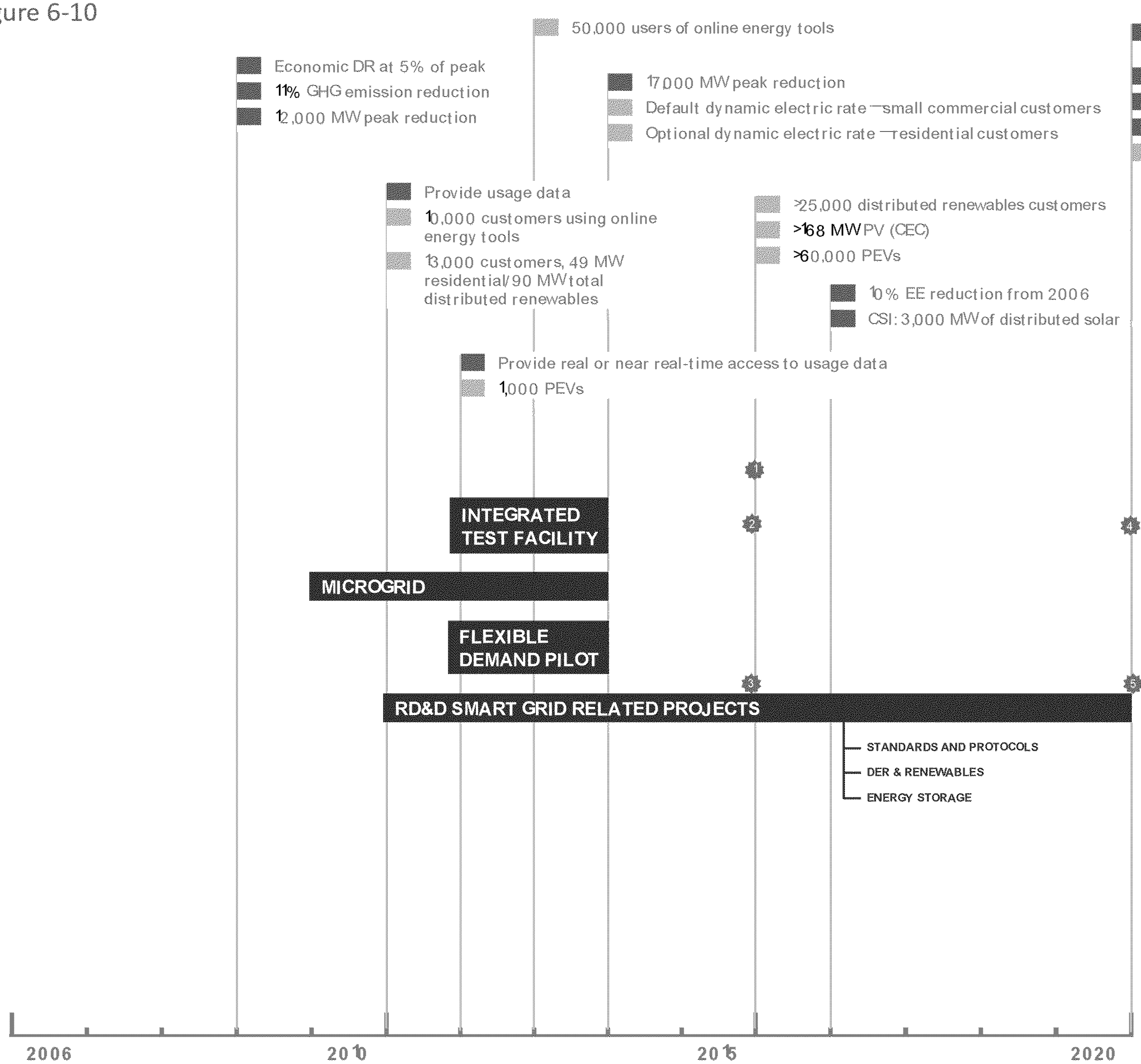
1 2 3 4 5 6 7 8 9 **2011 Smart Grid Roadmap**

SMART GRID RD&D

Key

- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-10



SDG&E Smart Grid Vision: by 2015

1. SDG&E is helping advance the development of protocols that enable full integration of customer Distributed Energy Resources
2. SDG&E is demonstrating the benefits of energy storage and communications with conventional technologies in practical applications
3. SDG&E customers have the ability to control loads autonomously and many have adopted energy efficiency technologies to attain zero net energy objectives

SDG&E Smart Grid Vision: by 2020

4. SDG&E continues to work with the industry to develop interfaces with customer loads to allow dynamic control and regulation
5. Widely adopted NIST standards are creating a ubiquitous market of plug-and-play networked devices in homes and businesses

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6.4.8 INTEGRATED AND CROSS-CUTTING SYSTEMS

SDG&E recognizes that some broad-based investments are required to achieve Smart Grid capabilities. In areas such as application platform development, data management and analytics, and grid communications; an integrated investment approach will ensure that costs are managed efficiently while creating the platform to deliver streams of benefits across SDG&E operations.

SDG&E will invest in a next-generation application platform to meet the demands of its Smart Grid investments. Investments in enterprise information management will ensure that new Smart Grid equipment for grid operations can readily communicate with new and legacy equipment and act on the information exchanged. SDG&E investments in communications will converge into a single purpose communications network, working toward a unified communications network. The short-term investments enhance and build new communications infrastructure to enable new sensor, metering, maintenance, and grid asset control networks. Mid-term investments extend SDG&E's physical and logical network security perimeter to enable increased secure information exchange with SDG&E, service partners and customers. The long-term investments will extend the transition to a unified communications infrastructure, furthering easily-enabled and secure information exchange between Smart Grid domains, systems, and participants.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Integrated and Cross-cutting Systems program includes the following:

Low Power Wide Area Communications Network – This project builds out the low-speed wireless network and backhaul connectivity to enable electric T&D to deploy and monitor fault circuit indicators (FCIs) and to more effectively monitor aviation lights required for aviation safety. This includes support for the Sunrise Powerlink, new aviation lights, faulted circuit indicators for High Risk Fire Areas (HRFA), and other FCIs and aviation lights needs. This capability will also provide fault notification and integration with OMS/DMS and other infrastructure and communication monitoring systems.

CISCO Data Archiving (E) – Growth in data volume and increased size of the database can yield performance degradation to batch, online and distributed programs associated with SDG&E's customer information system (CISCO). This project will develop a data life cycle for CISCO data with the aim of reducing database sizes and improved online, web service and batch process performance.

CISCO Replacement / Upgrade (E) – SDG&CISCO will need to be replaced or significantly upgraded as various Smart Grid technologies are implemented. The current customer information system was put in service in approximately 1998, and SDG&E anticipates that replacement or significant upgrades will be necessary in the 2015 – 2020 period.

Data Management and Analytics – The Data Management and Analytics project will provide an infrastructure to house the vast amounts of new data generated by Smart Grid and will make it available for analysis on a near real time basis. New analytics tools will be deployed and specifically tailored to the Smart Grid business domains to uncover a greater understanding of this new data in areas such as: Predictive Asset Maintenance, Demand Forecasting, Situational Analysis, Optimization and Customer Usage Analytics. Underlying foundational capabilities include ensuring that internal company data is consistently used and aligned with external Smart Grid industry standards.

SDG&E Grid Communications Services – SDG&E Grid Communication Services will implement an advanced wireless communications system that will allow SDG&E to monitor, communicate with and control transmission and distribution equipment, thus accelerating deployment of Smart Grid applications and devices. The Next Generation SDG&E Grid Communications Services project will deploy next generation wireless communications technology to improve coverage, capacity, and performance to meet a greatly expanded Smart Grid communications landscape.

Precision Time System – This project will assess, test, and deploy standardized precise time synchronization for the electric system and harmonize the time standards with the information network. Standardizing highly precise time synchronization across the utility systems will be vital to delivering Smart Grid operational and efficiency objectives. Currently, different time synchronization standards and protocols are used within the electric system, while the Network Time Protocol (NTP) is predominant in the information network. Smart Grid requirements for highly precise time synchronization is driving the work of the NIST Priority Action Plan PAP 13: Harmonization of IEEE C37.118 with IEC 61850 and Precision Time Synchronization.

Next Generation Application Platform – Design and implementation of a next generation application platform to support Smart Grid operation and customer enablement. The new platform will support versatile application deployment through web, mobile, in house HAN and others. It would enable reliable and scalable operations and support massive parallel processing and enable centralized policy and entitlement management and distributed enforcement for application and device security.

Implementation of Internet Protocol v6 (IPv6) (E) – This project will migrate the SDG&E technical infrastructure to leverage Internet Protocol version 6 (IPv6) as a key enabler for deploying an increasing and vast number of network participating devices, including smart devices deployed by projects on the Smart Grid roadmap. This project will prepare the network, server, and application infrastructure needed to support this migration.

The Integrated and Cross cutting Systems program will continue to evolve and provide new and improved technical capabilities for all of SDG&E. While not specifically included in the Smart Grid roadmap, projects that deliver improved technical capabilities will be leveraged by Smart Grid deployments. Some examples include:

- Continued server consolidation through virtualization to reduce the number of servers, as well as total energy consumption.

- Meeting increasing storage demand via data de-duplication, thin provisioning, automatic data tiering, and improved storage resource management.
- A virtual network perimeter environment to increase network flexibility, security, reliability, and scalability.

The timeline of SDG&E's Integrated and Cross-cutting Systems program is shown in Figure 6-11 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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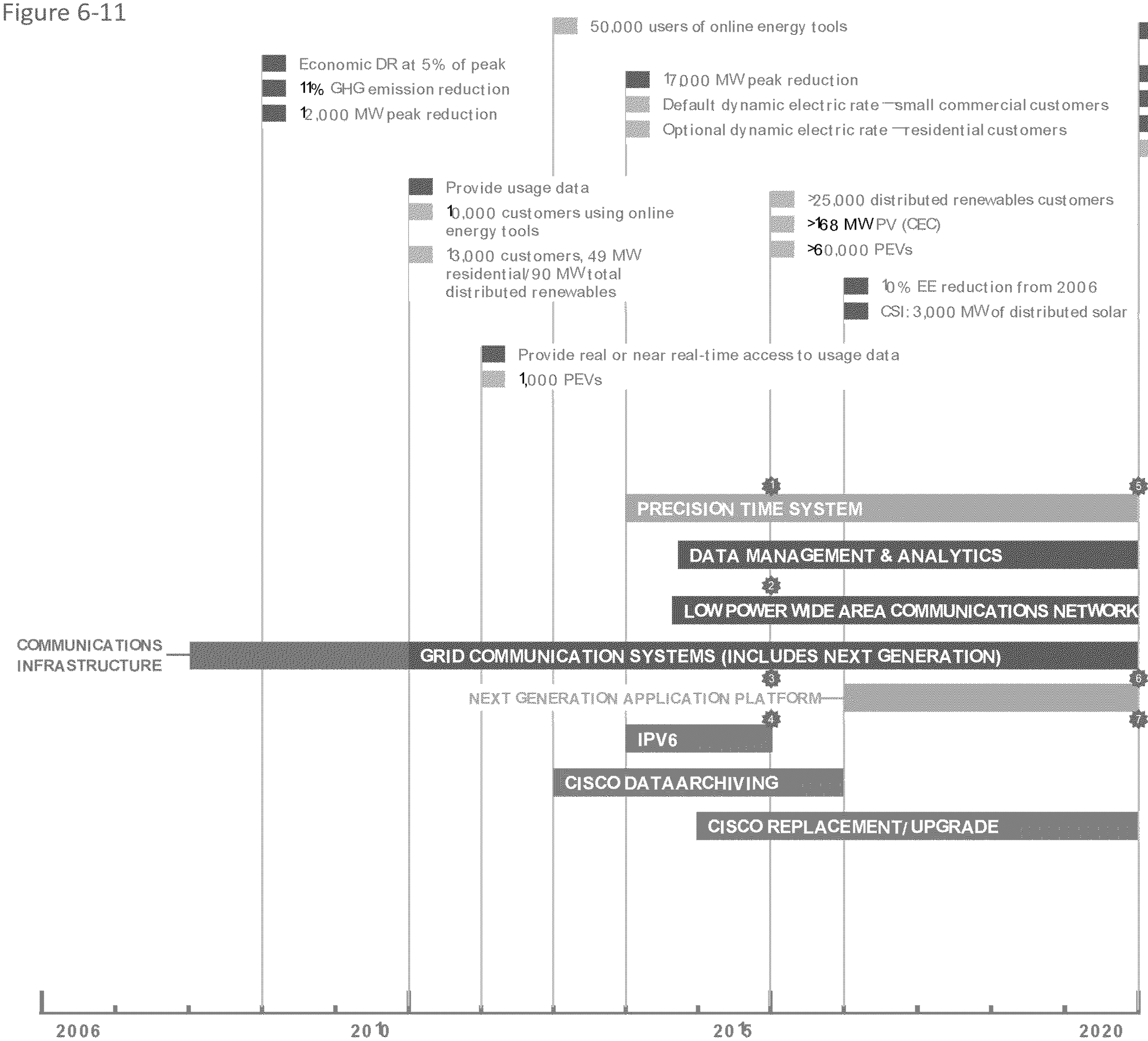
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

INTEGRATED AND CROSS-CUTTING SYSTEMS

Key
- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-11



SDG&E Smart Grid Vision: by 2015

1. SDG&E continues to enhance near real-time analytic services for control room analysis (via time-series or alternative analytic tools) enabling predictive and geospatial analyses
2. Robust grid communications are enabling the near real time and real-time information access required operate the grid more efficiently
3. Smart Grid communications enabled along distribution lines connecting Distributed Energy Resource and energy storage providers, enabling timely and secure information exchange with the CAISO markets
4. SDG&E's system integration platform is providing improved interoperability among different systems

SDG&E Smart Grid Vision: by 2020

5. Fully integrated data systems enable a holistic approach to data management improving overall utility situational awareness regarding the state of the grid
6. SDG&E provides customers with opportunities to participate in the market using open standards and applications by leveraging time series data and event correlations, as well as meter data brought together using system integrations
7. SDG&E is enabling automatic server workload migration capabilities, based on availability, cost, and source (fossil fuel, solar, wind generated) of power

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6.4.9 WORKFORCE DEVELOPMENT

SDG&E's Workforce Development program enables the activities of the other programs by ensuring that Smart Grid requirements are met by a skilled and prepared workforce.

A list of the specific projects that SDG&E is incorporating in its Smart Grid Deployment Plan for the Workforce Development program includes the following:

Smart Grid Organizational Change Management – This project will put in place the training, communication, policies and practices necessary to ensure that as the many Smart Grid related initiatives are implemented that change management is handled consistently and effectively. This initiative develops new job skills for some employees, new positions for other required job skills and new business processes to ensure continued compliance with regulatory and safety mandates.

Survey Tools (E) – This project will result in implementing the survey tools necessary to gauge employee attitudes toward and understanding of various initiatives being pursued.

Workforce Planning Tools (E) – This project will implement the tools necessary to project workforce requirements and aid in planning to meet those requirements.

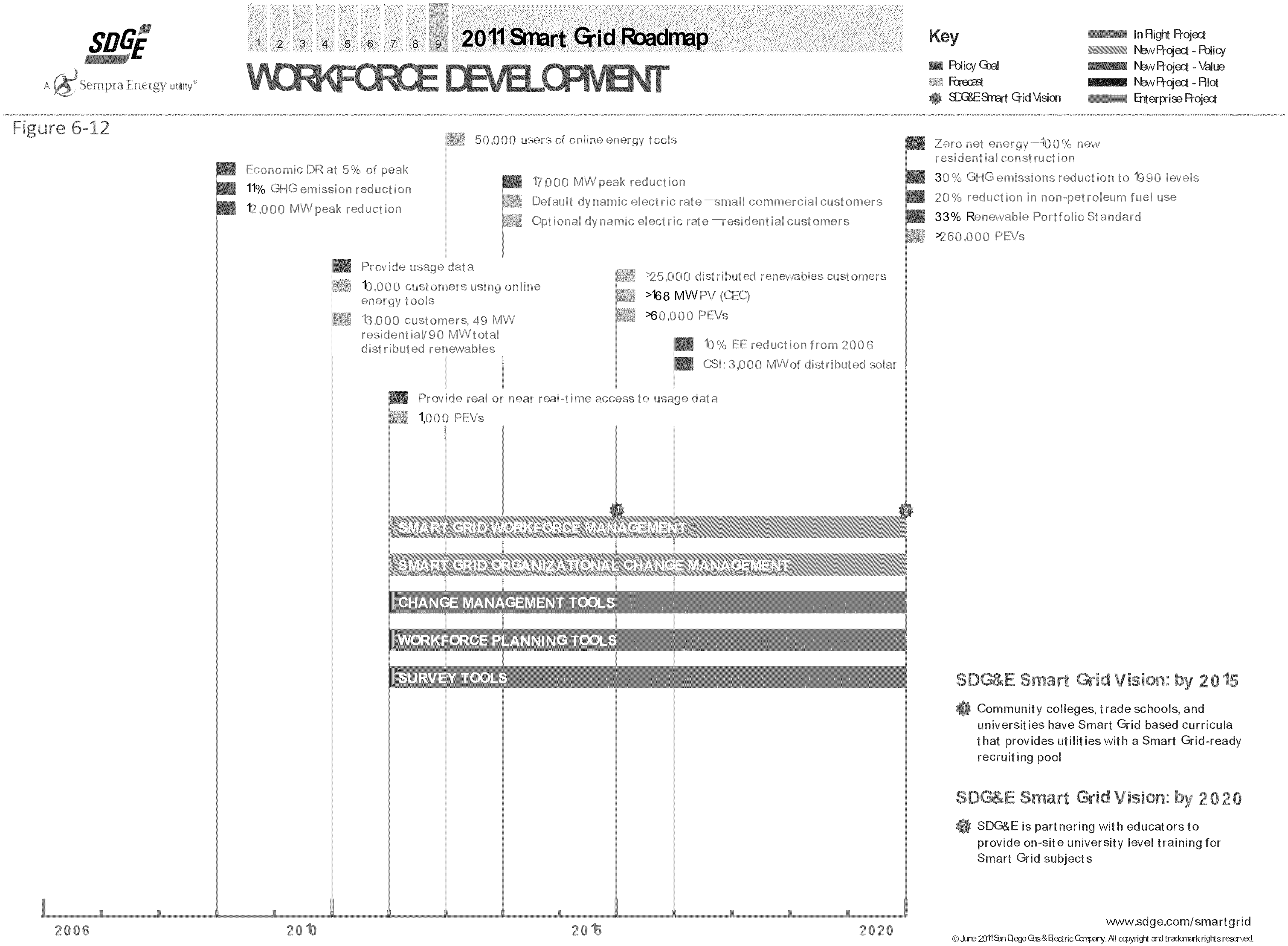
Smart Grid Workforce Management – This project will result in the implementation of recruiting strategies and client partnerships necessary to manage the Smart Grid related workforce. For example, SDG&E engineering and IT departments have started to recruit jointly in an effort to attract and hire students with a blend of electrical engineering and computer science, computer engineering, and/or management engineering backgrounds.

Change Management Tools (E) – This project will result in the implementation of the tools necessary to ensure effective organizational change management.

SDG&E has a strong commitment to ensure its workforce reflects the labor markets it serves. Therefore, as with all of its recruitment strategies, SDG&E will ensure the outreach for all employment opportunities related to Smart Grid is inclusive to all.

The timeline of SDG&E's Workforce Development program is shown in Figure 6 12 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

Figure 6-12



SB_GT&S_0376159

6.5 CONCLUSION

SDG&E's Smart Grid Deployment Plan facilitates achievement of AB 32, the *California Long Term Energy Efficiency Strategic Plan*, state mandated energy efficiency and demand response goals, RPS, and full solar PV deployment under the California Solar Initiative; and it includes plans to deploy infrastructure enabling customers with access to energy consumption and pricing data. Through SDG&E's nine Smart Grid program areas, the utility is able to build the capabilities required to meet the needs of customers and the state's ambitious energy policy goals.

Section 7 COST ESTIMATES

This section contains conceptual and/or provisional cost estimates reflecting the best available information at the time of preparation of the Smart Grid Deployment Plan. These estimates are not intended for use in new requests for funding and are subject to change as new information becomes available.

7 COST[44] ESTIMATES

7.1 INTRODUCTION

As part of its Smart Grid Deployment Plan, SDG&E has developed cost and benefit calculation procedures to identify, quantify, and, where possible, monetize the costs and benefits of its current and planned Smart Grid investments. SDG&E has approached each of the nine program areas described throughout this document from a cost effectiveness perspective as described in D.10 06 047 in order to determine whether each project's costs are outweighed by its benefits. This analysis is a high priority for SDG&E in developing its Smart Grid deployment roadmap and has been applied to all projects in the Smart Grid Deployment Plan whether required to meet state or federal policy requirements or to support customer choice and preferences. SDG&E will not request authorization for funding of projects not necessary to comply with policy unless the benefits exceed the associated costs or where they are required to effectively communicate with customers.

SDG&E has developed and applied a thorough and comprehensive analysis of its proposed Smart Grid technology and infrastructure investments. As explained in the following section, this analysis is intended to be as accurate as possible, given currently available information. The analysis identified which cost and performance data offer the best approach and gauged the reliability of both cost and performance estimates for each project in SDG&E's nine Smart Grid Deployment Plan program areas. However, as explained in section 7.2.3, an estimate of the cost per customer (or participating customer) has not been provided.

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[44] "Cost" in this Smart Grid Deployment Plan is defined as capital expenditures and operating and maintenance (O&M) expenses. It does not include additional elements of total costs of projects that are included in rates paid by customers.

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Due to the nascent state of much of Smart Grid technology and the fact that actual deployment will be based on future lessons and pilots, these estimates will certainly change over time as SDG&E learns more. Additionally, it is common for competing labor resources, technology complexities, new and changing requirements, and other unforeseen circumstances to increase cost and cause project delay. In order to mitigate schedule delays and cost overruns, SDG&E's project managers leverage a number of best practices, which can aid in developing accurate estimates but, at this stage in the Smart Grid's evolution and industry deployment experience, many are not available for Smart Grid Deployment Plan projects.

To develop cost estimates leveraging best practices, detailed requirements are developed, prototypes are implemented, contingency is added to cover new and unanticipated changes based on the complexity and size of the project, lessons learned from previous project implementations are accounted for, proposals are requested from experienced integrators that are asked to commit to fixed prices, project materials are forecasted based on market prices, and experienced employees are assigned or hired to resource the project. Smart Grid projects are currently unable to leverage many of these practices, but will as they mature over time.

As the CPUC noted in D.10-06-047[45], these estimates are preliminary and conceptual. SDG&E will file supporting applications when sufficiently precise estimates are available and will revise the deployment roadmap as requirements and technology capabilities evolve.

As described in the Deployment Baseline, SDG&E has been pursuing Smart Grid solutions for several years and the CPUC has already authorized a substantial portion of the costs reflected in SDG&E's Smart Grid Deployment Plan. Those costs are included for

[45] D.10-06-047 at p.69

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the 2006 – 2020 time period and do not apply the provisional range factors described in section 7.2.2.

In addition to previously authorized expenditures, this plan includes proposed investments that have been previously filed with the CPUC in SDG&E's Test Year 2012 (TY2012) General Rate Case[46] (GRC), or in separate applications (such as Smart Grid related Demand Response[47] and Dynamic Pricing[48] programs). These estimates do not apply the provisional range factors described in section 7.2.2.

Projected costs incremental to these two groups are also estimated and summarized below according to their regulatory jurisdiction, CPUC or FERC.

The total estimated costs of Smart Grid deployments for the years 2006 – 2020 described in this plan are approximately $3.5 to $3.6 billion, broken down as follows:

[46] A.10-12-005, information available at http://www.sdge.com/regulatory/A10-12-005.shtml
[47] A.11-03-002, information available at http://www.sdge.com/regulatory/A11-03-002.shtml
[48] A.10-07-009, information available at http://www.sdge.com/regulatory/A10-07-009.shtml

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Table 7-1: Smart Grid Deployments Total Estimated Costs 2006-2020

Previously authorized investments[49] (Smart Meter, OpEx 20/20 Smart Grid projects)	$1,042 MM
2012 Test Year General Rate Case[50]	$1,424 MM
Other active applications (Demand Response[51], Dynamic Pricing[52])	$237 MM
Estimated incremental investments – CPUC	$299 MM - $364 MM
Estimated incremental investments – FERC	$466 MM - $555 MM

7.2 APPROACH

In order to determine the overall business value of its Smart Grid Deployment Plan, SDG&E embarked on an extensive initiative to forecast and compile both the projected costs and benefits for the various projects that support Smart Grid. As part of this exercise, SDG&E examined the costs of projects and programs that provide Smart Grid functionality which are already underway or expected to begin prior to 2020.

[49] Costs for previously authorized investments have been forecast beyond the period reflected in SDG&E's TY2012 General Rate Case (A.10-12-005).
[50] Costs for projects in the TY2012 General Rate Case (A.10-12-005) have been forecast beyond the period reflected in the application.
[51] Only the Smart Grid related costs for the Demand Response (A.11-03-002) program are included and have been forecast beyond the period reflected in the application.
[52] Ongoing costs for the Dynamic Pricing Program application (A.10-07-009) have been forecast beyond the period reflected in the application.

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7.2.1 PROJECT CLASSIFICATIONS

The cost compilation exercise involved examining the costs at the individual project level to ensure that a best cost estimate was collected. As discussed in its Smart Grid Strategy, projects were grouped into one of three classifications:

- Policy[53] – projects which serve to meet a specific regulatory mandate or policy; the driver for the project solution is the solution that is the least cost/best fit;
- Value – projects that are expected to provide overall benefits (e.g. reliability, economic, societal) to the utility and/or customer, including effective communications with customers, that justify the project investment; or
- Pilot – projects meant to explore new technologies or serve as a proof of concept or preliminary test case prior to the full deployment of a larger program.

7.2.2 CONCEPTUAL AND PROVISIONAL ESTIMATES

While SDG&E made every effort to ensure the validity of the costs, the final compiled figures are meant strictly to be used for informational purposes, and, consistent with D.10-06-047[54], are shown using conceptual estimates for the years 2011-2015 and provisional ranges for 2016-2020.

The project costs were collected from one or more sources, where both the labor and non-labor components of each project were examined to conduct estimates of capital expenditures and operations and maintenance (O&M) expenses.

[53] In this Smart Grid Deployment Plan, SDG&E categorizes investments as either necessary to achieve state and federal policy objectives or as warranted by the value the investment would create for customers. The term "Policy" as used in this Smart Grid Deployment Plan is distinct and distinguishable from the concept of "policy-driven" investments as used by FERC-jurisdictional transmission operators such as the CAISO; as used herein, the term "Policy" includes investments necessary to ensure reliability and safety as well as other investments necessary to comply with SDG&E's obligation to serve, regulatory compact with the state of California and ratepayers, and other federal and state-imposed utility obligations.

[54] D.10-06-047 at p.69

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- Costs for in flight projects or those scheduled to begin in 2011 were sourced from actual costs to date (where available) or estimated costs submitted in prior GRC or application filings.
- Costs for projects in SDG&E's TY2012 GRC filing or other active applications were sourced from those filings.

For projects expected to extend beyond the TY2012 GRC filing period; estimates were made to determine the costs through the year 2020, for the 2011 2015 'conceptual' timeframe and the 2016 2020 'provisional' timeframe.

Depending on the nature of the project scope, schedule, and technology maturity; individual projects may have a project level contingency factor applied, consistent in the Smart Grid Deployment Plan with assumptions made by the engineers and project managers developing those initiatives.

In order to account for the increasing level of uncertainty around project costs further out in time, additional factors were applied to project a provisional range of costs for the years 2016 2020. Because funding for projects previously authorized and proposed through the GRC and other applications are limited to prior years, these projects do not apply the provisional range factors – they apply only to incremental projects. These provisional range factors (as a percentage of the base forecasted cost) reflect what are believed to be a reasonable range above (+) and below ( ) the estimated cost projections.

SDG&E has presented provisional ranges for 2016 – 2020 where costs could be 25 percent higher than the base case or 25 percent lower. This is due to several reasons, including the following:

1. Forecasted projects costs may include technologies that have yet to be developed and/or do not have an established cost;

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2. Costs are a snapshot in time based on data available at the time of estimation and are subject to change due to unpredictable external factors (e.g. rate of inflation, health of economy, rate of technology progression); and

3. The level of uncertainty around future costs increases as a function of time; therefore, the further out the cost forecast, the higher the degree of inaccuracy.

Table 7-2 summarizes the provisional range factors used to determine the cost estimates in SDG&E's Smart Grid Deployment Plan.

Table 7-2: Summary of Provisional Range Factors

Provisional Range	Provisional Range Factors Costs 2016-2020
High	+25%
Low	-25%

7.2.3 COSTS PER CUSTOMER

Note: SDG&E investigated calculating costs per customer, but ultimately determined that this metric would be misleading so did not calculate or provide this assessment. This decision is based on a few key reasons:

1. The impacted customer base for each project varies depending on project scope. For example, the impacted user base for pilots can potentially be significantly smaller than that for projects affecting SDG&E's entire customer base. This precludes consistent comparison of cost per customer across projects if actual impacted customer count is used.

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2. For certain projects, the correct customer count to be used when calculating the cost per customer is not clear. For example, in the case of pilot projects, the actual customer count involved in the project may be disproportionately small compared to that of the full program. But to use the full customer base could be misleading since the pilot cost is smaller than the full program cost.
3. The cost per customer metric for certain projects may mask the fact that there may be substantial economies of scope or scale that can be obtained if the project is either expanded to a larger customer footprint or if other project/programs can leverage the current project (e.g. subsequent projects build off infrastructure established in current project)
4. As the Smart Grid platform evolves, alternative rate structures and other price signals are expected to emerge that will more accurately reflect the costs to provide utility services and avoid cross subsidization. Thus, the costs for some future investments may not be borne by all customers, and projecting these costs as impacting all customers may be inaccurate and potentially misleading.

7.3 COST ESTIMATES BY PROGRAM

Provided below is a summary of the Smart Grid Deployment Plan program costs, within each project classification. As a reminder, all cost estimates are nominal, reflect the best information available at this time and are not intended for use in new requests for funding. Please note subtotals in tables in section 7.3 may differ due to rounding.

All estimates are subject to change as new information becomes available.

7.3.1 CUSTOMER EMPOWERMENT

As discussed in the Roadmap, SDG&E's Customer Empowerment program will insure customers have the information and capabilities that they need in order to make energy management decisions that meet their values, needs and desires.

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The primary drivers of costs in the Customer Empowerment program, grouped by their classification are:

- Policy: The infrastructure required to deliver energy information and dynamic pricing signals to customers via HAN and other customer premise technologies; the technology needed to provide access to energy usage data via third-party information service providers; and customer outreach and education programs that will enable customers to maximize the value they realize from these capabilities.
- Value: Smart Meters and Smart Grid-related demand response programs.
- Pilot: Research, development and demonstration of customer end-use technologies; integration of distributed energy resources in a new residential community.

Customer Empowerment projects have significant state policy drivers, including SDG&E's AMI Settlement (D.07-04-043), D.09-12-046, SB 17, the *California Long Term Energy Efficiency Strategic Plan* and achievement of the energy efficiency and demand response goals per §454.5 and §454.55 of the California Public Utilities Code.

The conceptual and provisional cost estimates for SDG&E's Customer Empowerment program are as follows:

Table 7-3: Customer Empowerment Program Conceptual and Provisional Cost Estimates

	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	($2,676)	($83,836)	($10,481)	($10,481)	($1,700)	($100,215)	($131,912)	($131,912)	($330,819)	($330,819)
Value	($320,368)	($184,775)	($55,493)	($55,493)	($48,202)	($156,265)	($132,303)	($132,303)	($897,407)	($897,407)
Pilot	$0	($24,254)	$0	$0	$0	($8,169)	($6,789)	($11,315)	($39,212)	($43,739)
Subtotal	($323,044)	($292,865)	($65,974)	($65,974)	($49,902)	($264,650)	($271,004)	($275,530)	($1,267,439)	($1,271,965)

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For the corresponding benefits of the Customer Empowerment program, please see the Benefits Estimates section.

7.3.2 RENEWABLE GROWTH

SDG&E customers continue to install significant numbers of photovoltaic electric generation installations at residential and non residential premises. To support distribution level renewable generation, SDG&E plans investments that increase measurement, control and management capabilities.

Renewable Growth projects are largely driven by state policy requirements, particularly the California Solar Initiative, Self Generation Incentive Program (SGIP), Feed in Tariffs[55], and Net Energy Metering[56].

The primary drivers of costs in the Renewable Growth program, grouped by their classification are:

- Policy: Installation of phasor measurement units in substations and on distribution lines, sensors on distribution lines to develop dynamic conductor ratings, advanced energy storage, and expansion of SDG&E's SCADA system to include all distribution circuits and to install SCADA controls of distribution line capacitors.
- Pilot: Provide customers the opportunity to participate in a community solar program.

Renewable Growth projects have significant state policy drivers, including SB 17, the *Global Warming Solutions Act of 2006* (AB 32), the *California Long Term Energy*

[55] Summary available at http://www.cpuc.ca.gov/PUC/energy/Renewables/feedintariffssum.htm
[56] http://www.cpuc.ca.gov/PUC/energy/DistGen/netmetering.htm

This section contains conceptual and/or provisional cost estimates reflecting the best available information at the time of preparation of the Smart Grid Deployment Plan. These estimates are not intended for use in new requests for funding and are subject to change as new information becomes available.

Efficiency Strategic Plan and full solar photovoltaic deployment under the California Solar Initiative.

The conceptual and provisional cost estimates for SDG&E's Renewable Growth program are as follows:

Table 7-4: Renewable Growth Program Conceptual and Provisional Cost Estimates

	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	$0	($350,440)	($244,877)	($244,877)	$0	($31,878)	($33,101)	($33,101)	($660,297)	($660,297)
Value	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$0	$0	$0	$0	($3,036)	($2,094)	($3,489)	($5,130)	($6,525)
Subtotal	$0	($350,440)	($244,877)	($244,877)	$0	($34,914)	($35,195)	($36,591)	($665,426)	($666,822)

While the Renewable Growth projects are primarily driven by state policy requirements, there are significant benefits associated with the successful integration of renewable resources. Please refer to the Benefits Estimates section for a discussion on the societal and environmental benefits of renewable resources and details on the economic and reliability benefits associated with the Renewable Growth program.

7.3.3 ELECTRIC VEHICLE GROWTH

As discussed in the Roadmap, SDG&E is preparing for the growth in public adoption of Plug-in Electric Vehicles. In anticipation of this growth, SDG&E plans investments that will help promote the adoption of electric vehicles, educate the public on their usage with regard to the electric grid, and assist third parties involved with the electric vehicle ecosystem to ensure successful integrate of electric vehicles within the grid.

The policy drivers of the Electric Vehicle Growth program are the *Global Warming Solutions Act of 2006* (AB 32), California's Low Carbon Fuel Standard, and SB 17.

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The primary drivers of costs in the Electric Vehicle Growth program, grouped by their classification are:

- Policy: Installation of utility-owned public access charging facilities, installation of sensors and communication technology on distribution transformers and upgrades to the electric distribution system (i.e.: to primary distribution feeders) to accommodate PEVs.
- Pilot: Test the integration of stationary batteries with PEV charging as a step toward vehicle to grid (V2G) capabilities.

The conceptual and provisional cost estimates for SDG&E's Electric Vehicle Growth program are as follows:

Table 7-5: Electric Vehicle Growth Program Conceptual and Provisional Cost Estimates

	Capital				**O&M**				**Total Estimated Capital + O&M**	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	$0	($84,260)	($35,675)	($35,675)	$0	($19,293)	($32,419)	($32,419)	($171,646)	($171,646)
Value	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	($6,740)	($3,744)	($6,241)	$0	($936)	($1,191)	($1,985)	($12,611)	($15,901)
Subtotal	$0	($91,000)	($39,419)	($41,916)	$0	($20,228)	($33,610)	($34,404)	($184,257)	($187,547)

While the Electric Vehicle Growth projects are primarily driven by state policy requirements, there are significant benefits associated with the successful integration of PEVs. Please refer to the Benefits Estimates section for a discussion on the societal and environmental benefits of PEVs, and details on the economic and reliability benefits associated with the Electric Vehicle Growth program.

7.3.4 RELIABILITY AND SAFETY

As discussed in the Roadmap, SDG&E's goal is to maintain and/or improve reliability in the face of intermittent resources and electric vehicles through improving its

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measurement, control, protection, recording, and management and optimization abilities. Investments into the aforementioned abilities will supplement the existing technology investments made to improve the accuracy and speed of fault isolation and system restoration time.

Reliability and safety projects have significant state policy drivers, including SB 17, the *California Long Term Energy Efficiency Strategic Plan*, achievement of the energy efficiency and demand response goals per §454.5 and §454.55 of the *California Public Utilities Code*, achievement of the renewable portfolio standard and full solar photovoltaic deployment under the California Solar Initiative.

The primary drivers of costs in the Reliability and Safety program, grouped by their classification are:

- Policy: Implement advanced ground fault detection capabilities and advanced system planning tools, install pulse closing at additional points on the system as well as dynamic volt and VAR control capabilities, advanced energy storage to improve the localized reliability of the transmission system, conduct a renewable transmission planning study and convert manual line switches to remote SCADA operations.
- Value: Optimize advanced weather monitoring capabilities, implement wireless faulted circuit indicators, expand condition based maintenance (CBM) capabilities to selected 4 kV substation transformer banks, develop automated fault location for transmission events, implement a real time voltage stability program and develop a plan for the deployment of synchrophasor units integrating with Western Electricity Coordinating Council (WECC).
- Pilot: Develop a capability for arc detection in 230 kV underground vaults and overhead facilities and demonstrate composite core conductor installations.

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The conceptual and provisional cost estimates for SDG&E's Reliability and Safety program are as follows:

Table 7-6: Reliability and Safety Program Conceptual and Provisional Cost Estimates

	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	($3)	($315,878)	($129,411)	($215,684)	$0	($1,071)	$0	$0	($446,363)	($532,637)
Value	($625)	($51,608)	($9,275)	($15,039)	$0	($7,591)	($11,296)	($11,296)	($80,395)	($86,158)
Pilot	$0	($7,235)	$0	$0	$0	$0	$0	$0	($7,235)	($7,235)
Subtotal	($628)	($374,722)	($138,686)	($230,723)	$0	($8,662)	($11,296)	($11,296)	($533,994)	($626,031)

For the corresponding benefits of the Reliability and Safety program, please see the Benefits Estimates section.

7.3.5 SECURITY

As discussed in the Roadmap, the core tenets of SDG&E's security strategy are: adhere to security principles, broaden awareness, converge security governance and distribute security controls. SDG&E plans to support these tenets by investing into a portfolio of security projects.

The policy drivers of the Security program include SB 17 and the NERC Critical Infrastructure Protection (CIP) standards.

The primary drivers of costs in the Security program, grouped by their classification are:

- Policy: Select and implement a replacement to the current security incident and event management environment, improve the physical access controls and network monitoring of alarm systems at substations, improve internal and external security awareness collaboration and training, improve reporting of compliance metrics and risk reporting, improve the compliance control framework, improve security threat and vulnerability management, implement

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hardware and software solutions for improved vulnerability assessment and management, and develop SDG&E standards and guidelines for improving the security of SCADA technology.

The conceptual and provisional cost estimates for SDG&E's Security program are as follows:

Table 7-7: Security Program Conceptual and Provisional Cost Estimates

Project Class	Capital: Historical 2006-2010	Capital: Conceptual Estimates 2011-2015	Capital: Provisional Ranges 2016-2020 Low	Capital: Provisional Ranges 2016-2020 High	O&M: Historical 2006-2010	O&M: Conceptual Estimates 2011-2015	O&M: Provisional Ranges 2016-2020 Low	O&M: Provisional Ranges 2016-2020 High	Total Estimated Capital + O&M Low Range	Total Estimated Capital + O&M High Range
Policy	($1,789)	($118,179)	($10,518)	($10,518)	$0	($15,005)	($35,853)	($35,853)	($181,344)	($181,344)
Value	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	($1,789)	($118,179)	($10,518)	($10,518)	$0	($15,005)	($35,853)	($35,853)	($181,344)	($181,344)

For the corresponding benefits of the Security program, please see the Benefits Estimates section.

7.3.6 OPERATIONAL EFFICIENCY

As discussed in the Roadmap, SDG&E has designed an Operational Efficiency program to improve its ability to monitor, operate and optimize its system. To advance the overall efficiency of its grid operations, SDG&E will invest in numerous projects in its Operational Efficiency program.

The Operational Efficiency program is driven by customer value, rather than policy.

The primary drivers of costs in the Operational Efficiency program, grouped by their classification are:

- Value: Implement micropile technology, 3D modeling using state-of-the-art technology (PLS-CADD/LIDAR), a distributed energy resource management

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system (DERMS), condition based maintenance (CBM), infrared inspection technology at the distribution level, an enterprise geographic information system (GIS), outage management system / distribution management system (OMS/DMS), and implement an automated facilities rating system.

- Pilot: Evaluate 'Fire Scout' arc detection capabilities in back country areas, develop criteria for appropriate applications of dynamic line ratings on the transmission system and begin a pilot program with the CAISO to use dynamic transmission line ratings in dispatch.

The conceptual and provisional cost estimates for SDG&E's Operational Efficiency program are as follows:

Table 7 8: Operational Efficiency Conceptual and Provisional Cost Estimates

Project Class	Capital: Historical 2006 2010	Capital: Conceptual Estimates 2011 2015	Capital: Provisional Ranges 2016 2020 Low	Capital: Provisional Ranges 2016 2020 High	O&M: Historical 2006 2010	O&M: Conceptual Estimates 2011 2015	O&M: Provisional Ranges 2016 2020 Low	O&M: Provisional Ranges 2016 2020 High	Total Estimated Capital + O&M Low Range	Total Estimated Capital + O&M High Range
Policy	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Value	($84,313)	($183,156)	($24,337)	($39,635)	($20,076)	($38,835)	($28,874)	($33,648)	($379,592)	($399,664)
Pilot	$0	($653)	$0	$0	$0	($0)	$0	$0	($653)	($653)
Subtotal	($84,313)	($183,809)	($24,337)	($39,635)	($20,076)	($38,835)	($28,874)	($33,648)	($380,245)	($400,317)

For the corresponding benefits of the Operational Efficiency program, please see the Benefits Estimates section.

7.3.7 SMART GRID RESEARCH, DEVELOPMENT, AND DEMONSTRATION

As discussed in the Roadmap, many of the Smart Grid technologies are still the nascent stages of development, or are only concepts. SDG&E plans to promote the development and realization of such technologies by investing in projects to research and pilot these technologies.

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The primary drivers of costs in the Smart Grid Research, Development, and Demonstration program, grouped by their classification are:

- Pilot: Install a demonstration microgrid project, construct facility upgrades, purchase and install equipment to create a Smart Grid integrated test facility, work with the CAISO to aggregate battery technology in a flexible demand pilot and conduct other Smart Grid related RD&D projects.

The conceptual and provisional cost estimates for SDG&E's Research, Development, and Demonstration program are as follows:

Table 7-9: Research, Development and Demonstration Program Conceptual and Provisional Cost Estimates

	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Value	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	($2,749)	($62,631)	$0	$0	($1,680)	($20,145)	($30,691)	($30,691)	($117,896)	($117,896)
Subtotal	($2,749)	($62,631)	$0	$0	($1,680)	($20,145)	($30,691)	($30,691)	($117,896)	($117,896)

For the corresponding benefits of the Smart Grid Research, Development, and Demonstration program, please see the Benefits section.

7.3.8 INTEGRATED AND CROSS-CUTTING SYSTEMS

As discussed in the Roadmap, SDG&E recognizes the need to develop a robust enterprise-wide application platform to support its Smart Grid applications. This platform will enable new systems to co-exist with legacy systems as well as support the adoption and integration of increasingly complex data management and analytics as

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well as grid communications. To create this application platform, SDG&E will invest in numerous projects to advance its application and communications infrastructure.

The Integrated and Cross-cutting Systems program includes projects required to support a variety of policy-driven projects. Projects in this program area will provide infrastructure and application services to other systems that are required to implement policies such as the Renewable Portfolio Standard, and the California Solar Initiative.

The primary drivers of costs in the Integrated and Cross-cutting Systems program, grouped by their classification are:

- Policy: Deploy a precision time system and a next-generation application platform.
- Value: Build out a low-power wireless communication network, implement an improved data management and analytics capability commensurate with Smart Grid applications and deploy a next generation wireless communication network.

The conceptual and provisional cost estimates for SDG&E's Integrated and Cross-cutting Systems program are as follows:

Table 7-10: Integrated and Cross-cutting Systems Program Conceptual and Provisional Cost Estimates

	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	$0	($9,521)	($14,076)	($23,460)	$0	$0	($855)	($1,424)	($24,452)	($34,405)
Value	($7,874)	($48,990)	($20,201)	($33,668)	$0	($8,193)	($15,451)	($20,848)	($100,707)	($119,572)
Pilot	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	($7,874)	($58,511)	($34,276)	($57,127)	$0	($8,193)	($16,305)	($22,273)	($125,159)	($153,977)

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Costs shown in the Integrated and Cross cutting Systems program are net of a $28.1 million Smart Grid Investment Grant from the DOE[57], and a $1 million PIER grant from the CEC[58]. For the corresponding benefits of the Integrated and Cross cutting Systems program, please see the Benefits Estimates section.

7.3.9 WORKFORCE DEVELOPMENT

As discussed in the Roadmap, a key element in the success of the SDG&E Smart Grid Deployment Plan resides in the education and adoption of the program within its current and future workforce. SDG&E plans on investing in numerous human resource projects that will help deploy organizational structures as well as tools that maximize the utility's ability to manage and support the overall Smart Grid program.

State energy policies do not require utilities to have a Smart Grid Workforce Development program. However, to achieve state policy goals requires the implementation and maintenance of a complex integration of information and energy technologies, requiring a workforce with skills in these evolving areas. As Workforce Development projects are designed to meet that requirement, SDG&E has therefore classified them as "Policy."

The primary drivers of costs in the Workforce Development program, grouped by their classification are:

- Policy: Implement Smart Grid workforce management and improved organizational change management programs.

The conceptual and provisional cost estimates for SDG&E's Workforce Development program are as follows:

57 http://www.oe.energy.gov/recovery/1249.htm
58 http://www.energy.ca.gov/contracts/PON 08 011_FOA_NOPA.PDF

This section contains conceptual and/or provisional cost estimates reflecting the best available information at the time of preparation of the Smart Grid Deployment Plan. These estimates are not intended for use in new requests for funding and are subject to change as new information becomes available.

Table 7-11: Workforce Development Program Conceptual and Provisional Cost Estimates

	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
Project Class	**2006-2010**	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Policy	$0	$0	$0	$0	$0	($5,991)	($5,755)	($9,591)	($11,746)	($15,582)
Value	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$0	$0	$0	$0	$0	($5,991)	($5,755)	($9,591)	($11,746)	($15,582)

For the corresponding benefits of the Workforce Development program, please see the Benefits Estimates section.

7.4 CONCLUSION

SDG&E's Smart Grid Deployment Plan Cost Estimates are based on an assessment of historical, conceptual and provisional estimates and broken out by policy, customer value and/or pilot driven expenses for all of the planned projects in each deployment program area. The project costs include estimates of capital expenditures and operations and maintenance (O&M) expenses for the periods from 2011-2015 and 2016-2020 with a total estimated cost of approximately $3.5 - $3.6 billion. Corresponding benefits were also calculated and are presented in the Benefits Estimates section of the deployment plan.

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Section 8 – BENEFITS ESTIMATES

This section contains conceptual and/or provisional benefits estimates reflecting the best available information at the time of preparation of the Smart Grid Deployment Plan. These estimates are not intended for use in new requests for funding and are subject to change as new information becomes available.

8 BENEFITS ESTIMATES

8.1 INTRODUCTION

SDG&E and many of its key stakeholders believe that implementing strategic, intelligent Smart Grid investments will produce long term benefits for customers, market participants, the environment and society as a whole. This section presents SDG&E's approach to cataloging, measuring and monetizing the benefits associated with the Smart Grid in its service territory.

Determining future benefits from technology innovations is an inexact science. In 2006, SDG&E began working to determine the benefits from a full deployment of smart electric and gas meters throughout its service territory. Some of the benefits were apparent, such as saving the existing cost for manually reading meters. Others, such as how much demand response the ability to verify hourly interval usage would enable and the value of such an energy shift, were more difficult to project with an adequate level of certainty. Just as no one predicted there would be revenue from ringtone sales for cell phones, predicting other value streams for SDG&E's customers once the advanced metering infrastructure was deployed was an exercise limited by the utility's and customers' experiences and expectations at that moment in time. Those benefits are just starting to be realized now, with increasing benefits over time.

Although no single project in the currently envisioned SDG&E Smart Grid Deployment Plan is as large as Smart Meter, the challenges of benefit valuation for them are similar. Nascent and future technology, inability to predict customer adoption rates, a lack of models to value benefit, economic fluctuations and environmental policy all contribute to high levels of uncertainty in determining benefits. However, as was the case when telecommunications first went digital, the opportunities for further benefits in the future are limited only by our imagination.

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Societal benefits are the broadest category to calculate taking into account all benefits to all customers such as added efficiency, avoided generation costs including line losses, avoided transmission and distribution costs, reliability benefits to customers (determined through value of service studies) and environmental benefits.

The societal perspective is the one generally used to evaluate cost-effectiveness by focusing on efficiency in the production and delivery of energy and environmental quality improvement. This type of benefit evaluation is used to determine the cost effectiveness of energy efficiency programs; storage as it relates to the effective integration of more renewable resources, reduced air emissions from generation; and improved utilization of grid assets (i.e., generation and T&D equipment). In most cases, societal benefits are accompanied by an internalizable or partially internalizable benefit. For example, a utility customer uses storage to reduce on-peak energy use. An internalizable benefit accrues to that customer in the form of reduced cost; however, other societal benefits may accrue to utility customers as a group and/or to society as a whole. For example, reduced peak demand could lead to reduced air emissions and a general improvement of businesses' cost competitiveness.

Empowering customers and maintaining and/or improving the reliability of the grid in the face of great change are pressing drivers for Smart Grid projects. Both of these drivers are difficult to value. Empowering customers with choice and the tools required to support their new preferences and behaviors has greater value to participating customers than to those that do not exercise their choice or adopt new behaviors. Additionally, determining the number of customers that will engage and the level of their engagement is also challenging to forecast with precision. While SDG&E customers are currently leading the country in renewable energy adoption, the depth of market penetration over the long term is as yet undetermined. Moreover, it is also difficult to determine a precise value for new functionality, but certainly many customers expect that SDG&E will provide them with modern tools to interact with the

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company and their energy information. (Compare today's exercise in estimating Smart Grid deployment benefits to the challenge years ago when it was difficult to cost justify having a website or email.)

Grid reliability is an expectation of modern society. However, the grid was not designed for the challenges posed by modern society such as plug in electric vehicles, fuel cells, batteries, wind, and rooftop photovoltaics. Estimating adoption rates of these technologies and their impact to reliability is inexact, which requires careful consideration to quantify the benefits of enabling technologies. However, given the current high levels of reliability of today's grid and our customers' growing appetite for high quality energy, it is imperative that no loss in reliability or quality occur through the transition to a modern grid. However, absent the deployment of the Smart Grid, the reliability and quality of service will deteriorate as more and more electric vehicles and intermittent energy resources are deployed.

As with any other investment in technology, the benefits to SDG&E customers from Smart Grid investments will occur over time after this equipment and software has been installed and capabilities enabled. As with other investments, customers will not see immediate rate reductions as the investments are made, but rather will see increasing benefits, including cost savings and increased functionality, during the useful life of the investments. Another factor that cannot be overlooked is that without these investments, reliability and quality of electricity delivery will deteriorate. Simply maintaining reliability and quality of service will be a daunting challenge that SDG&E's customers expect it to meet. And, while some benefits directly reduce electric rates, such as the reduction in meter field personnel as a result of smart meter installation, many benefits are not directly reflected in lower rates, but instead provide enabling technology for the customer to take more active control over and participate in energy management.

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These 'soft' benefits take other forms such as reduced environmental impact through the safe and reliable integration of renewable generation, which Smart Grid investments ensure can be accomplished in the most cost effective way, impacting electric rates less than alternative methods. By enabling customers with energy management tools and greater information about energy consumption and associated cost, SDG&E customers will be able to manage their total electric bill and, more importantly for some, save personal time. In addition, leveraging digital and advanced technology to safely and reliably integrate new products, such as PEVs and PV systems, will directly benefit some customers through lower fuel costs, as well as the societal benefit of lessening environmental impact and achieving American energy independence at the lowest cost. While these societal and environmental benefits are not reflected in electric rates, these softer benefits provide significant value.

Consistent with D.10 06 047, SDG&E has developed benefit estimates to support the Smart Grid Deployment Plan. The total estimated benefits of Smart Grid deployment described in this plan for the San Diego region are between approximately $3.8 $7.1 billion, including societal and environmental benefits for the years 2011–2020 of approximately $760 million $1.9 billion.

Table 8 1 breaks these benefits down by their source:

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Table 8-1: Societal and Environmental Benefits 2011 – 2020

Societal / Environmental Benefit Source	Societal / Environmental Benefit Range	Estimated tons of CO_2e Avoided[59]
Estimated Avoided Emissions from Energy Reductions and Peak Load Shifting	\$12 MM - \$83 MM	~ 0.7 million
Estimated Avoided Emissions Reduction by Integrating Centralized Renewable Energy	\$85 MM - \$612 MM	~ 5.4 million
Estimated Avoided Emissions Reduction by Integrating Distributed Generation	\$10 MM - \$79 MM	~ 0.7 million
Estimated Avoided Net Emissions Reduction by Integrating Electric Vehicles	\$284 MM - \$550 MM[60]	~ 0.9 million

[59] NO_x, SO_x, and PM_{10} were also included in the monetized benefits estimates.
[60] A significant portion of these benefits are valued from avoided NO_x emissions (approximately 13,000 tons in the base case).

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In addition, the potential fuel savings benefits for customers adopting electric vehicles have been identified and estimated as follows:

Table 8-2: Potential Fuel Cost Savings for Adopting Electric Vehicles

Benefit Source	Benefit Range	Purchased Gallons of Gasoline Avoided
Estimated Avoided Fuel Cost by Integrating Electric Vehicles	$369 MM - $615 MM[61]	~ 207 million

These benefits will be explained in more detail in section 8.3.1.

In addition, estimates were calculated for economic and reliability benefits (which are primarily "soft" benefits) for 2006-2020, including their associated terminal value (post-2020), totaling approximately $3.0 billion - $5.1 billion.

Table 8-3 breaks down these benefits by investment category:

[61] Benefit range for avoided fuel cost is based on a low and high gasoline price derived from a forecast base case in report no. CEC-600-2011-001 prepared by the California Energy Commission titled "*Transportation Fuel Price Cases Demand Scenarios: Inputs and Methods for the 2011 Integrated Energy Policy Report*" dated February 2011 and available at http://www.energy.ca.gov/2011publications/CEC-600-2011-001/CEC-600-2011-001.PDF

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Table 8-3: Economic and Reliability Benefits 2006 – 2020

Investment Category	**Economic and Reliability Benefits 2006 – 2020 and Terminal Value**
Benefits identified related to previously authorized funding (Smart Meter[62], OpEx 20/20 Smart Grid projects)[63]	$1,378 MM
Benefits identified for projects in TY2012 General Rate Case[64]	$966 MM - $2,263 MM
Benefits identified for other active applications (Demand Response[65])	$29 MM - $139 MM
Estimated incremental investment benefits – CPUC	$253 MM - $491 MM
Estimated incremental investment benefits – FERC	$434 MM - $906 MM

These benefits will be explained in more detail in section 8.3.2.

[62] Smart Meter benefits were sourced from the original CPUC application (A.05-03-015).
[63] Benefits in the Smart Grid Deployment Plan may differ from any shown in SDG&E's TY2012 General Rate Case (A.10-12-005) because of differences in presentation of data.
[64] Ongoing benefits for projects in SDG&E's TY2012 General Rate Case (A.10-12-005) have been forecast beyond the period reflected in the application to the CPUC.
[65] Only the Smart Grid related benefits for the Demand Response program are included and have been forecast beyond the period reflected in the application to the CPUC (A.11-03-002).

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8.2 APPROACH

At the same time program costs were compiled, SDG&E also engaged in a comprehensive exercise to identify the corresponding benefits associated with its Smart Grid programs and projects. Wherever possible, SDG&E sought to not only identify the benefits, but also convert them into a monetary figure. In the interest of using a common set of benefit categories and methodologies that is unbiased, clear and easily understood, SDG&E chose to model its benefits framework after the benefits evaluation model that EPRI included in the report titled *"Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects"*.[66]

SDG&E's approach leveraged the benefit categories defined by EPRI as follows:

- Economic – includes avoided or reduced costs and investments due to improved system efficiency or asset utilization.
- Reliability – includes avoidance or reduction in electrical service interruptions and improvements in power quality and the reliability benefits to customers that are determined through value of service studies.
- Environmental – includes avoided or reduced emissions which impact climate change and adversely impact human health and various ecosystems.
- Other – includes improvements to cyber security, worker/customer safety, customer satisfaction as well as reduction in oil dependence.

[66] Final Report No. 1020342, *"Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects"*, dated January 2010 and available at http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=000000000001020342&RaiseDocType=Abstract_id

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Furthermore, SDG&E also augmented the EPRI categories with additional types of benefits identified through best practices and independent research. The resulting benefits framework served as the model used to identify all potential benefits associated to each of the SDG&E Smart Grid program areas. To help quantify the economic value of the Smart Grid benefits, efforts were made to translate identified benefits into a monetary value using factors provided by external sources where possible. The following table (8 4) provides a summary of the scope of benefits for each category as a guidance utilized during the identification, quantification and monetization process.

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Table 8-4: SDG&E Benefits Framework

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

The majority of projects within SDG&E's Smart Grid program areas were identified as providing either qualitative and/or quantitative benefits. Numerous factors dictated the type and extent of the benefits each Smart Grid project provided, as well as impacted the accuracy of the estimated benefits. Some of the factors include the following:

- Project type – Projects classified as Policy, which meet a regulatory mandate or policy, may have fewer benefits as they are implemented to meet specified requirements. Pilot projects may also have fewer benefits, as they are used to

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test the viability of new technologies whose exact benefits have yet to be fully understood.

- New or future technologies – Quantifying and estimating the monetary benefit of new, emerging or future technologies can be difficult given the lack of precedence and/or sufficient historical data.

- Qualitative benefits – Certain benefit types by nature are difficult to quantify, let alone convert into a monetary value (e.g. customer engagement, reduction of reliance on oil). Measuring such benefits may be difficult and/or there is no methodology to calculate the benefit's economic value or the methodology is overly complex or time consuming for deployment planning purposes.

- Inconsistencies of standards – Conversion factors are used to convert specific benefit units (e.g. MWh, MW) into monetary units. The conversion factor values themselves can vary greatly depending upon the source, where the inconsistency is attributed to varying calculation methodologies.

- Lack of historical adoption rate data – Certain technologies (e.g. PEVs) are new to the market. As a result, the magnitude and extent of their benefits realized are largely dependent upon their rates of adoption by consumers or their rates of penetration into the industry, both of which are difficult to predict.

Project benefits were calculated in a similar fashion as project costs, where each project was reviewed for benefits as defined within the benefits framework. Historical benefits were noted for in flight projects that have already realized benefits, and benefit projections were made for roadmap projects slated for the 'conceptual' 2011 2015 timeframe and/or the 'provisional' 2016 20 project time frame.

In order to account for the difficulty of estimating benefits, the benefit forecast for Smart Grid projects used a range of potential values for both conceptual and provisional

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estimates. These range values (as a percent of the base forecasted benefit) reflect what are believed to be a reasonable range above (+) and below (-) the estimated benefit projections.

Table 8-5 summarizes the conceptual and provisional contingency values incorporated into 2011-2020 benefit estimates to reflect the uncertainty associated with the methodology and a long timeframe. Supporting a conservative view towards attaining benefits, and the greater uncertainty in the longer term, the range is 50 percent below to 30 percent above for the years 2011 to 2015, and 75 percent below to 75 percent above forecasted benefits for the years 2016 to 2020.

Table 8-5: Conceptual and Provisional Range Factors for 2011-2020 Benefits Estimates

Range	Conceptual Range Factors Benefits 2011-2015	Provisional Range Factors Benefits 2016-2020
High	+30%	+75%
Low	-50%	-75%

In addition to historical and projected benefits, terminal values were also calculated. For each of the Smart Grid Deployment Plan projects, a terminal value accounts for ongoing net benefits that continue to accrue for the working life of capital assets beyond 2020. Thus, the terminal values complement the historical, projected conceptual and provisional timeframe benefits to provide a complete end view of the total anticipated benefits associated with a given Smart Grid project.

As discussed, all benefit estimates are presented in nominal dollars (i.e. not discounted) and reflect the best available information at this time. These estimates are not intended for use in new requests for funding and will change as new information becomes available.

8.3 SOCIETAL AND ENVIRONMENTAL BENEFITS

SDG&E collaborated with the Environmental Defense Fund (EDF), a leading environmental non-governmental organization (NGO), in its effort to quantify the societal and environmental benefits of its Smart Grid Deployment Plan, particularly those that are expected to result from the integration of centralized and distributed renewable resources and PEVs. While the economic and reliability benefits were estimated on a project-level basis, and summarized by program and classification in

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section 8.3.2, the calculation of the following societal and environmental benefits were calculated at the portfolio level, because these benefits are a result of multiple Smart Grid projects or programs and have significant dependencies on external factors. Consistent with our conservative approach towards benefits, terminal values are not reflected in estimates for societal benefits from these sources.

8.3.1 ESTIMATED AVOIDED EMISSIONS FROM ENERGY REDUCTIONS AND PEAK LOAD SHIFTING

SDG&E estimated the avoided emissions reduction benefits associated with reduced energy consumption, more efficient grid operations and peak load shifting enabled by new Smart Grid technologies and other investments, using the following assumptions and methods:

- Quantification of kWh of energy avoided or reduced and kWh of energy shift from peak to non peak periods.
- Conversion of kWh to emissions reduction based on tons of CO_2e, NO_x, SO_x and PM_{10}.
- Prices per ton of CO_2e, NO_x, SO_x and PM_{10} based on a report prepared by the California Environmental Protection Agency (Cal/EPA).[67]

As a result, a potential range of benefits in this category was estimated at $12 MM – $83 MM for the 2011 2020 time period.

[67] Prices based on report prepared by the California Environmental Protection Agency titled *Updated Economic Analysis of California's Climate Change Scoping Plan* dated March 24, 2010 and available at http://www.arb.ca.gov/cc/scopingplan/economics sp/updated analysis/updated_sp_analysis.pdf

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8.3.2 ESTIMATED AVOIDED EMISSIONS REDUCTION BY RELIABLY INTEGRATING CENTRALIZED RENEWABLE ENERGY

SDG&E estimated the avoided emissions reduction benefits associated with the integration of centralized renewable energy using the following assumptions and methods:

- Integration of centralized renewable energy up to 20 percent RPS can be done without Smart Grid, resulting in zero benefits. RPS increase from 20 percent to 33 percent requires Smart Grid investment.
- Prices per ton of CO_2e, NO_x, SO_x and PM_{10} based on a report prepared by the Cal/EPA.[68]

As a result, a potential range of benefits in this category was estimated at $85 MM – $612 MM for the 2011 – 2020 time period.

8.3.3 ESTIMATED AVOIDED EMISSIONS REDUCTION BY INTEGRATING DISTRIBUTED GENERATION

SDG&E estimated the avoided emissions reduction benefits associated with the integration of distributed renewable energy generation using the following assumptions and methods:

- Conversion of kWh to emissions reduction based on tons of CO_2e, NO_x, SO_x and PM_{10}.
- Prices per ton of CO_2e, NO_x, SO_x and PM_{10} based on a report prepared by the Cal/EPA.[69]

[68] Ibid.
[69] Ibid.

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- Applied time differentiated emission production factors.

As a result, a potential range of benefits in this category was estimated at $10 MM – $79 MM for the 2011 – 2020 time period.

8.3.4 ESTIMATED AVOIDED NET EMISSIONS REDUCTION BY INTEGRATING ELECTRIC VEHICLES

SDG&E estimated the avoided emissions reduction benefits associated with the integration of PEVs using the following assumptions and methods:

- Net emissions reductions calculated based on the differential of consumption of electricity to supply energy needs versus gasoline consumption.
- MPG standards for California market based on report prepared by California Air Resources Board.[70]
- Conversion of kWh to emissions reduction based on tons of CO_2e, NO_x, SO_x and PM_{10}.
- Prices per ton of CO_2e, NO_x, SO_x and PM_{10} based on a report prepared by the Cal/EPA.[71]

As a result, a potential range of benefits in this category was estimated at $284 MM – $550 MM for the 2011 – 2020 time period.

[70] MPG standards based on report prepared by the California Air Resources Board titled *Comparison of Greenhouse Gas Reduction Under CAFE Standards and ARB Regulations Adopted Pursuant to AB1493* dated January 2, 2008 and available at http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated_sp_analysis.pdf

[71] Prices based on report prepared by the California Environmental Protection Agency titled *Updated Economic Analysis of California's Climate Change Scoping Plan* dated March 24, 2010 and available at http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated_sp_analysis.pdf

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8.3.5 ESTIMATED AVOIDED FUEL COST BY INTEGRATING ELECTRIC VEHICLES

SDG&E estimated the avoided fuel cost benefits associated with the integration of PEVs using the following assumptions and methods:

- Avoided fuel cost calculated based on the differential of cost of gasoline versus electricity.
- Forecast of gasoline prices based on a report prepared by the California Energy Commission (CEC).[72]
- Forecast of electricity prices based on a report prepared by the CEC.[73]

As a result, a potential range of benefits in this category was estimated at $369 MM – $615 MM for the 2011 – 2020 time period.

8.4 ECONOMIC AND RELIABILITY BENEFITS ESTIMATES BY PROGRAM AREA

Provided below is a summary of the monetized economic and reliability Smart Grid benefits, grouped by program area and project classification. Please note subtotals in tables in section 8.4 may differ due to rounding.

8.4.1 CUSTOMER EMPOWERMENT

As discussed in the Roadmap (section 6.0 of this plan), SDG&E's Customer Empowerment program will ensure customers have the information and capabilities

[72] Forecast of gasoline prices based on report no. CEC-600-2011-001 prepared by the California Energy Commission titled *"Transportation Fuel Price Cases Demand Scenarios: Inputs and Methods for the 2011 Integrated Energy Policy Report"* dated February 2011 and available at http://www.energy.ca.gov/2011publications/CEC-600-2011-001/CEC-600-2011-001.PDF

[73] Forecast of electricity prices based on report no. CEC-200-2009-012-CMF prepared by the California Energy Commission titled *"California Energy Demand 2010-2020 Adopted Forecast"* dated December 2009 and available at http://www.energy.ca.gov/2009publications/CEC-200-2009-012/CEC-200-2009-012-CMF.PDF

This section contains conceptual and/or provisional benefits estimates reflecting the best available information at the time of preparation of the Smart Grid Deployment Plan. These estimates are not intended for use in new requests for funding and are subject to change as new information becomes available.

that they need in order to make energy management decisions that meet with their values, needs and desires.

The Smart Meter project drives the large majority of benefits under the Customer Empowerment program. The deployment of smart meters has and will continue to provide substantial cost savings by reducing distribution operational costs, curtailing energy theft, and improving demand response efficiency. The conceptual and provisional benefit estimates for SDG&E's Customer Empowerment program are as follows:

Table 8-6: Customer Empowerment Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$3,898	$10,134	$12,445	$87,114	$16,342	$97,247	$10,833
Value	$69,491	$379,480	$402,395	$337,296	$424,888	$786,266	$896,775	$365,447
Pilot	$0	$2,195	$5,706	$1,510	$10,573	$3,705	$16,280	$7,544
Subtotal	$69,491	$385,572	$418,235	$351,251	$522,575	$806,314	$1,010,301	$383,824

For the corresponding costs of the Customer Empowerment program, please see the Cost Estimates section.

8.4.2 RENEWABLE GROWTH

As discussed in the Roadmap, SDG&E customers are continuing to install significant numbers of PV electric generation systems at residential and non-residential premises. To support distribution-level renewable generation, SDG&E plans investments that increase measurement, control, and management capabilities.

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Investments to improve SCADA technologies and expand their deployment will drive the majority of benefits by increasing the overall reliability of energy delivery to customers.

Other projects generate significant benefits by introducing dynamic line ratings and augmenting phasor measurement capabilities to defer capital infrastructure expenses and reduce operational expenses. The conceptual and provisional benefits estimates for SDG&E's Renewable Growth program are as follows:

Table 8-7: Renewable Growth Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$59,431	$154,520	$64,243	$449,701	$123,674	$604,221	$321,374
Value	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$0	$59,431	$154,520	$64,243	$449,701	$123,674	$604,221	$321,374

For the corresponding costs of the Renewable Growth program, please see the Cost Estimates section.

8.4.3 ELECTRIC VEHICLE GROWTH

As discussed in the Roadmap, SDG&E is preparing for the increased public adoption of plug-in electric vehicles. In anticipation of this growth, SDG&E plans investments that will help promote the adoption of electric vehicles, educate the public on their usage with regard to the electric grid, and assist parties involved with the electric vehicle ecosystem to ensure the successful integration of electric vehicles within the grid.

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Investments that install smart transformers are expected to enable cost savings by reducing equipment failures associated with the increase in load from electric vehicles. Other infrastructure and technology investments to support electric vehicle adoption will improve the efficiency of electric distribution and reduce usage and reliance on ancillary services. The conceptual and provisional benefits estimates for SDG&E's Electric Vehicle Growth program are as follows:

Table 8-8: Electric Vehicle Growth Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$14,343	$37,293	$24,051	$168,355	$38,394	$205,648	$107,978
Value	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$0	$14,343	$37,293	$24,051	$168,355	$38,394	$205,648	$107,978

For the corresponding costs of the Electric Vehicle Growth program, please see the Cost Estimates section.

8.4.4 RELIABILITY AND SAFETY

As discussed in the Roadmap, SDG&E's goal is to maintain and/or improve reliability in the face of intermittent resources and electric vehicles through improving its measurement, control, protection, recording, and management and optimization abilities. Investments into the aforementioned abilities will supplement the existing technology investments made to improve accuracy and speed of fault isolation and system restoration time.

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Under the Reliability and Safety program, strategic investments in technologies to help balance and regulate voltage on transformers will result in a notable cost avoidance benefit by precluding the need to construct a new power generation plant altogether. Other projects to improve electric reliability, such as improvements to synchrophasors, are expected to reduce costly major grid outages.

The conceptual and provisional benefit estimates for SDG&E's Reliability and Safety program are as follows:

Table 8-9: Reliability and Safety Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$243,460	$632,995	$6,144	$43,011	$249,604	$676,006	$120,239
Value	$0	$47,849	$124,408	$45,657	$319,596	$93,506	$444,004	$202,918
Pilot	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$0	$291,309	$757,403	$51,801	$362,607	$343,110	$1,120,010	$323,157

For the corresponding costs of the Reliability and Safety program, please see the Cost Estimates section.

8.4.5 SECURITY

As discussed in the Roadmap, the core tenets of SDG&E's security strategy are: adherence to security principles, broaden awareness, converge security governance, and distribute security controls. SDG&E plans to support these tenets by investing into a portfolio of security projects.

Collectively, SDG&E's investments in security-related initiatives are expected to provide significant benefits by minimizing disruptions in power and avoiding data breaches. This

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figure excludes the invaluable societal benefits arising from improved security measures. Significant societal benefits include maintaining customer data privacy and enforcing national security by preventing foreign cyber attacks on the electrical grid.

The conceptual and provisional benefit estimates for SDG&E's Security program are as follows:

Table 8-10: Security Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$41,176	$107,057	$22,824	$159,766	$64,000	$266,823	$7,938
Value	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$0	$41,176	$107,057	$22,824	$159,766	$64,000	$266,823	$7,938

For the corresponding costs of the Security program, please see the Cost Estimates section.

8.4.6 OPERATIONAL EFFICIENCY

As discussed in the Roadmap, SDG&E has designed an Operational Efficiency program to improve its ability to monitor, operate, and optimize its system. To advance the overall efficiency of its grid operations, SDG&E will invest in a number of projects in its Operational Efficiency program.

Technology investments, such as Light Detection and Ranging (LIDAR) and Geographic Information Systems (GIS), will improve energy reliability through a combination of improving the ability to take pre-emptive measures to avoid faults, or increasing the efficiency of electric restoration after an outage has occurred. Such technologies will

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also avoid significant capital expenses by reducing costly equipment repair or replacement costs and extending the life of existing assets.

The conceptual and provisional benefit estimates for SDG&E's Operational Efficiency program are as follows:

Table 8-11: Operational Efficiency Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$0	$0	$0	$0	$0	$0	$0
Value	$48,462	$97,235	$128,094	$80,524	$182,313	$226,220	$358,869	$81,313
Pilot	$0	$15	$38	$13	$92	$28	$129	$120
Subtotal	$48,462	$97,249	$128,132	$80,537	$182,405	$226,248	$358,998	$81,433

For the corresponding costs of the Operational Efficiency program, please see the Cost Estimates section.

8.4.7 SMART GRID RESEARCH, DEVELOPMENT, AND DEMONSTRATION

As discussed in the Roadmap, many of the Smart Grid technologies are still in the nascent stages of development or are only concepts. SDG&E plans to promote the development and realization of such technologies by investing in projects to research and pilot these technologies.

Smart Grid RD&D projects, by design, are not meant by themselves to return significant financial benefits. Instead, their purpose is to explore new technologies and test ideas which in turn can be leveraged in the future to generate significant economic and societal value. As a result, the Smart Grid RD&D projects were not a key source of benefits. The conceptual and provisional benefit estimates for SDG&E's Smart Grid Research, Development, and Demonstration program are as follows:

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Table 8-12: Research, Development and Demonstration Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$0	$0	$0	$0	$0	$0	$0
Value	$0	$0	$0	$0	$0	$0	$0	$0
Pilot	$0	$6,799	$17,677	$1,719	$12,035	$8,518	$29,712	$7,156
Subtotal	$0	$6,799	$17,677	$1,719	$12,035	$8,518	$29,712	$7,156

Benefits shown in the Smart Grid Research, Development and Demonstration program include approximately $7.5 million awarded through a Renewable and Distributed Systems Integration (RDSI) grant from the DOE[74], and approximately $2.8 million awarded through a Public Interest Energy Research (PIER) grant from the CEC[75].

For the corresponding costs of the Smart Grid RD&D program, please see the Cost Estimates section.

8.4.8 INTEGRATED AND CROSS-CUTTING SYSTEMS

As discussed in the Roadmap, SDG&E recognizes the need to develop a robust enterprise-wide application platform to support its Smart Grid applications. This platform will enable new systems to co-exist with legacy systems as well as support the adoption and integration of increasingly complex data management and analytics as

[74] http://events.energetics.com/rdsi2008/pdfs/presentations/wednesday-part1/Merrill%20Eric%20RDSI_Review_102908.pdf
[75] http://www.energy.ca.gov/2010publications/CEC-500-2010-018/CEC-500-2010-018-CMF.PDF

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well as grid communications. To create this application platform, SDG&E will invest in numerous projects to advance its application and communications infrastructure.

For example, the use of phasor measurement information both for real-time grid monitoring and operational control requires the existence of a precision time service to ensure all data streams are correlated and assessed correctly. Likewise, new communications systems are required to bring all these new data "home" to achieve Smart Grid operations. The deployment of a next generation, high-speed communications network will provide numerous system efficiencies. These efficiencies in turn enable notable costs savings by reducing the effort and investments needed to operate and maintain the grid, lowering capital expenditures, as well as avoiding other more costly capital investments needed to support a high-speed enterprise communications platform.

The conceptual and provisional benefit estimates for SDG&E's Integrated and Cross-cutting Systems program are as follows:

Table 8-13: Integrated and Cross-cutting Systems Program Conceptual and Provisional Benefits Estimates

	Benefits					Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015		Provisional Ranges 2016-2020		2006-2020 Total		Beyond 2020
Project Class	**2006-2010**	**Low**	**High**	**Low**	**High**	**Low Range**	**High Range**	**Terminal Value**
Policy	$0	$0	$0	$0	$0	$0	$0	$0
Value	$0	$31,068	$80,776	$13,423	$93,961	$44,491	$174,737	$173,059
Pilot	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$0	$31,068	$80,776	$13,423	$93,961	$44,491	$174,737	$173,059

For the corresponding costs of the Integrated and Cross-cutting Systems program, please see the Cost Estimates section.

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8.4.9 WORKFORCE DEVELOPMENT

As discussed in the Roadmap, a key element in the success of the SDG&E Smart Grid Deployment Plan resides in the education and adoption of the plan within its current and future workforce. SDG&E plans on investing in several human resource projects that will help deploy organizational structures as well as tools that maximize SDG&E's ability to manage and support its Smart Grid program. Through its collaborative vision and ongoing stakeholder outreach to regional workforce development, academic and technology organizations, SDG&E will help facilitate the development of a broader Smart Grid savvy workforce in its service territory, including local businesses and diverse business enterprises (DBEs).

Similar to the Security program, the monetary benefit of the Workforce Development program is difficult to quantify since its real value is more qualitative in nature. Projects in the Workforce Development program are integral to educating present and future utility personnel on the benefits of Smart Grid technology, maximizing the successful adoption and deployment of the program, and realizing the program's full potential and associated benefits.

Workforce development is critical to the success of Smart Grid implementation. While there are no specific, individual, cost reductions or quantifiable benefits directly tied to the Workforce Development program activities, workforce development is a critical enabler of each Smart Grid initiative.

For the corresponding costs of the Workforce Development program, please see the Cost Estimates section.

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8.5 CONCLUSION

SDG&E's Benefits Estimates are modeled upon the benefits framework developed by EPRI to guide calculations of economic, reliability, environmental, security, safety and customer satisfaction outcomes; augmented with SDG&E's own best practices and additional industry research; and enhanced by the utility's collaboration with the EDF which helped quantify the societal and environmental benefits of its Smart Grid Deployment Plan.

SDG&E's conceptual and provisional benefits estimates are broken out by policy, customer value or pilot driven benefits for all of the planned projects in each of its nine deployment program areas.

The nascent nature of current and future Smart Grid technology, the inability to predict customer adoption rates, the lack of models to value benefits, and the impact of economic fluctuations and changing environmental policy make it difficult to precisely estimate the plan's future benefits. However, through a calculation of both societal and environmental benefits as well as economic and reliability benefits, SDG&E has identified a range of total estimated benefits to its service territory from its Smart Grid Deployment Plan of $3.8 to $7.1 billion.

This section contains conceptual and/or provisional benefits estimates reflecting the best available information at the time of preparation of the Smart Grid Deployment Plan. These estimates are not intended for use in new requests for funding and are subject to change as new information becomes available.

Section 9 – METRICS

9 METRICS

9.1 INTRODUCTION

During the second half of 2010, SDG&E collaborated with the other California Investor Owned Utilities (IOUs) and the Environmental Defense Fund to define consensus metrics to be included with the IOUs' Smart Grid Deployment Plans.

D.10-06-047 found that "Smart Grid Deployment Plans should include metrics that permit the assessment of progress, but the adoption of specific metrics requires additional work by parties. A subsequent decision later this year will endorse specific metrics for inclusion in Smart Grid Deployment Plans and other reports."[76]

While that decision has not yet been issued by the Commission, it is SDG&E's assumption that the consensus metrics identified in the draft *Report on Consensus and Non-Consensus Smart Grid Metrics*[77] filed with the Commission on December 29, 2010, will be included in the Commission's future decision regarding metrics and have, therefore, included those metrics in this Smart Grid Deployment Plan.

SDG&E will continue working with the Commission, the Environmental Defense Fund, the other California IOUs, interested parties and key stakeholders in the development of additional Smart Grid-related metrics in additional topic areas such as environmental and cyber security.

[76] D.10-06-047 at p. 5
[77] The Report, which includes specific definitions of each metric herein, is http://docs.cpuc.ca.gov/efile/RULINGS/129001.pdf

9.2 SMART GRID-RELATED CONSENSUS METRICS

The Smart Grid-related metrics included in this plan are based on the consensus metrics proposed in the draft *Report on Consensus and Non-Consensus Smart Grid Metrics*. The objective of these consensus metrics is twofold.

First, the consensus metrics will be an initial source of information available to the Commission for use in meeting its obligation under Section 8367 of the Public Utilities Code to provide an initial annual report to the California Legislature about Smart Grid deployments in California.

Second, the consensus metrics will provide a useful initial guidance in measuring Smart Grid progress. These metrics should be reviewed on a regular basis to address their applicability and effectiveness as a measure of SDG&E's Smart Grid Deployment Plan. The Smart Grid consensus metrics included 19 metrics grouped into four topics: Customer/AMI (nine consensus metrics), Plug-In Electric Vehicle (one consensus metric), Energy Storage (one consensus metric) and Grid Operations (eight consensus metrics). Each Smart Grid consensus metric supports a policy goal as recommended by the Commission.

9.2.1 CUSTOMER/AMI METRICS

Metric 1 The number of advanced meter malfunctions where service is disrupted.

Purpose/Policy Goal Supported: To measure improvements in grid reliability at the customer level and to measure the ability of the Smart Grid to avoid and identify outages, §8360(a).

Table 9-1: Customer/AMI Metric 1

Number of SDG&E Advanced Meter Malfunctions Where Service is Disrupted		
Metric	**Units**	**2010 Value**
Number of meters	Meters	37

Metric 2 – Load impact from Smart Grid enabled, utility administered demand response (DR) programs (in total and by customer class, to the extent available)

Purpose/Policy Goal Supported: To measure the achievement of energy efficiency and demand response goals as listed in §454.5 and §454.55 – §8366(d)

Table 9-2: Customer/AMI Metric 2

Load Impacts of SDG&E Administered DR Programs[78]		
Metric	**Units**	**2010 Value**
Residential	MW	14
C&I < 500 kW	MW	30
C&I > 500 kW	MW	0
Other	MW	6
Total by Customer Class		**50**

[78] As defined in the December 29, 2010 ALJ Ruling entitled "Administrative Law Judge's Ruling Seeking Comments on Proposed Interim Metrics to Measure Progress by PG&E, SCE and SDG&E in Implementing a Smart Grid", this includes PTR, CPP, TOU, A/C Cycling.

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

Purpose/Policy Goal Supported: The Smart Grid seeks to promote the use of demand response and is tied to §8366(d) and §8360(d).

Table 9–3: Customer/AMI Metric 3

Percentage of SDG&E DR enabled by AutoDR		
Metric	**Units**	**2010 Value**
Percentage of demand response enabled by AutoDR – Capacity Bidding Program (CBP)	%	6%
Percentage of demand response enabled by AutoDR – Critical Peak Pricing (CPP) program	%	4%

Metric 4 – The number of utility-owned advanced meters with consumer devices with Home Area Network (HAN) or comparable consumer energy monitoring or measurement devices registered with the utility by customer class, California Alternative Rates for Energy (CARE), and climate zone, to extent available.

Purpose/Policy Goal Supported: Some of the benefits of the Smart Grid are linked to customer usage of its capabilities, and this metric seeks to measure customer use of Smart Grid and advanced meter capabilities. Tied to §8360(f), (h), (i) and §8366(a).

Table 9-4: Customer/AMI Metric 4

SDG&E Owned Advanced Meters With HAN / Comparable Devices Registered		
Metric	**Units**	**2010 Value**
Residential	# meters	0
C&I < 500 kW	# meters	0
C&I > 500 kW	# meters	0
Other	# meters	0
Total by Customer Class		**0**
CARE	# meters	0
Non-CARE	# meters	0

SDG&E Owned Advanced Meters With HAN / Comparable Devices Registered		
Total by CARE/non CARE		**0**
Coastal	# meters	0
Inland	# meters	0
Mountain	# meters	0
Desert	# meters	0
Total by Climate Zone		**0**

Metric 5 – Number of customers that are on a time-variant or dynamic pricing tariff (by customer class, CARE, and climate zone, to extent available.

Purpose/Policy Goal Supported: Some of the benefits of the Smart Grid are linked to customer usage of its capabilities, and this metric seeks to measure customer use of Smart Grid and advanced meter capabilities, §8360(f) (h) (i) and §8366(a).

Table 9-5: Customer/AMI Metric 5

Number of SDG&E Customers on a Time Variant or Dynamic Tariff[79]		
Metric	**Units**	**2010 Value**
Residential	# customers	1,886
C&I < 500 kW	# customers	23,495
C&I > 500 kW	# customers	688
Other	# customers	19
Total by Customer Class		**26,088**
CARE	# customers	0
Non-CARE	# customers	26,088

[79] As defined in the December 29, 2010 ALJ Ruling entitled "Administrative Law Judge's Ruling Seeking Comments on Proposed Interim Metrics to Measure Progress by PG&E, SCE and SDG&E in Implementing a Smart Grid", this includes CPP, TOU, RTP, and customers enrolled in PTR notifications and separately metered PEV rates.

Number of SDG&E Customers on a Time Variant or Dynamic Tariff[79]		
Total by CARE/non CARE		**26,088**
Coastal	# customers	16,373
Inland	# customers	9,335
Mountain	# customers	315
Desert	# customers	65
Total by Climate Zone		**26,088**

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

Purpose/Policy Goal Supported: Linked to cost – effectiveness and provision of information to customers, §8360(a)(e)(h).

Table 9 ‑6: Customer/AMI Metric 6

Number of Escalated SDG&E Customer Complaints Related to: 1 – Accuracy, Functioning or Installation of Advanced Meters, or 2 – Functioning of an SDG&E Administered Home Area Network With Registered Devices		
Metric	**Units**	**2010 Value**
Number of customer complaints	Complaints	2,123

Metric 7 – Number of utility-owned advanced meters replaced annually before the end of their expected useful life.

Purpose/Policy Goal Supported: Linked to cost-effectiveness and provision of information to customers §8360(a), (e), (h).

Table 9-7: Customer/AMI Metric 7

Number of SDG&E Owned Advanced Meters Replaced in 2010 Before the End of Their Expected Useful Life		
Metric	**Units**	**2010 Value**
# meters	meters	27,472[80]

[80] All meters counted in metric #7 were replaced under warranty by their manufacturer. Advanced meters owned by SDG&E have a 5-year warranty that covers the parts and labor costs of replacement.

Metric 8 – Number of advanced meter field tests performed at the request of customer pursuant to utility tariffs providing for such field tests

Purpose/Policy Goal Supported: Linked to cost-effectiveness and provision of information to customers. §8360(a) (e) (h).

Table 9-8: Customer/AMI Metric 8

Number of Advanced Meter Field Tests Performed at the Request of SDG&E Customers		
Metric	**Units**	**2010 Value**
Number of meters	Meters	329

Metric 9 - Number and percentage of customers with advanced meters using a utility-administered internet or web-based portal to access energy usage information or to enroll in utility energy information programs.

Purpose/Policy Goal Supported: Linked to cost-effectiveness and provision of information to customers, §8360(a) (e) (h).

Table 9-9: Customer/AMI Metric 9

Number / Percentage of SDG&E Customers With Advanced Meters Using SDG&E's Web-Based Portal to Access Energy Usage Information or to Enroll in SDG&E Energy Information Programs		
Metric	**Units**	**2010 Value**
Number of customers	Customers	0
Percentage of customers	%	0%

9.2.2 PLUG-IN ELECTRIC VEHICLES

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

Purpose/Policy Goal Supported: Provides a view into the usage of plug in electric vehicles; consistent with §8362(g).

Table 9-10: Plug-in Electric Vehicles Metric 1

Number of SDG&E Customers Enrolled in a Time Variant Electric Vehicle Tariff		
Metric	**Units**	**2010 Value**
Number of customers	Customers	30

9.2.3 ENERGY STORAGE

Metric 1 – MW and MWh of grid connected energy storage interconnected at the transmission and distribution system level[81]

Purpose/Policy Goal Supported: Determine the number of units providing storage services to the network and their capability; §8362(g)

Table 9-11: Energy Storage Metric 1

SDG&E – MW and MWh of Grid Connected Energy Storage		
Metric	**Units**	**2010 Value**
Grid connected energy storage	MW	0
Grid connected energy storage	MWh	0

[81] Because storage systems are not 100 percent efficient and there are efficiency differences between different technologies, as storage comes online SDG&E will be measuring both the energy put into storage, and the energy taken out of storage, in order to understand the efficiencies of the various technologies.

9.2.4 GRID OPERATIONS

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), shown by Major Events Included and Excluded

Purpose/Policy Goal Supported: Meet reporting requirements of §8366(e) and the policy goal of §8360(a)

Table 9-12: Grid Operations Metric 1

SDG&E System Average Interruption Duration Index (SAIDI) Major Events Included / Major Events Excluded		
Metric	**Units**	**2010 Value**
SAIDI – Major Events Included	SAIDI index	89.77
SAIDI – Major Events Excluded	SAIDI index	67.74

SB_GT&S_0376226

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), shown by Major Events Included and Excluded.

Purpose/Policy Goal Supported: Meet reporting requirements of §8366(e) and the policy goal of §8360(a).

Table 9-13: Grid Operations Metric 2

SDG&E System Average Interruption Frequency Index (SAIFI) Major Events Included / Major Events Excluded		
Metric	**Units**	**2010 Value**
SAIFI – Major Events Included	SAIFI index	0.863
SAIFI – Major Events Excluded	SAIFI index	0.543

Metric 3 – The number of momentary outages per customer system-wide per year as reflected by the Momentary Average Interruption Frequency Index (MAIFI), shown by Major Events Included and Excluded.

Purpose/Policy Goal Supported: Meet reporting requirements of §8366(e) and the policy goal of §8360(a).

Table 9-14: Grid Operations Metric 3

SDG&E Momentary Average Interruption Frequency Index (MAIFI) Major Events Included / Major Events Excluded		
Metric	**Units**	**2010 Value**
MAIFI – Major Events Included	MAIFI index	0.507
MAIFI – Major Events Excluded	MAIFI index	0.428

Metric 4: Number of customers per year and circuits per year experiencing greater than 12 sustained outages

Purpose/Policy Goal Supported: Meet reporting requirements of §8366(e) and the policy goal of §8360(a)

Table 9-15: Grid Operations Metric 4

SDG&E Customers / Circuits Experiencing >12 Sustained Outages		
Metric	**Units**	**2010 Value**
Number of customers	Customers	15
Number of circuits	Circuits	8

Metric 5 – System load factor and load factor by customer class.

Purpose/Policy Goal Supported: Meet reporting requirements of §8366(e) and the policy goal of §8360(a).

Table 9-16: Grid Operations Metric 5

SDG&E Load Factors		
Metric	**Units**	**2010 Value**
System Load Factor	% load	51%
Load Factor – Residential	% load	46%
Load Factor – C&I < 500 kW	% load	46%
Load Factor – C&I > 500 kW	% load	77%
Load Factor – Other[82]	% load	53%

[82] Other is composed of small agriculture

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

Purpose/Policy Goal Supported: State policy seeks to promote both distributed generation and the use of renewables. The ability to integrate these resources is an expected benefit of the Smart Grid. This is tied to §8366(b) renewable and §8360(c) distributed generation.

Table 9 17: Grid Operations Metric 6

Number and Total Nameplate Capacity of SDG&E Customer Owned or Operated Grid Connected Distributed Generation Facilities		
Metric	**Units**	**2010 Value**
Number of distributed generation facilities (solar)	Distributed generation facilities (solar)	11,770
Number of distributed generation facilities (non solar)	Distributed generation facilities (non solar)	93
Total number of distributed generation facilities (solar and non solar)		**11,863**
Capacity of Units (solar)	MW (solar)	90.4
Capacity of Units (non solar)	MW (non solar)	249.6
Total capacity of distributed generation facilities (solar and non solar)	***MW***	**340**

Metric 7 - Total annual electricity deliveries from customer-owned or operated, utility grid-connected distributed generation facilities.

Purpose/Policy Goal Supported: State policy seeks to promote both distributed generation and the use of renewables. The ability to integrate these resources is an expected benefit of the Smart Grid. This is tied to §8366 (b) renewable and §8360(c) distributed generation.

Table 9-18: Grid Operations Metric 7

Total Annual Electricity Deliveries from SDG&E Customer-Owned or Operated Grid-Connected Distributed Generation Facilities		
Metric	**Units**	**2010 Value**
Total annual electricity deliveries from customer-owned DG	GWh	860

Metric 8 – Number and percentage of distribution circuits equipped with automation or control equipment, including Supervisory Control and Data Acquisition (SCADA) systems.

Purpose/Policy Goal Supported: Measure the extension/development of the Smart Grid.

Table 9-19: Grid Operations Metric 8

Number & Percentage of SDG&E Distribution Circuits Equipped with Automation or Control Equipment Including SCADA		
Metric	**Units**	**2010 Value**
Number of circuits	Circuits	725
Percentage of circuits	%	73%

9.3 ADDITIONAL SMART GRID RELATED METRICS

The consensus metrics defined and included in SDG&E's Smart Grid Deployment Plan are based on those identified in the draft *Report on Consensus and Non-Consensus Smart Grid Metrics* filed with the CPUC last December and permit the utility to benchmark and assess the progress achieved through its Smart Grid deployments.

SDG&E plans to continue working with the CPUC, stakeholders such as the Environmental Defense Fund, the other California IOUs and various interested parties in the development and adoption of additional Smart Grid related metrics in the near future.

10 CONCLUSION

SDG&E's Smart Grid Deployment Plan is intended to empower customers, increase renewable generation, integrate plug in electric vehicles (PEVs) and reduce greenhouse gas (GHG) emissions while maintaining and/or improving system reliability and operational efficiency, ensuring security and protecting customer privacy.

SDG&E's customers have been early adopters of new clean technologies including rooftop solar and PEVs, and the state of California has set the bar in the U.S. for environment friendly energy and environmental policies and regulations. SDG&E's deployment plan is a response to both the need to deliver customer value and meet such policy requirements. The utility evaluates its projects against these criteria, pursuing those projects where estimated benefits exceed costs wherever possible, even where a project is entirely policy driven.

The SDG&E Smart Grid Deployment Plan is consistent with the utility's Smart Grid vision, which is to work collaboratively with key stakeholders to create the foundation for an innovative, connected and sustainable energy future. To that end, it has conducted exhaustive outreach to representative stakeholders from across its service territory, incorporated their input into its plan and established a process to continue engaging stakeholder input over the lifetime of the deployment plan and beyond.

SDG&E's Smart Grid baseline is fairly mature with previously deployed or in flight automation and control technologies, operational process reengineering, microgrids, and SCADA and AMI installations. The utility opts for open standards, where cost effective and available, and pilots new technologies before full deployment in order to avoid stranded costs and remain open to capturing new benefits as its experience with the Smart Grid unfolds.

Maintaining and/or improving reliability remains a high priority for this utility as the grid is challenged by the two way energy flow from distributed generation; the intermittent availability of solar and wind generated power; and the large, mobile and growing load required by electric vehicle charging. Ultimately, SDG&E foresees a significant reduction in the environmental footprint of electricity generation and delivery in the region as well as a more resilient grid that offers customers greater convenience, more ways to generate and manage electricity and enjoy their electrical appliances as well as opportunities for them to participate actively in the electricity market and support for authorized third party participants.

To enhance the customer's experience, the plan ensures that customer data will be protected by "designing in" privacy as a key and early component of all projects. Data will also be secured as part of the rigorous cyber and physical security protocols that SDG&E also plans to protect the Smart Grid and customers from threats.

SDG&E has developed a roadmap for its Smart Grid projects around nine program areas with costs and benefits estimated for each, where possible: Customer Empowerment; Renewable Growth; Electric Vehicle Growth; Reliability and Safety; Security; Operational Efficiency; Smart Grid Research, Development and Demonstration; Integrated and Cross cutting Systems; and Workforce Development.

Its adaptive management approach ensures that the roadmap will continually evolve in response to future technology breakthroughs, changing state and federal policies, shifting stakeholder priorities and other unanticipated events that the utility considers as a given over the coming 10 year period.

Ultimately, the preliminary and conceptual costs of SDG&E's Smart Grid deployments for the years 2006–2020 are estimated at approximately $3.5 to $3.6 billion with the majority of the estimated costs attributable to previously authorized investments, Smart Grid projects included in its TY2012 General Rate Case (GRC) and other active applications before the Commission. The estimated incremental investments flowing from new projects are approximately 25 percent of the overall estimated costs.

The total estimated benefits associated with the Smart Grid deployments for the years 2006–2020 are between $3.8 and $7.1 billion. This calculation includes estimated economic and reliability benefits as well as estimated societal and environmental benefits.

SDG&E's Smart Grid Deployment Plan is not a request for funding. The utility will not pursue funding requests for the plan's incremental projects until it can accurately project associated costs and benefits for a project.

SDG&E looks forward to realizing the potential of a more fully deployed Smart Grid and continuing to work in collaboration with all grid stakeholders to ensure its priorities are consistent with its stakeholders' priorities and that the benefits of the Smart Grid are shared broadly across society.

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CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing **SMART GRID DEPLOYMENT PLAN APPLICATION OF SAN DIEGO GAS & ELECTRIC COMPANY (U 902 E)** on all parties identified in Docket No. R.08-12-009, R.10-05-006 and A.10-12-005 by U.S. mail and electronic mail, and by Federal Express to the assigned Commissioner and Administrative Law Judge in R.08-12-009, and to Chief Administrative Law Judge Karen Clopton.

Executed this 6th day of June 2011, at San Diego, California.

/s/ *Jenny Norrin*
Jenny Norin