



Section 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 ALIGNMENT³⁷

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.

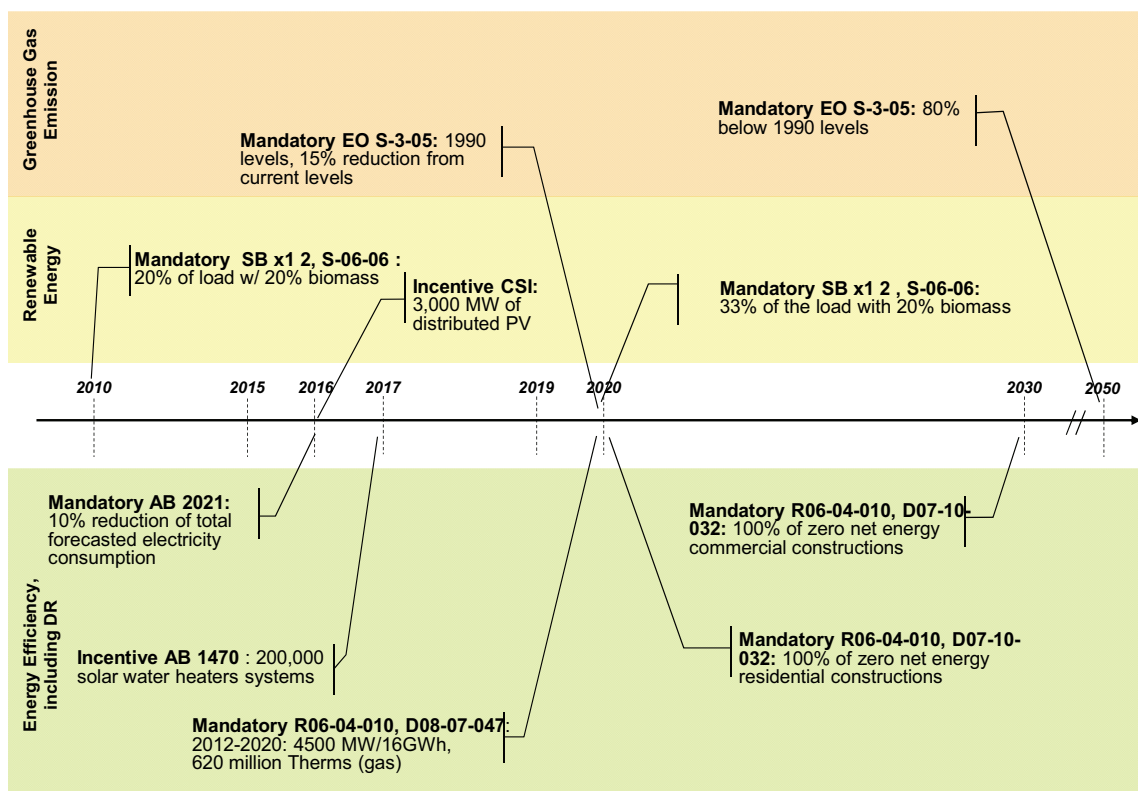


Figure 6-1: California Energy Policy Elements

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 Plan³⁸ 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.

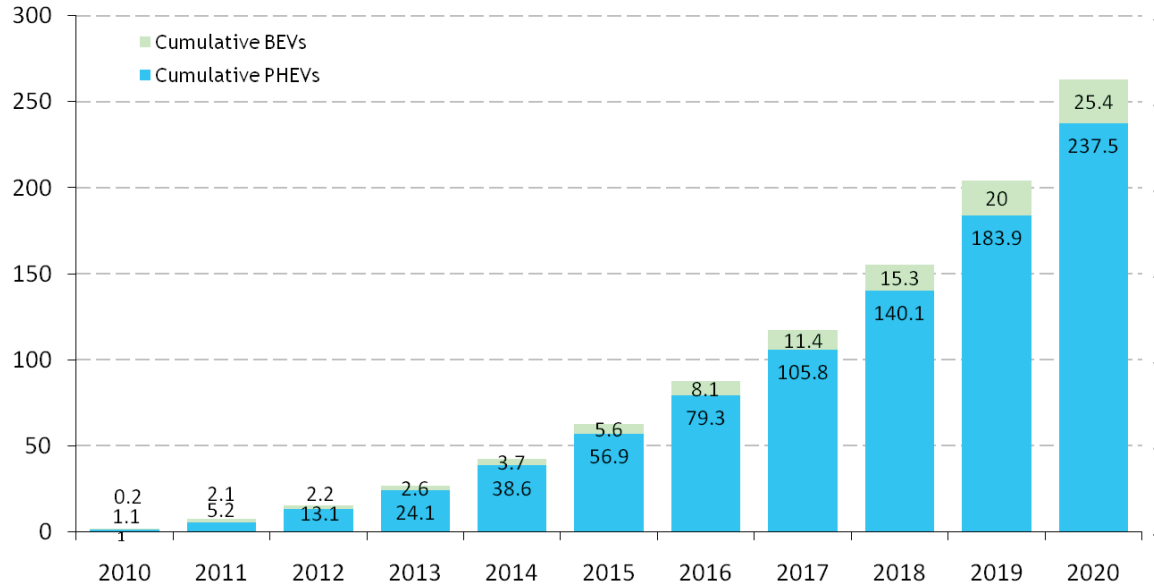
6.2.6 ELECTRIC TRANSPORTATION

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

Cumulative PEV sales (2010 to 2020)
BEVs and PHEVs (x 1,000)



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.

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 customers⁴¹ 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.

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

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.11-03-002⁴³) 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

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).

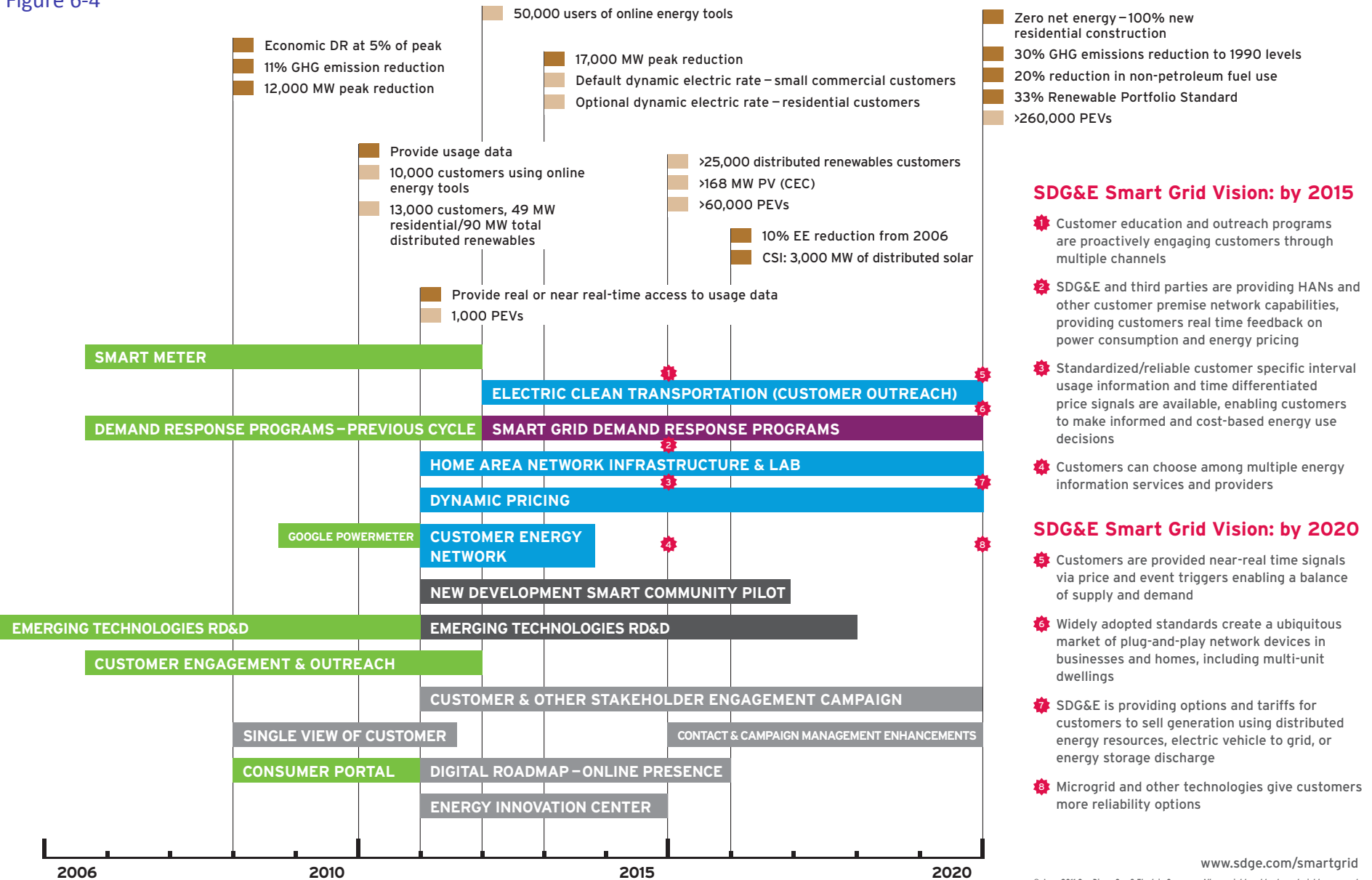
The timeline of SDG&E’s Customer Empowerment program is shown in Figure 6-4 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

CUSTOMER EMPOWERMENT

Key

- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Policy Goal
- Forecast
- ★ SDG&E Smart Grid Vision
- 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

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.

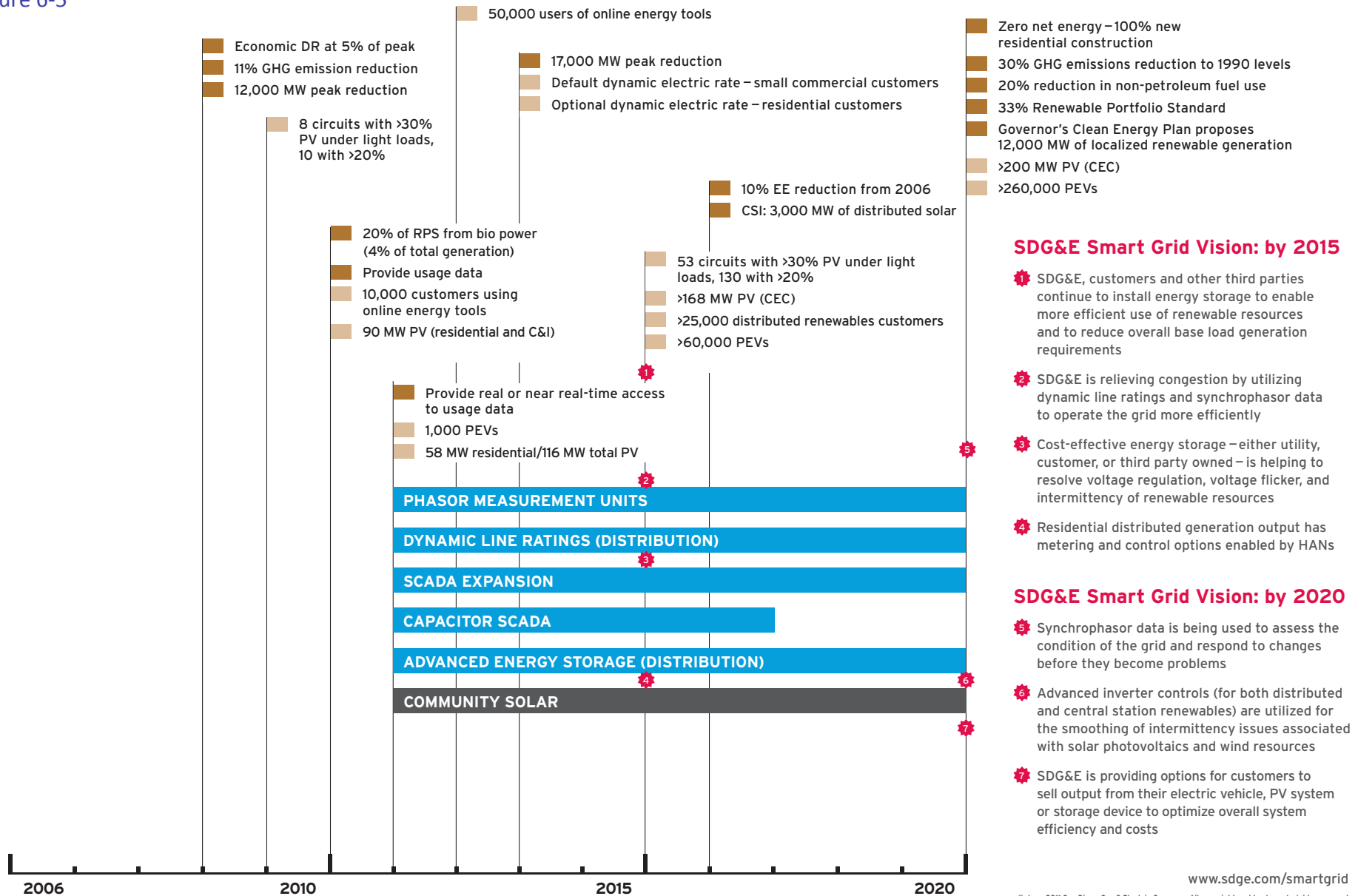
The timeline of SDG&E’s Renewable Growth program is shown in Figure 6-5 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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



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.

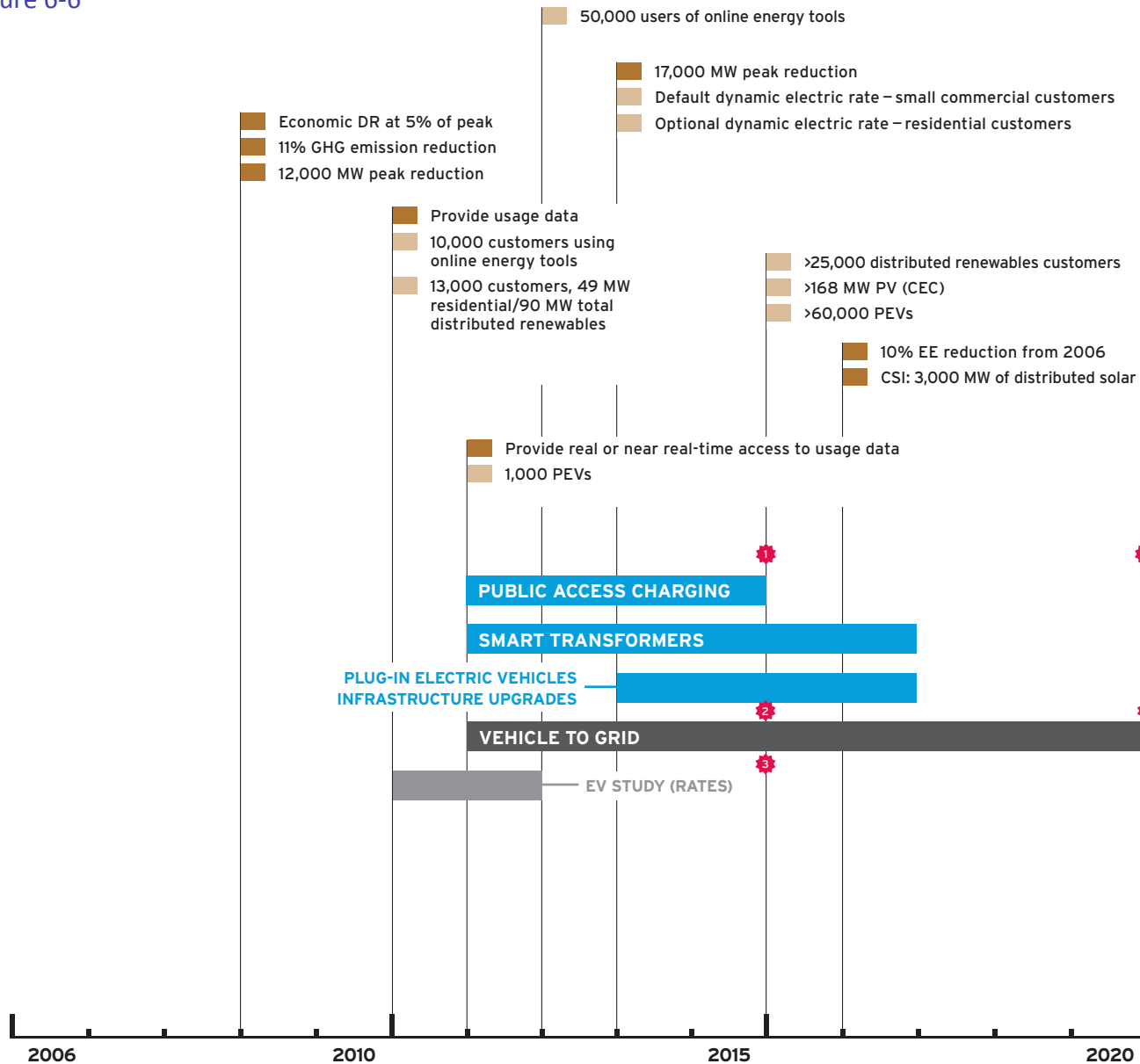
The timeline of SDG&E's Electric Vehicle Growth program is shown in Figure 6-6 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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

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.

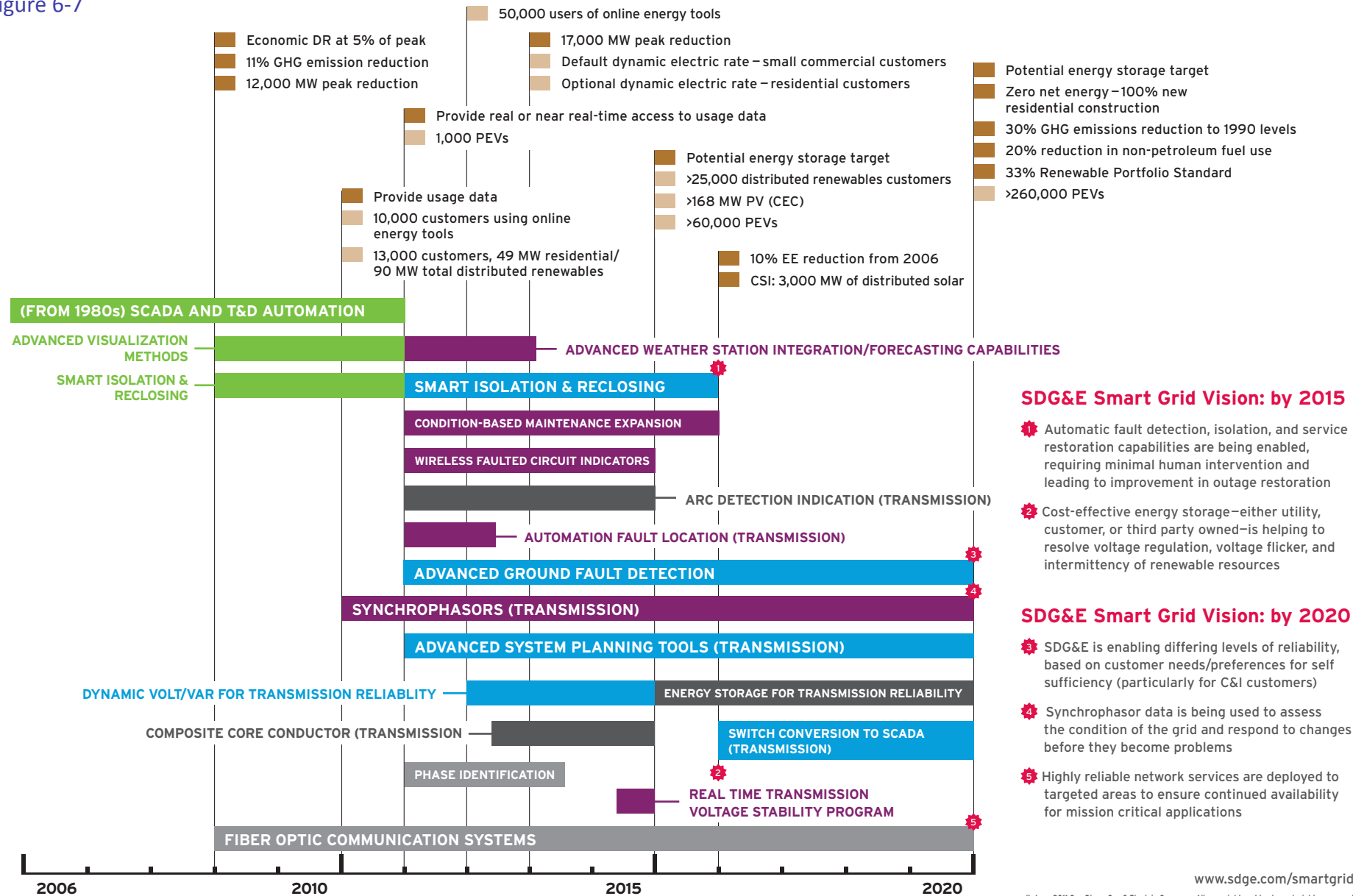
The timeline of SDG&E's Reliability and Safety program is shown in Figure 6-7 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

RELIABILITY AND SAFETY

Key

- In Flight Project
- New Project - Policy
- New Project - Value
- Policy Goal
- Forecast
- New Project - Pilot
- ✱ SDG&E Smart Grid Vision
- Enterprise Project

Figure 6-7



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.

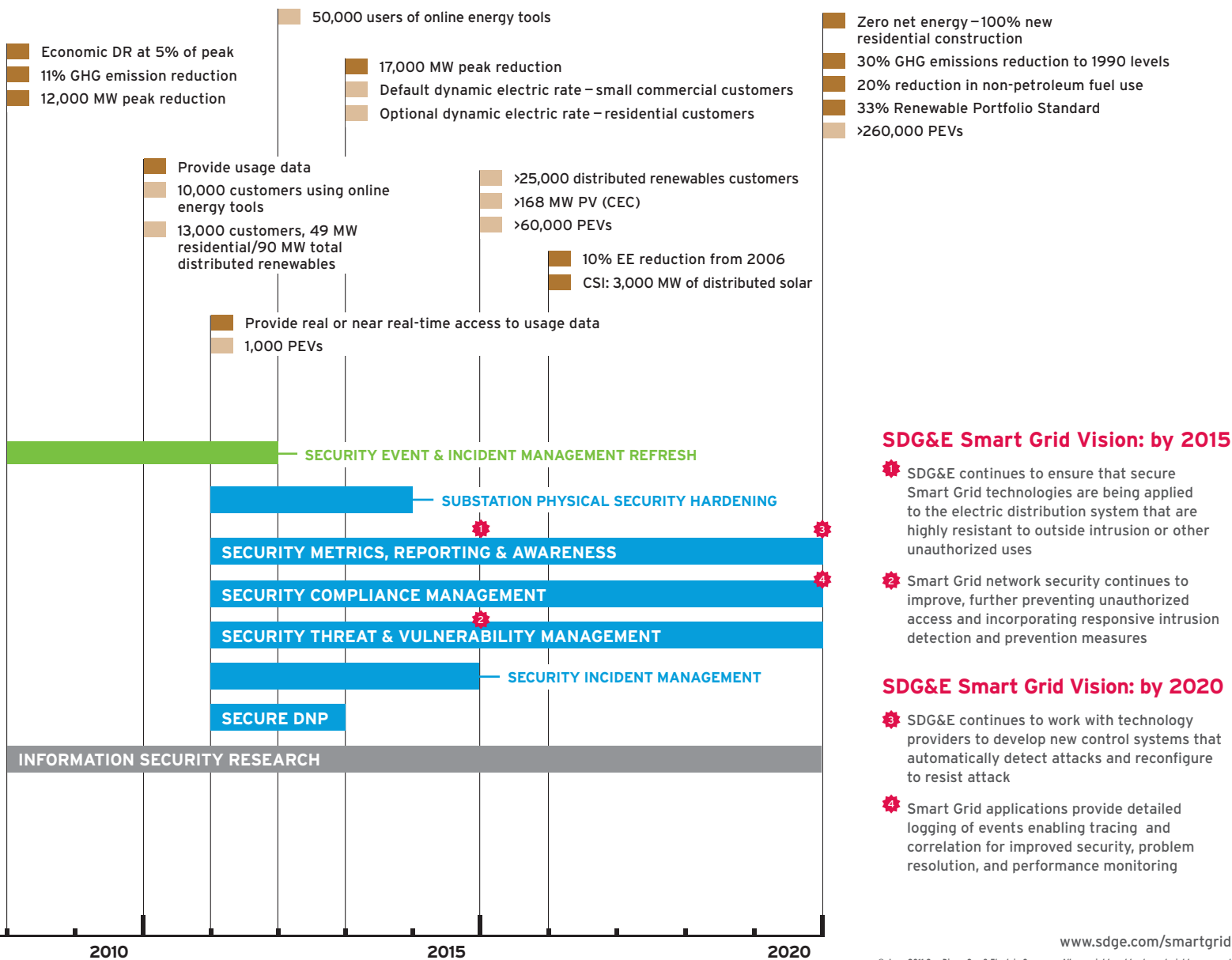
The timeline of SDG&E’s Security program is shown in Figure 6.8 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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



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.

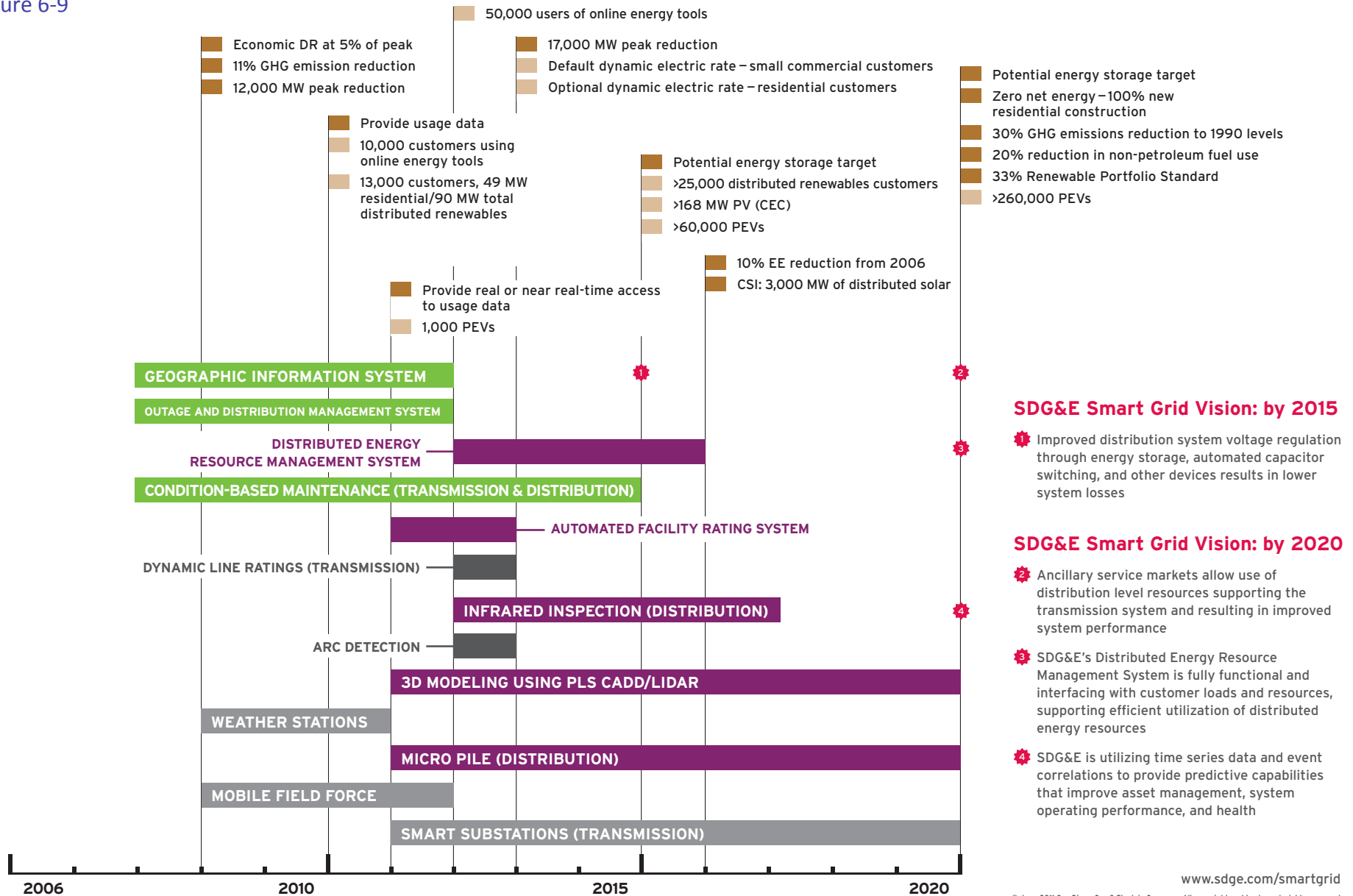
The timeline of SDG&E’s Operational Efficiency program is shown in Figure 6.9 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

OPERATIONAL EFFICIENCY

Key

- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Policy Goal
- Forecast
- ✱ SDG&E Smart Grid Vision
- Enterprise Project

Figure 6-9



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.

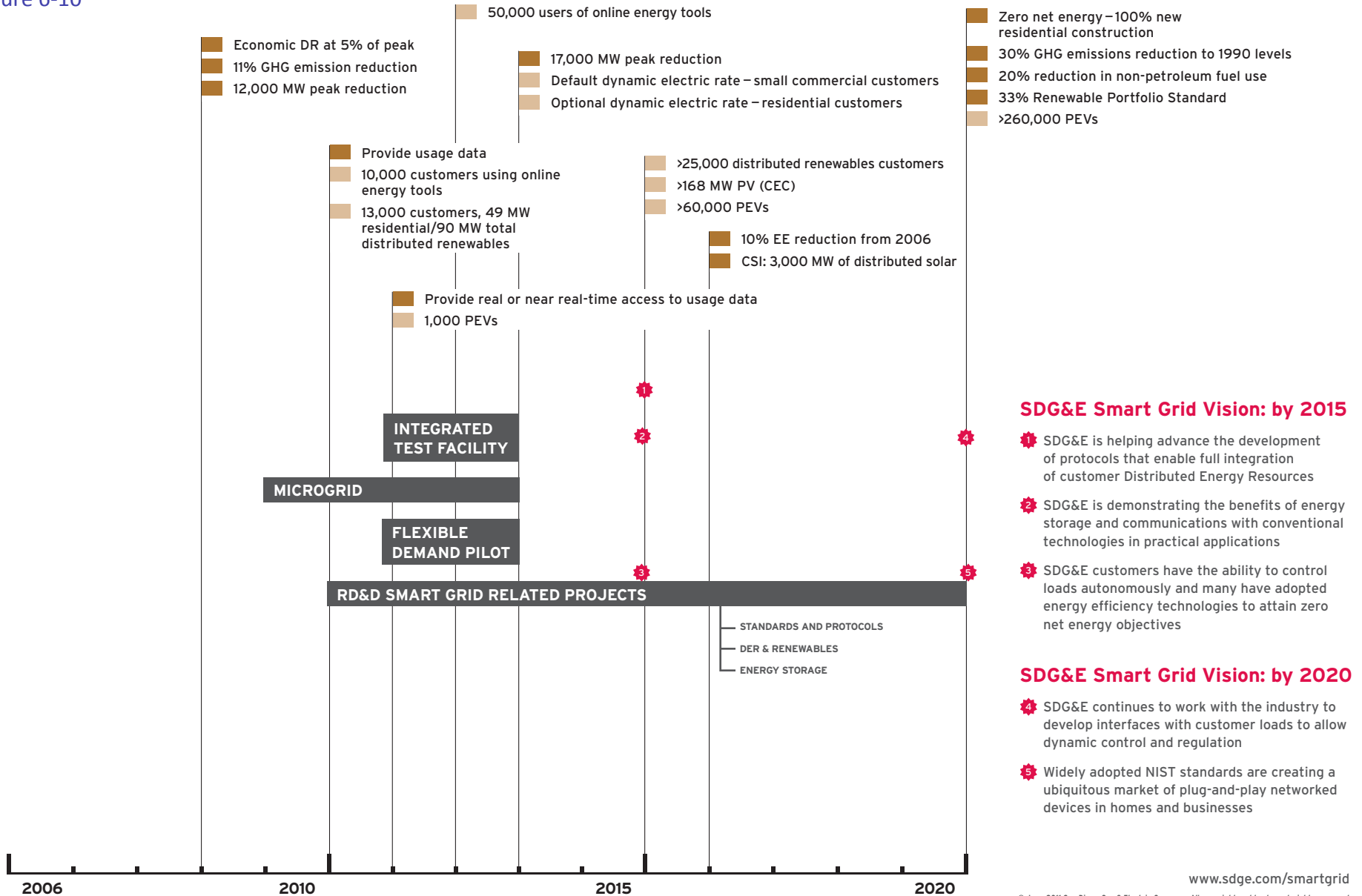
The timeline of SDG&E's RD&D program is shown in Figure 6-10 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

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



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.

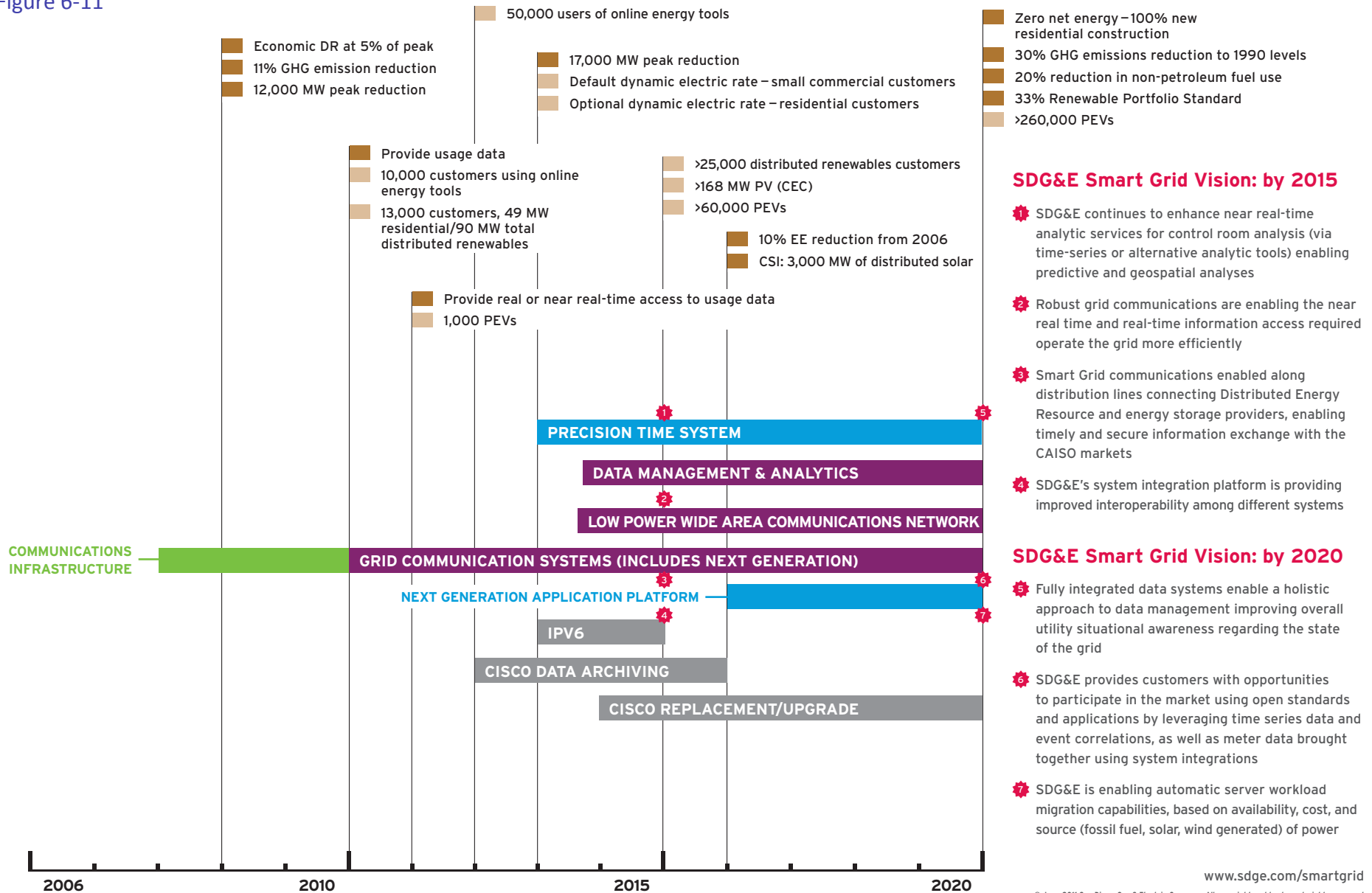
The timeline of SDG&E's Integrated and Cross-cutting Systems program is shown in Figure 6-11 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

INTEGRATED AND CROSS-CUTTING SYSTEMS

Key

- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- Enterprise Project

Figure 6-11



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.

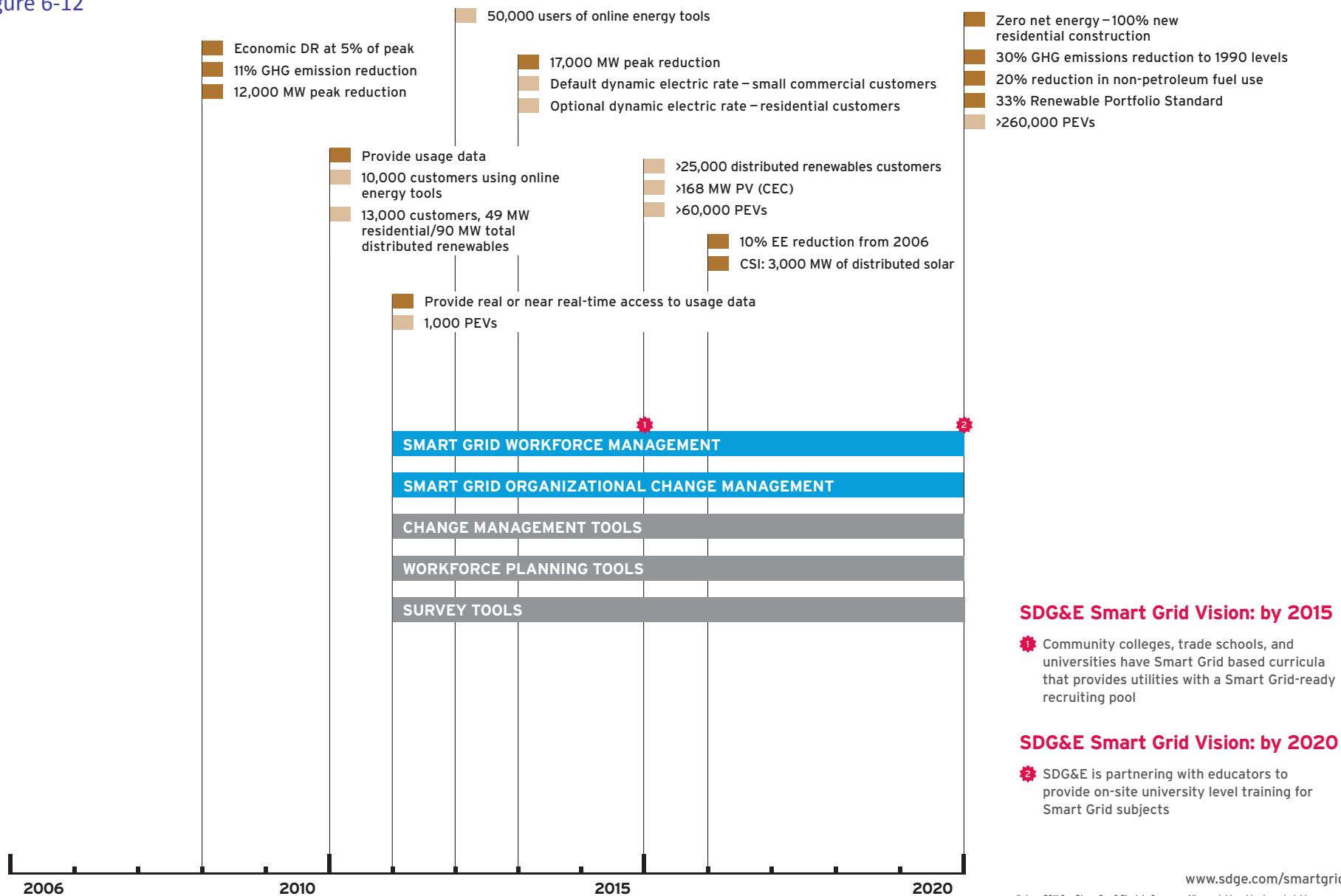
The timeline of SDG&E's Workforce Development program is shown in Figure 6-12 below, including how that timeline relates to state policy requirements, related SDG&E forecasts and the 2015/2020 detailed vision statements provided in the Vision section of this Smart Grid Deployment Plan.

WORKFORCE DEVELOPMENT

Key

- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project
- Policy Goal
- Forecast
- ✱ SDG&E Smart Grid Vision

Figure 6-12



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.