



## Memorandum

**To:** Peter Franzese; CPUC  
**From:** Olivia Patterson, Mary Sutter; Opinion Dynamics  
**Date:** September 30, 2014  
**Re:** Energy Efficiency and Demand Response Behavior Market Characterization Study – Preliminary Memo Regarding Smart Meter Business Case Decisions and Smart Grid / AMI Projects

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This memo is the first of three deliverables for the PY2013-2104 California Energy Efficiency and Demand Response Residential Behavior Market Characterization Study. This first memo summarizes Investor Owned Utility (IOU) advanced metering infrastructure and smart grid project efforts. In particular, we focus on residential projects that provide residential customers with information and feedback to motivate behavioral change.<sup>1</sup>

Specifically, this memo addresses the following research questions:

- What IOU Smart Meter/Advanced Metering Infrastructure (AMI) projects have been approved by the CPUC? What were their funding amounts and what were the projected costs and benefits of the projects? Is there any overlap between energy efficiency (EE) funding and Smart Meter/AMI funding?
- How do the IOUs calculate the EE and DR benefits from their Smart Meter/AMI projects? What assumptions are used? In what ways are they consistent or different across the IOUs? How does the Smart Meter/AMI methodology compare to methods for estimating benefits from EE pilots?
- What is the status of Green Button Connect?
- Do the projected EE savings for AMI projects contribute to the current EE savings goals set forth in the Energy Efficiency Potential and Goal Study?<sup>2</sup> Should the projected savings be considered as separate or alternative savings goals?

Moving forward, Opinion Dynamics will provide a second memo that reports on the progress to date for the behavioral projects implemented by the IOUs included within the Smart Grid Deployment Plans and their Annual Updates. Additionally, we will focus on the benefits these projects deliver, and benchmark those benefits against other similar programs offered across the country. This analysis will provide inputs towards our third deliverable, a final report, which will provide insights into determining potential cost-effective behavioral feedback based pilots and programs moving forward.

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<sup>1</sup> Given the numerous acronyms and technical terms used in this memo, we included a glossary of terms in Appendix F.

<sup>2</sup> Navigant Consulting, Inc. November 2013. 2013 California Energy Efficiency Potential and Goals Study.

## 1.1 Study Limitations

Our team reviewed multiple documents from a variety of sources to compile the results presented below. One of our main charges was to find projects that attempt to change customer behavior through providing feedback from AMI-enabled data (e.g., information from an in-home device associated with a smart meter). Once we identified the projects, we needed to assign costs and benefits to each. However, we were unable to comprehensively complete this task given current reporting.

Many of the sources we reviewed present high-level information on program costs and benefits, some of which were across different time horizons or in different units (i.e., the documents presented benefits in nominal values or present value rate of return depending on the IOU). Determining the specific projects and their associated budgets was also extremely difficult due to a lack of common identifiers and full listings of projects. Additionally, there were cases where information was not available or inconsistent across sources. For example, the IOUs present some project funding information in their Smart Grid Deployment Plan's (SGDP), but the projects are not contained in the Smart Grid Annual Report updates. Further, because SCG was not required to create a SGDP, the projects we include in the scope of this study are only for PG&E, SCE, or SDG&E. In addition, the Smart Grid Annual Report updates do not provide project budgets, but do provide annual expenditures by projects. As a result, we compiled the data across sources to present a summary of Smart Grid Projects and efforts to date, but are cautious regarding drawing definitive conclusions due to the high degree of uncertainty within the data. Given the limitations inherent in the data, we occasionally change how we refer to projects within the memo.

Based on our review, we anticipate working with the CPUC to determine next steps for the study. In particular, our review indicates that there are opportunities to develop a framework for data tracking moving forward to support evidence-based policy choices. Further, we may not be able to address some of the overarching study research questions given evaluability concerns.

In the following sections, we address the four research questions. We begin with an introduction of California's AMI efforts to provide context to the study.

## 1.2 Introduction to California's Advanced Metering Infrastructure Efforts

According to the *2014 CPUC Annual Report to the Governor and Legislature – California Smart Grid*, the smart grid is a “fundamental re-architecting and modernization of the existing electricity infrastructure, with the following objectives:

- Create a more secure, reliable and resilient electricity supply
- Reduce the carbon footprint and environmental impact of energy production, distribution and transmission
- Enable customers to more intelligently manage their energy use, and give them more opportunities for participation in electric markets, both as consumers and as producers



- Create more market opportunities for electric service delivery through smart markets.”<sup>3</sup>

However, a grid does not become “smart” without comprehensive policy guidance and planning. For the California IOUs, the CPUC provided guidance over a ten-year period to create the needed infrastructure and then began to focus activities on realizing anticipated benefits from the built environment. Our team reviewed 28 regulatory and utility documents spanning 2004 to 2014 related to building AMI in California and making the grid smarter.<sup>4</sup> These documents serve as the foundation for our understanding of the regulatory framework and IOU roadmaps that support the development of enhanced customer engagement and use of smart meter data.

Based on a somewhat natural break in CPUC guidance, we categorized the documents into two phases: Phase 1: Building AMI, and Phase 2: Deploying Smart Grid Projects. The first phase, Building AMI, reflects early efforts beginning in 2004 to build infrastructure in support of a smart grid. The second phase, Deploying Smart Grid Projects, highlights later efforts beginning in 2010 to leverage advanced metering infrastructure to make utility operations, markets and customers smarter about their energy use. [Figure 1](#) provides an overview of the various decisions and documents each phase.<sup>5</sup>

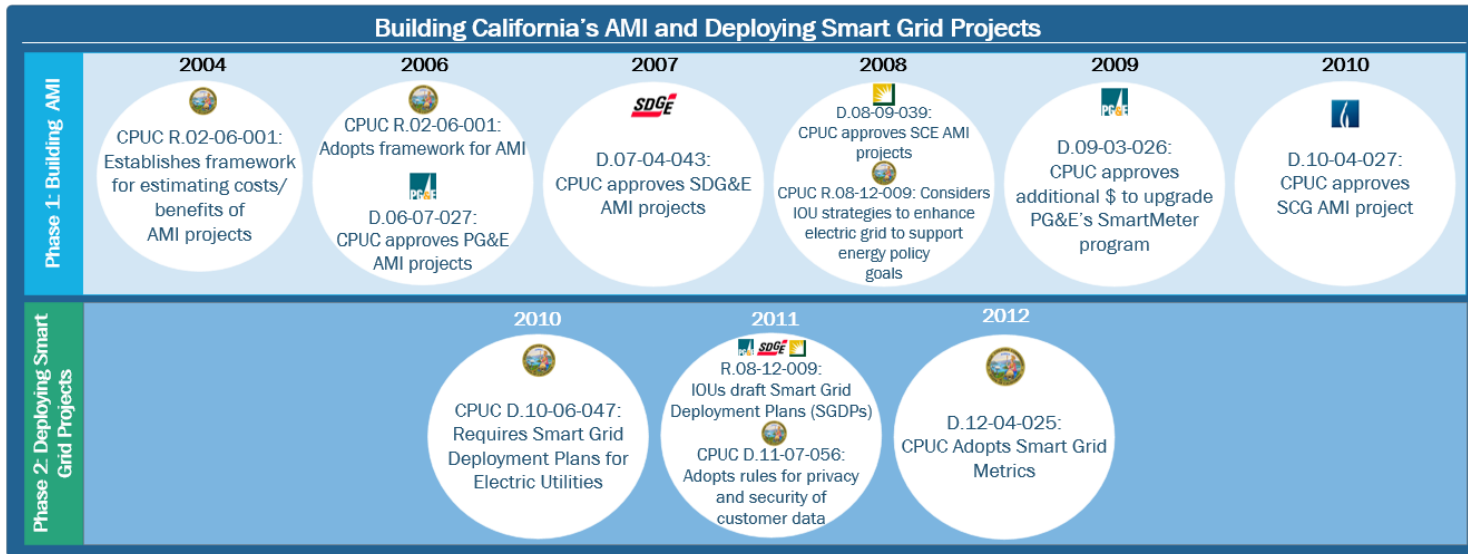
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<sup>3</sup> 2013 Smart Grid Report, April 2014.

<sup>4</sup> Refer to for a list of these documents.

<sup>5</sup> Appendix A provides a brief summary of each decision and document.

Figure 1: California's Advanced Metering Infrastructure Efforts (2004-2014)

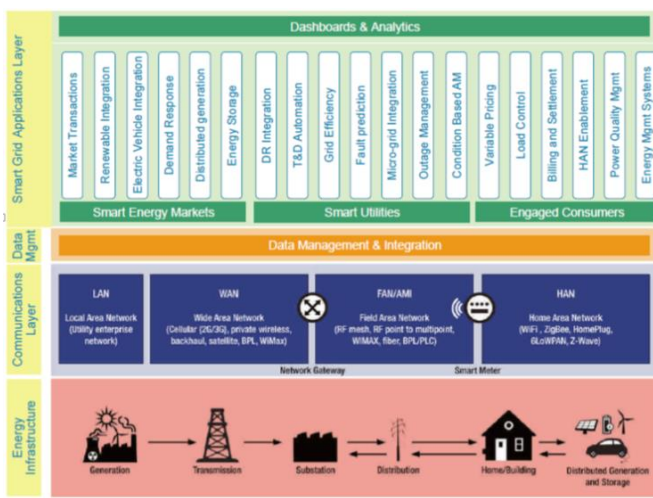


Below we share findings from these documents to provide context to the research within this memo.

**Phase 1: Building AMI (2004-2010)**

In 2004, the CPUC established a framework for AMI that, over the course of four years (2006-2010), the IOUs built.<sup>6</sup> The CPUC asked the IOUs to develop “Business Cases” to assess the cost-effectiveness of AMI investments. Based on these business cases, subsequent decisions<sup>7</sup> by the CPUC approved specific levels of AMI funding totaling \$5.5 billion within California, with the IOUs projecting over \$6 billion in benefits.<sup>8</sup> These costs cover many different needed efforts to build an advanced metering infrastructure. As shown in Figure 2, there are multiple layers of new or improved hardware and software to create an infrastructure that can be considered “advanced”.

**Figure 2. Example of the Multiple Activities Needed to Create an AMI**



Source: PG&E’s Smart Grid Deployment Plan pp. 19.

While there are substantially more than just customer meters installed through this first effort, it is one of the more substantial costs. Table 1 shows the progress of AMI electric meter deployment by IOU. As of October 2013, over 90% of IOU customers had received a smart meter with very few customers choosing to opt-out.

<sup>6</sup> ALJ Ruling R. 02-06-001 (July 2004) established business case analysis framework for AMI. The framework was approved in 2006.

<sup>7</sup> Decisions include D.06-07-027, D. 07-04-043, D. 08-09-039, D. 09-03-026, D. 10-04-027.

<sup>8</sup> For more detail, please refer to Table 14 and Table 15 in Appendix C.

Table 1: Smart Meter/AMI Deployment as of October 2013

IOU	Electric Meters Installed/Active	Electric Meters Remaining	Percent Complete	Opt-out
PG&E	5.26M/3.171M	371,000	93%	35,300
SCE	4.97M	0	100%	21,137
SDG&E	2.281M/2.278M	4,000	99.8%	2,141

Source: 2013 Smart Grid Report, April 2014.

## Phase 2: Deploying Smart Grid Projects (2010-Beyond)

In 2009, the California Legislature passed SB 17.<sup>9</sup> Due to this legislative mandate, the CPUC subsequently required each IOU to develop Smart Grid Deployment Plans (SGDP) in 2011.<sup>10</sup> This CPUC Decision provides a required outline for each IOU SGDP including smart grid vision, strategy, deployment baseline and roadmap, cost and benefit estimates, grid security and cyber security strategy, and metrics. Importantly for the purposes of our study, the SGDPs put a greater emphasis on realizing customer engagement benefits projected in the earlier Business Cases.<sup>11</sup> Additionally, the SGDPs are required to include all inputs into benefits and costs for smart grid deployment, including the sources for those inputs.

The SGDP's essentially shifted efforts towards leveraging AMI to realize customer benefits (amongst other benefits), concentrating efforts towards providing what customers need and value, including the ability to control energy use through access to their consumption information. An example of this prioritization is the first of PG&E's 10 strategic objectives for the SGDP is having engaged customers. Additionally, in some cases the SGDPs built upon AMI Business Case Decision projects, costs and benefits but developed a different set of costs and benefits.

As AMI deployment efforts continued, the CPUC turned its attention towards maximizing the benefits from the installed smart meters. As per the 2013 Smart Grid Report, the "focus for CPUC activities will be directed toward quantifying and evaluating customer and system benefits, so that the promises of a smart grid can be realized by Californians."<sup>12</sup>

<sup>9</sup> 2009, "Senate Bill 17, Padilla. Electricity: smart grid systems."

<sup>10</sup> D. 10-06-047 Decision Adopting Requirements for Smart Grid Deployment Plans Pursuant to Senate Bill 17 (Padilla), Chapter 327, Statutes of 2009 (June 2010).

<sup>11</sup> Appendix B provides Smart Grid Deployment Plan customer engagement roadmaps to offer a picture of planned efforts.

<sup>12</sup> Annual Report to the Governor and the Legislature, California Smart Grid. CPUC. May 2014.

### 1.3 What are the CPUC Approved IOU Smart Meter/AMI Projects?

The original budgets for Phases 1 and 2 exceed \$5 billion. Within those costs are many unique projects. The IOUs document these projects in the Smart Grid Deployment Plans (SGDPs) and their annual updates (going forward we refer to these as “Smart Grid Projects”).<sup>13</sup>

According to the SGDPs, there are six different Smart Grid Project sub-categories, based on the services they provide: 1) distribution, automation and reliability; 2) customer empowerment and engagement; 3) asset management, safety and operational efficiency; 4) transmission, automation and reliability; 5) integrated and crosscutting systems; and 6) security.

Per the research objectives, our review focuses exclusively on **one** of these project sub-categories: *customer empowerment and engagement projects*. ~~Table 2~~ **Table 2** provides a breakdown of total costs for Smart Grid Projects across all six sub-categories as of May 2014, with customer empowerment and engagement projects representing the second largest share of costs (approximately 28%).

Table 2. 2013 Total Costs for Smart Grid Projects

Program Sub-Categories	PG&E	SCE	SDG&E	Costs (Millions)	%
Distribution Automation and Reliability	\$112.800	\$41.017	\$36.676	\$190.49	35%
<b>Customer Empowerment and Engagement*</b>	<b>\$53.423</b>	<b>\$44.544</b>	<b>\$54.443</b>	<b>\$152.41</b>	<b>28%</b>
Asset Management, Safety and Operational Efficiency	\$42.000	\$0.216	\$25.142	\$67.35	12%
Transmission Automation and Reliability	\$27.300	\$23.897	\$5.865	\$57.06	11%
Integrated and Cross-Cutting Systems	\$19.220	\$16.695	\$9.115	\$45.03	8%
Security	\$10.000	\$6.417	\$12.825	\$29.24	5%
<b>IOU Total</b>	<b>\$264.743</b>	<b>\$132.788</b>	<b>\$144.066</b>	<b>\$541.58</b>	<b>100%</b>

**NOTE:** Cost information sourced from CPUC’s 2013 Smart Grid Annual Report.  
 \* This is the sub-category that is the focus of our study.

#### Smart Grid Customer Empowerment and Engagement Projects

As of 2013,<sup>14</sup> there were 56 projects labeled as customer empowerment and engagement projects approved by the CPUC from all three IOUs combined.<sup>15</sup> Our study has a very narrow purpose, covering only projects that attempt to change customer behavior through providing feedback through the provision of AMI-enabled data. These projects typically empower customers to contribute to effective grid operations by providing customers with near immediate feedback on their energy use through

<sup>13</sup> We are in the process of developing an Excel spreadsheet that compiles project descriptions, projected costs, projected benefits, and funding source information for each project selected by IOU.

<sup>14</sup> For this memo, we focus on 2013 customer empowerment and engagement projects as in most cases the 2012 SGDP Updates did not provide detailed cost information.

<sup>15</sup> This includes, PG&E, and SDG&E. SCG is not included in this list because they do not maintain an electric grid and were not required by the CPUC to submit an SGDP. Due to limitations in the data, we present only those projects within the Smart Grid Deployment Annual Updates, which likely cover both Phase 1 and Phase 2 efforts.



AMI, which enables energy conservation or peak-load reductions. These projects include Demand Response, Plug-In Electric Vehicle (PEV), and Home Area Networks (HAN).

Of the 56 customer empowerment and engagement projects, we identified 23 projects in 2013 that focused on residential customer feedback.<sup>16</sup> We excluded 33 projects because they installed smart meter infrastructure, were non-residential, or helped with developing back-office operations or information technology in support of future customer engagement efforts (Table 3). Appendix D provides a list of each of the 56 Customer Empowerment and Engagement Smart Grid Projects included within the scope of our study.

**Table 3: 2013 Customer Empowerment and Engagement Projects by Scope**

Project Focus	Number of Projects
<b>Residential Customer Feedback</b>	<b>23</b>
Back-office/operations <sup>a</sup>	14
Non-residential	5
Customers not involved in study	4
Smart meter deployment	3
Workshop/Outreach	3
Solar/Distributed Generation/Renewables	2
AC Cycling	1
In-person interactions with customer	1
<b>Total</b>	<b>56</b>
<sup>a</sup> An example of back-office / operations projects is SCE's HAN Phase III-Automate Back Office Processes (Formerly HAN Support Systems). HAN Phase III will automate manual back office processes to enable SCE to support forecasted customer HAN adoption forecasts, enable customer HAN self-service tools, support DR and pricing programs load reduction goals, and begin marketing HAN capabilities to customers.	

Below we provide five in-scope customer empowerment and engagement projects to help give a sense of the type of project included in our study. In 2013, the five projects with the largest costs to date included projects with time varying rates, Home Area Networks and Home Energy Reports.

- **Time Varying Rates (PG&E):** Offered time-varying pricing products, such as Peak Day Pricing (PDP) and Time-of-Use (TOU), that take advantage of SmartMeter™ capabilities by charging customers different rates based on varying system conditions (*Projected Cost: \$18.5 million from various funding sources*)
- **Smart Pricing Program (SDG&E):** Offered TOU and dynamic rates for residential and small business customers, along with IT/billing system upgrades and customer outreach and education efforts (*Projected Cost: \$17.6 million from DR funds*)
- **HAN Demand Response Integration Pilot Project (PG&E):** Provided approximately 2,000 residential and small business SmartRate™ and Peak Day Pricing (PDP) customers with Home

<sup>16</sup> Note that there were two projects in 2012 that were not continued into 2013.





Area Network (HAN) devices that provide real-time energy prices and respond to DR notifications of critical pricing events (*Projected Cost: \$11.9 million from DR funds*)

- **Edison SmartConnect Field Trials – HAN with Load Control (SCE):** Enabled customers to self-register HAN devices they purchase on SCE’s MyAccount website; customers receive a rebate between \$25 and \$125; also included a limited launch of 500 Programmable Communicating Thermostats to customers enrolled in Summer Discount Plan (*Projected Cost: \$9.5 million from AMI funds*)
- **Home Energy Reports (PG&E):** Home Energy Reports is a behavior-based energy efficiency initiative, under the Residential Energy Advisor (EA) program, that provides customers with normative neighborhood comparisons to similar households and personalized energy saving recommendations. The key features of the report include raising awareness of customer energy usage, using social norms to influence customer behaviors, and motivating customers to further engage with PG&E programs and resources such as registering to use My Energy Web Tools and the Universal Audit Tool. (*Projected Cost: \$5.5 million from EE funds*)

#### Funding Sources for Customer Empowerment and Engagement Projects

Overall, eight different sources fund in-scope Smart Grid Customer Empowerment and Engagement projects, with AMI being the most common funding source. [Table 4](#) below breaks down the sources for the 23 in-scope Smart Grid Customer Empowerment and Engagement Projects by IOU.

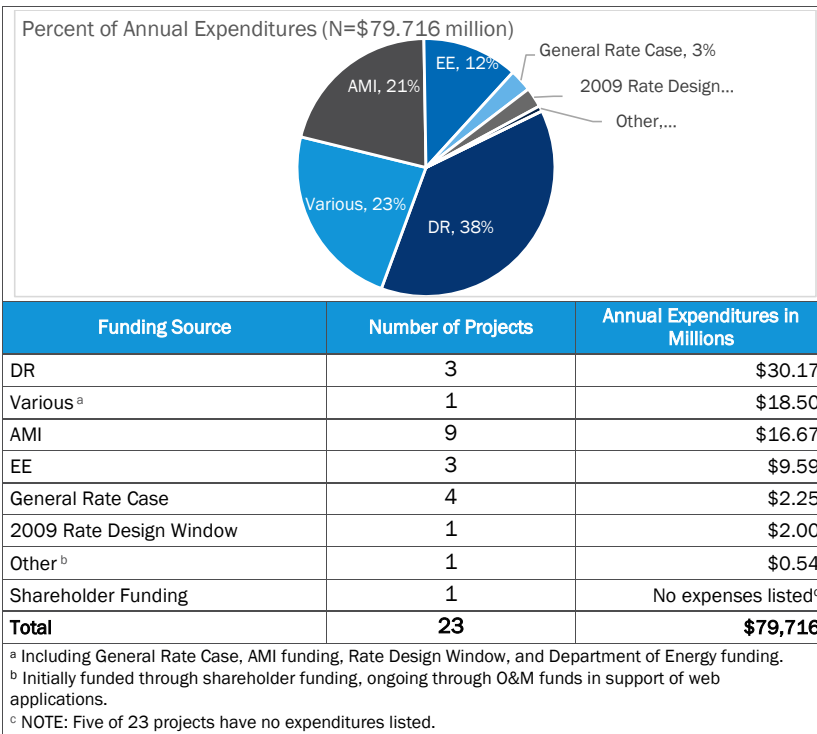
**Table 4: Funding Sources for In-Scope 2013 Smart Grid Customer Empowerment and Engagement Projects, by IOU**

Funding Source	PG&E	SCE	SDG&E	Total
AMI	2	7	0	9
General Rate Case	0	0	4	4
DR	1	0	2	3
EE	3	0	0	3
Shareholder Funding	1	0	0	1
2009 Rate Design Window	1	0	0	1
Various <sup>a</sup>	1	0	0	1
Other <sup>b</sup>	1	0	0	1
<b>Total Projects (In-Scope)</b>	<b>10</b>	<b>7</b>	<b>6</b>	<b>23</b>
<sup>a</sup> Including funding through the General Rate Case, AMI funding, Rate Design Window, and Department of Energy funding.				
<sup>b</sup> Initially funded through shareholder funding. Ongoing funding through those funds allocated to support web applications.				

It is our understanding that AMI funding comes from Phase 1: Building AMI decisions. We continue to work towards complete funding information for customer empowerment and engagement projects. In the interim, however, we have pulled together information on funding sources and cost-to-date for projects within each funding source. Notably, the Smart Grid Annual Report Updates provide costs-to-date, and do not provide budgets.

Table 5 represents the 23 in-scope Smart Grid Projects categorized as customer empowerment and engagement projects in each IOUs SGDP Updates in 2013. The 23 in-scope projects represent 52% of the 56 customer empowerment and engagement project costs.

**Table 5: Expenditures of In-Scope Customer Empowerment and Engagement Smart Grid Projects by Funding Source (July 1, 2012 to June 30, 2013)**



### Customer Empowerment and Engagement Project Benefits and Costs

In 2004, the CPUC asked the IOUs to develop “Business Cases” to assess the cost-effectiveness of AMI investments assuming a certain amount of energy efficiency and demand response benefits. As part of this effort, the CPUC asked the IOUs to design pilots and programs to provide customer empowerment and engagement benefits. As can be expected, the Business Cases provided high-level anticipated benefits, leveraging a variety of assumptions, to make a case for deploying AMI infrastructure (i.e., these benefits were not project based within the documents we reviewed). In 2010, the CPUC directed the IOUs to develop Smart Grid Deployment Plans that summarizes customer empowerment and engagement costs and benefits by project. Table 6 provides the anticipated benefits and costs for each phase: Phase 1: Building AMI, and Phase 2: Deploying Smart Grid



Projects.<sup>17</sup> Notably, given data limitations we present benefits and cost reflecting all customer empowerment and engagement projects offered not just the 23 in-scope projects presented earlier, as we cannot identify those benefits and costs specific to in-scope projects.

**Table 6: Projected Customer Empowerment and Engagement Project Costs and Benefits (in Millions)**

Phase	Cost (\$ Millions)	Benefits (\$ Millions)	Source
Phase 1: Building AMI	\$191	\$1,005-\$1,016	Business Cases
Phase 2: Deploying Smart Grid Projects	\$168 to \$211	\$594 to \$1,405	Smart Grid Deployment Plans

Over the last ten years, the IOUs have built new metering infrastructure and projected anticipated costs and benefits resulting from these efforts. These efforts provoke a few challenges in terms of accounting for anticipated costs and benefits over two distinct phases and multiple funding streams. In particular, two challenges arise, 1) accounting for incremental funding across the two AMI phases, and 2) ensuring that redundancy does not occur across funding streams. We outline these below.

**Challenge #1: Accounting for Incremental Funding Over Time**

As shown in Table 6, across all customer empowerment and engagement projects the IOUs have estimated slightly over \$2.4 billion in benefits from the high range of projects within the two phases. Moreover, as shown in Table 5, the IOUs fund just our 23 in-scope projects through at least six different funding streams. As such, given the information available, it is challenging to determine which funding sources provide additional (incremental) benefits over time and which do not. According to CPUC staff, AMI-funded Smart Grid projects in Table 6 above reflect costs projected in the AMI Business Case Decisions (Phase 1: Building AMI), while other funding sources reflect incremental costs to support realizing the benefits of providing customer access to AMI data (Phase 2: Deploying Smart Grid Projects). If this is the case, any projects funded outside of AMI are in addition to the approved cost-benefit ratios determined in these Business Cases. However, the available reporting does not make this distinction clear.

Because we have limited transparency in terms of which funding sources reflect Phase 1 or Phase 2 efforts, it is not clear if the benefits are already accounted for across the different funding sources. In other words, if these projects are funded through non-AMI funding streams, it is not clear whether their benefits accrue to their funding source (i.e., DR or EE), or both streams or if the benefits from the projects were actually counted under the original AMI benefits. If they accrue to both DR and EE funding streams, there is potential for double counting of benefits across funding streams as would any project with benefits associated with the original AMI funding that are now funded elsewhere.

**Challenge #2: Ensuring Redundancy Does Not Occur Across Funding Streams**

One of the objectives of this review is to identify potential funding overlaps between AMI-funded Smart Grid Projects and EE/DR funded projects. Since this study focuses on providing information to help in future CPUC decisions, an important element to determine is whether the Smart Grid efforts are double-counting benefits and/or under-counting costs.

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<sup>17</sup> For more detail, refer to Table 14 and Table 15 in Appendix C.

As noted earlier, there are a variety of funding sources for Smart Grid Projects. We identified EE and DR programs that have similar designs and targets to Smart Grid Projects, but were funded out of different funding streams. Our review is still on going and we expect to provide a much deeper look into possible projects to help us understand if there is overlap. However, we have identified four sets of potentially overlapping programs. Based on our initial analysis, these projects have overlapping EE or DR programs with similar goals, but are funded through different sources.

Table 7: Smart Grid Projects with Potential Overlap with Other Funding Streams

Project Name	Project Year/Cost	Funding Source	Similar Project
PG&E's My Energy Web Tools	2013 Projected Cost: \$2 million	2009 Rate Design Window	Universal Audit Tools (UAT) (Funding Source: EE)
PG&E's HAN Enablement Program – Phase 1 & Phase 2	2013 Projected Cost: \$1.8 million	AMI	DR pilot Home Area Network Demand Response Integration Pilot Project (Funding Source: DR)
SDG&E's HAN Projects	2013 Projected Cost: \$0.87 million	General Rate Case	Smart Meters program (Funding Source: DR)
SDG&E's Green Button Download My Data Project	2012 Projected Cost: less than \$0.10 million <sup>a</sup>	GRC, DOE Grant and EE funds	Green Button Connect My Data (Funding Source: DR)

<sup>a</sup> NOTE: There is no associated 2013 cost in the Smart Grid Deployment Update report.

Notably, these projects could be redundant, or they could work together to bring about anticipated benefits from the Smart Grid. Future research will assess the potential for redundancy across projects through interviews with IOU staff.

## 1.4 What is the IOU Approach to Calculating the EE and DR Benefits from Smart Meter/AMI projects?

Regardless of the difficulty identifying specific projects described above, our review of the documentation did allow us to determine the types of benefits included in the cost-effectiveness analyses of these phases and the difference in the types of benefits included for EE programs. We provide this review to illuminate how the CPUC deems these projects cost-effective, and how they differ between phases and other types of IOU programs.

We identified a 'silo effect' in the sense that each funding stream carries distinct policy rules surrounding inputs into cost-effectiveness. We begin by documenting any differences across the IOUs in calculating benefits, followed by a comparison to EE cost-effectiveness protocols.

We identified five general categories for the types of benefits calculated for Phase 1 and Phase 2 projects:

- 1) **Operational benefits:** for example, avoided energy procurement and capacity generation costs
- 2) **DR/Conservation benefits:** for example, energy or demand savings through changes to customer behavior, shifts in energy use from peak load, or increases to IOUs' demand response portfolio

- 3) **Societal:** The types of benefits that fall into societal vary significantly by IOU, but include benefits such as public safety, meter accuracy, and reduced energy theft<sup>18</sup>
- 4) **Reliability:** Refers to reductions in duration or avoidance of power outages, and increased service reliability
- 5) **Environmental:** Refers to avoided greenhouse gas (GHG) and other pollutant emissions

While this section focuses solely on the types of benefits used in cost-effectiveness analyses for the two Phases, refer to Appendix D for information on the inputs to benefits calculations used for Phase 1 and the types of costs included for Phase 2, and Appendix C for a summary of Phase 1 budgets.

### Variation across IOUs

For the Phase 1: Building AMI effort, the IOUs use a common methodology, with several common inputs and assumptions, set forth in ALJ Ruling R. 02-06-001. However, the IOUs differ in some benefits that they include. For instance, SDG&E and SCE include quantified societal benefits, while PG&E acknowledges societal benefits but does not quantify them (Table 8). This variation prevents the CPUC and other interested parties from making apples-to-apples comparisons of the IOUs' respective cost-effectiveness of AMI deployment projects.

For the Phase 2: Deploying Smart Grid Projects, PG&E calculates benefits using a methodology developed by the Electric Power Research Institute (EPRI) for calculating cost-effectiveness.<sup>19</sup> SCE uses a methodology developed by the Department of Energy's (DOE's) Office of Electricity Delivery and Energy Reliability.<sup>20</sup> SDG&E also primarily uses the same EPRI methodology as PG&E, but with additional operational and reliability benefits estimated based on Lawrence Berkeley National Laboratories' (LBNL's) Value-of-Service Reliability model.<sup>21</sup>

Because they use different methodologies, the IOUs vary in terms of the types of benefits included in their calculations. For instance, only PG&E and SDG&E include environmental benefits, while SCE does not (Table 8).

Table 8: Phase 1 Benefits Included, by IOUs

Types of Benefits Included	Phase 1: Building AMI Infrastructure <sup>(4)</sup>			Phase 2: Deploying Smart Grid Projects <sup>(2)</sup>		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
Operational	✓	✓	✓	✓	✓	✓
DR/Conservation	✓	✓	✓	✓	✓	✓
Societal	●	✓	✓	✗	✗	✓

<sup>18</sup> SDG&E categorizes reduced energy theft and meter accuracy as operational benefits.

<sup>19</sup> January 2010. EPRI. Final Report No. 1020342, "Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects".

<sup>20</sup> While no specific citation is included in SCE's 2013 Annual Report, it seems this is the same EPRI methodology used by SDG&E and PG&E.

<sup>21</sup> June 2009. LBNL. Final Report No. LBNL-2132E, "Estimated Value of Service Reliability for Electric Utility Customers in the United States".

Types of Benefits Included	Phase 1: Building AMI Infrastructure <sup>(1)</sup>			Phase 2: Deploying Smart Grid Projects <sup>(2)</sup>		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
Reliability	●	✓	●	✓	✓	✓
Environmental	×	×	✓	✓	×	✓

**Legend:**  
 ✓: Included  
 ●: Included, but do not appear to be quantified  
 ×: Not included

**Notes:**  
 (1)Based on AMI Business Case Decisions; (2)Based on Smart Grid Deployment Plans

### Comparison to EE Cost-Effectiveness Protocols

For Energy Efficiency programs, the IOUs use the CPUC-approved Energy Environment Economic (E3) Calculator to calculate cost effectiveness.<sup>22</sup> Benefits calculations for Phase 1 and Phase 2 projects also use several E3 calculator inputs. However, because the overall methodologies differ, the Phases differ in terms of the types of benefits included.

Table 9: Comparison of AMI Infrastructure and Deploying Smart Grid Projects to EE Inputs to Benefits Calculations

Types of Benefits Included	Phase 1: Building AMI Infrastructure <sup>(1)</sup>	Phase 2: Deploying Smart Grid Projects <sup>(2)</sup>	Energy Efficiency Programs <sup>(3)</sup>
Operational	✓	✓	✓
DR/Conservation	✓	✓	✓
Societal	✓	●	×
Reliability	●	✓	×
Environmental	●	●	×

**Legend:**  
 ✓: Included  
 ●: Included, but do not appear to be quantified  
 ×: Not included

**Notes on Sources:**  
 (1)Based on AMI Business Case Decisions; (2)Based on Smart Grid Deployment Plans; (3)2013-14 E3 Calculator technical memo (<https://ethree.com/>)

<sup>22</sup> <https://ethree.com/>

## 1.5 What is the status of Green Button Connect?

Below we provide a case study of one Smart Grid Project effort – Green Button and Green Button Connect. Across the IOUs, the IOUs fund Green Button projects through various sources (AMI, GRC, DR, shareholder funding, etc.). According to the reports, 2013 project costs were approximately \$2.5 million.



### Overview of Green Button

Green Button (GB) is a nation-wide initiative that launched in January 2012. The initiative was in response to the White House call-to-action<sup>23</sup> for utility customers to have easy and secure access to their energy usage information. By clicking on the “Green Button” on their utility’s website, customers can have instant access to their hourly energy use and cost information.<sup>24</sup> PG&E and SDG&E were the first utilities [nationally](#) to commit to implementing GB [nationally](#).<sup>25</sup> Since then, according to the Department of Energy (DOE), [35](#) utilities and electric suppliers<sup>26</sup>, servicing 36 million households and businesses, have implemented GB.<sup>27</sup> Beyond providing access to energy data, GB also fosters a national industry standard for energy usage data (the Energy Service Provider Interface (ESPI) data standard). This standardization has the potential to enable innovative businesses and software developers to create a wide variety of applications to help customers to understand and manage their energy use. Figure 3 shows the implementation of GB nationally.

**Commented [KMS1]:** Checked - no updates both on DOE site and GB website

<sup>23</sup> <http://www.whitehouse.gov/blog/2011/09/15/modeling-green-energy-challenge-after-blue-button>

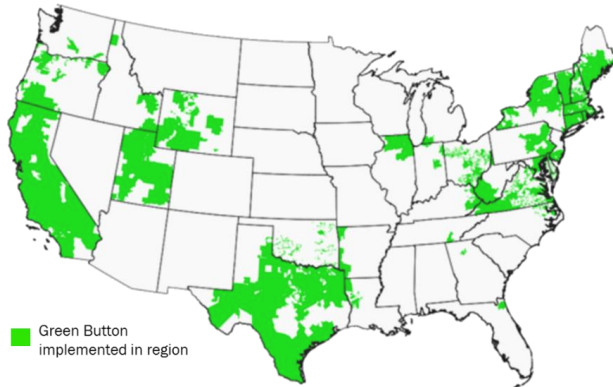
<sup>24</sup> For an example of a Green Button report, please visit [http://www.greenbuttondata.org/data/1hrLP\\_32Days.xml](http://www.greenbuttondata.org/data/1hrLP_32Days.xml)

<sup>25</sup> <http://www.whitehouse.gov/blog/2012/01/18/green-button-providing-consumers-access-their-energy-data>

<sup>26</sup> Other sources indicate that as many as 41 utilities/electricity suppliers implement Green Button nationally; please visit <http://greenbuttondata.org/> and [http://en.openei.org/wiki/Green\\_Button#Participating\\_Green\\_Button\\_UTILITY\\_Providers](http://en.openei.org/wiki/Green_Button#Participating_Green_Button_UTILITY_Providers) for additional list of Green Button providers (last accessed [8/27/2015](#))

<sup>27</sup> <http://energy.gov/data/green-button>; Last accessed [1/27/2015](#)

Figure 3: National Status of Green Button Implementation



Map Source:  
[http://en.openei.org/wiki/Green\\_Button#Green\\_Button\\_UTILITY\\_Participation\\_Map](http://en.openei.org/wiki/Green_Button#Green_Button_UTILITY_Participation_Map) (last accessed 8/27/14)  
Note: Map was last updated in October 2012



### Overview of Green Button Connect

Green Button Connect (GBC) is an offshoot of the Green Button initiative that provides utility customers the ability to automate the secure transfer of their energy usage data to an authorized third party. The industry has been engaged in ongoing discussions to implement GBC securely. In July 2011, the CPUC issued Decision 11-07-056 on the security and privacy of customer usage data. Within this Decision, the CPUC ordered the IOUs to submit advice letters seeking approval for new Electric Rules setting up procedures for the secure release of customer usage data to third parties (Rule 25 for PG&E, Rule 26 for SCE, and Rule 34 for SDG&E). The IOUs submitted these advice letters in March 2014.<sup>28</sup> In April, several stakeholders filed protests against these advice letters, and the CPUC suspended these Rules and ordered that the IOUs submit amendments to address these protests. As of August 2014, PG&E and SDG&E have submitted amendments<sup>29</sup> in August 2014, followed by SCE in October 2014. SDG&E, and SCE have since received Advice Letters of compliance to Decision 13-09-025 as of November 2014 while PG&E received approval in December 2014 from Energy Division. SCE has not yet submitted an amendment.

Commented [KMS2]: Checked - no updates

Smart Grid Project Case Study

Commented [KMS3]: Advice Letters are stored here:

Q:\8120-CPUC DNV Residential\Behavior Study\Evaluation Activities\CPUC & IOU Secondary Data

Filenames:

AL to SCE 3018-E-A Adding Language to Rule 26 20141124  
AL to PG&E 4378-E-A 20141208  
AL to SDG&E 2586-E-A 20141124

<sup>28</sup> Advice Letters 4378-E (PG&E), 3018-E (SCE), and 2586-E (SDG&E).

<sup>29</sup> Advice Letters 4378-E-A (PG&E), ~~and~~ 2586-E-A (SDG&E) and 3018 E-A (SCE).



Nationally, 38 companies support or have pledged to support the use of Green Button data to develop third party applications<sup>30</sup>, and these companies have developed 65 Green Button Connect applications.<sup>31</sup>

Below we provide an overview of California's Green Button and Green Button Connect status.

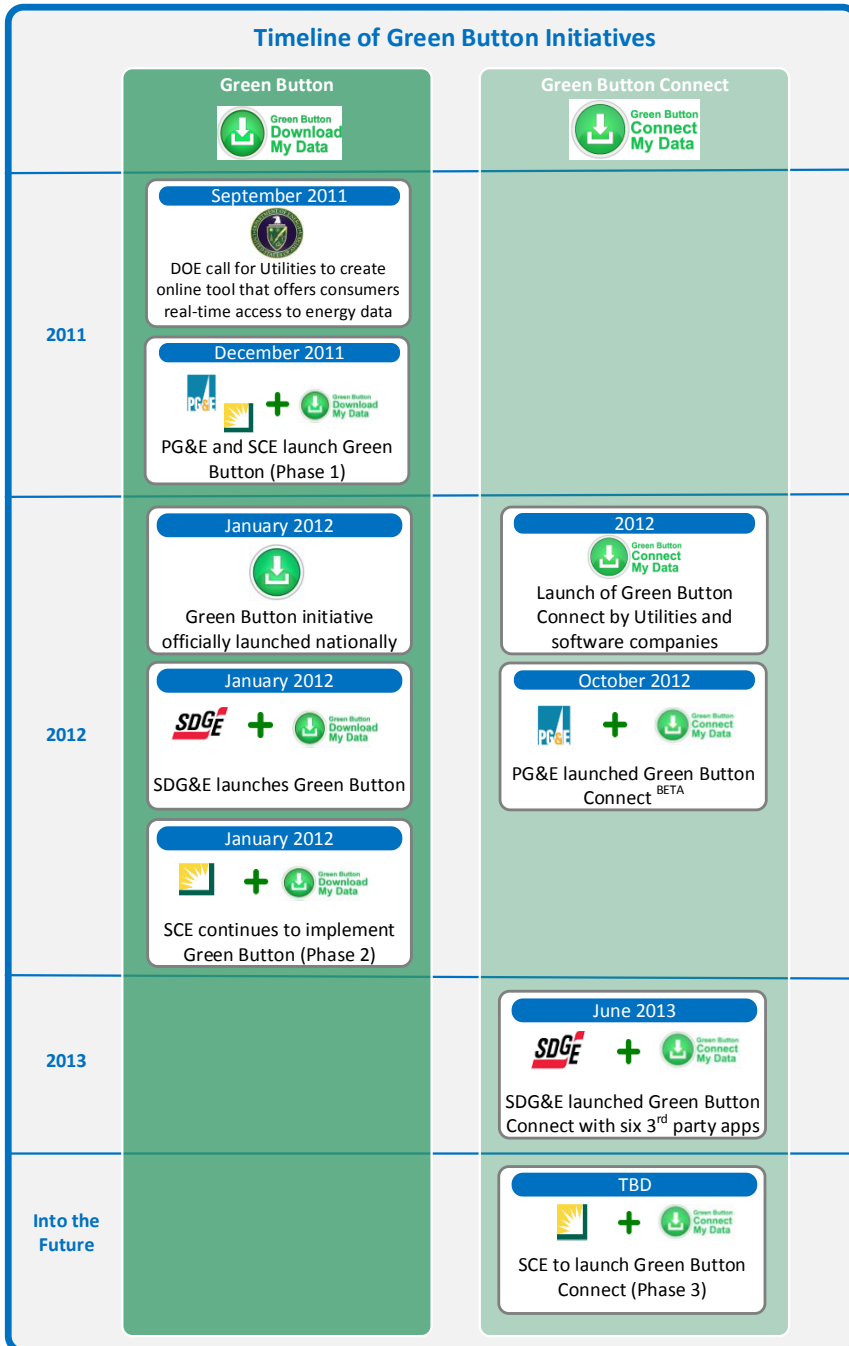
Commented [KMS4]:

Commented [KMS5]: Checked no updates

<sup>30</sup> <http://energy.gov/data/green-button>; Last accessed [1/27/2015 8:27/2014](#)

<sup>31</sup> <http://en.openei.org/apps/?keyword=Green%20Button%20Apps>; Last accessed [1/27/2015 8:27/2014](#)

Figure 4: California IOU's Progress in Implementing Green Button and Green Button Connect



As of 2013, the 2013 Smart Grid Annual Report updates indicate that PG&E, SCE and SDG&E have implemented GB. Further, PG&E and SDG&E have also completed initial launches of GBC. Additionally, California has 24-22 different applications available through GBC.

- **PG&E:** In October 2012, PG&E began beta testing GBC. PG&E launched GBC Beta with three initial third party applications (see Appendix G for a list of Green Button Connect Applications in California). Since GBC Beta began, PG&E created and launched an application process for interested third parties in January 2013. As of August 2013, PG&E received 50 applications and accepted eight that are available to customers.
- **SCE:** As of 2013, SCE implemented Green Button but not GBC. SCE anticipates launching its ESP<sup>32</sup> platform to enable GBC by September 2014. However, the suspension of SCE Electric Rule 26 may be causing delays in the implementation of GBC, as SCE has yet to submit amendments for this Rule.
- **SDG&E:** As of June 2013, SDG&E's Green Button Connect My Data launched 6 third party applications. To date, 16-17 applications (see Appendix G) use GBC.<sup>33</sup>
- **Statewide:** The 24-22 applications mainly provide information on use (14 apps), with 4 providing recommendations to save energy, 2 providing the ability to control equipment, and 2-3 providing forecasting to help with demand response and to save HVAC energy.

Commented [KMS6]: No new apps for GBC

Commented [KMS7]: No updates to this

Commented [KMS8]: Haven't found any updates on this

Commented [KMS9]: 1 new app for GBC; see updated appendix G for details re: new app for SDG&E

Commented [KMS10]: Updated

### Customer Uptake of Green Button and Green Button Connect

Theoretically, when customers gain access to near-real time usage information using GB, or a third party presents it to them in a GBC application, customers become more informed about their energy usage. As a result, customers may modify their energy usage, or shift energy usage to different periods (whether to save energy, help the environment, or lower utility bills). With GBC in particular, customers can use applications on smart phones or other mobile devices to monitor their energy usage more frequently and conveniently. This level of access to information allows for the possibility of developing long-term energy-saving habits over time. However, despite these potential benefits, customer uptake of GB and GBC remains low relative to the number of smart meters installed (Table 10).

Table 10: Customer Uptake of Green Button and Green Button Connect (As of 2013)

IOU	N of Smart Meters Installed / Active <sup>(1)</sup>	Energy Use Information Downloads via Green Button	Used GBC to Provide Data Access to Third Parties	
			Number of Customers	Percentage of Smart Meters Installed/Customers
PG&E <sup>(3)</sup>	5.26M / 3.171M	36,300	15,000	0.29%
SCE	4.97M	Data not available	Data not available	Data not available

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<sup>32</sup> Green Button also fosters a national industry standard for energy usage data (the Energy Service Provider Interface, or ESPI, data standard).

<sup>33</sup> <http://www.sdge.com/using-green-button-connect-my-data>. Last accessed 8/20/14.

IOU	N of Smart Meters Installed / Active <sup>(1)</sup>	Energy Use Information Downloads via Green Button	Used GBC to Provide Data Access to Third Parties	
			Number of Customers	Percentage of Smart Meters Installed/Customers
SDG&E <sup>(3)</sup>	2.281M / 2.278M	33,000	2,800	0.12%
<b>Sources:</b> (1) Smart Meter installation information sourced from IOU Smart Grid Annual Reports to CPUC, October, 2013 (2) PG&E Customer uptake information sourced from 2013 PG&E Smart Grid Annual Report (3) SDG&E customer uptake information sourced from <a href="http://www.sdge.com/newsroom/2013-12-04/sdge-expands-commitment-to-green-button-initiative-in-2013">http://www.sdge.com/newsroom/2013-12-04/sdge-expands-commitment-to-green-button-initiative-in-2013</a> <b>Note:</b> Data sources only provided approximate numbers				

## 1.6 Do the projected EE savings from AMI projects contribute to the current EE savings goals set forth in the Energy Efficiency Potential and Goal Study?

The EE Potential and Goals Study (PGS) is an assessment of energy savings potential for each of the four Investor Owned Utilities (IOUs) EE programs as well as for California. The PGS provides guidance for utilities' next energy efficiency portfolios, updates the forecast for energy procurement planning, informs strategic contributions to California's greenhouse gas reduction targets, as well as sets benchmarks for shareholder incentives.<sup>34</sup> More specifically, the PGS provides quantitative and qualitative assessments of savings potential to help the CPUC frame and choose energy efficiency goals to meet CPUC policy objectives.

The most recent study (2013 Potential & Goals Study) incorporates one behavior-based program -- feedback-based home energy report (HER) programs.<sup>35</sup> This 2013 PGS study estimates that HER behavioral program savings range from approximately 45 to 58 GWh per year, and reflect 0.1% to 0.2% of the market potential in California in any given year. As such, the study excluded savings from AMI-enabled behavioral programs. Because savings potential is derived from equipment, the 2013 study had difficulty disaggregating savings from equipment installation versus changes to usage-based behavior. The study authors and CPUC staff are aware of these limitations to the PGS and plan to incorporate additional behavior based savings within the next PGS, where possible.<sup>36</sup>

Beyond understanding the level of behavioral savings in the 2013 PGS, the evaluation team convened a meeting with four CPUC staff to discuss implications and ramifications of incorporating savings from AMI-enabled devices and projects within future PGS efforts. Staff provided a unique perspective based on their area of expertise.<sup>37</sup> During the meeting, we discussed whether the next round of PGS should incorporate AMI-enabled behavior-based savings and, if so, the implications of that inclusion.

<sup>34</sup> <http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm>

<sup>35</sup> Navigant Consulting and Hescong Mahone Group. March 2012. Analysis to Update Energy Efficiency Potential, Goals, and Targets for 2013 and Beyond.

<sup>36</sup> Opinion Dynamics is member of the newly scoped PGS and will bring our knowledge to support improving the behavioral component.

<sup>37</sup> We included member of the current and past PGS team, as well as a staff involved with DR and AMI.

Overall, we found that from a conceptual standpoint there are benefits to incorporating these efforts within the study. Benefits include:

- **Consistent with IDSM Policy Direction.** The California Energy Efficiency Strategic Plan recognizes the integration of demand-side management (DSM) options including energy efficiency (EE), demand response (DR), and distributed generation (DG) as fundamental to achieving California's strategic energy goals.<sup>38</sup> Additionally, the Demand Response team is working to develop a potential and goals study with Lawrence Berkeley National Laboratories. As such, the various groups are well positioned to work together and collaborate across disciplines to better integrate planning efforts to realize the potential benefits from these efforts across these groups.
- **Increase in California's EE Potential Savings.** Incorporating additional AMI-enabled behavior-based savings potential and supporting pilot and program efforts can support achievement of California's aggressive energy savings goals. More research is required to understand the scale of potential savings (future memos will provide a range of savings from other jurisdictions).
- **Integration of AMI into DSM Program Design.** The AMI Business Cases assumed that AMI would present an opportunity to enhance existing programs as well as develop new EE and DR programs that leverage AMI-data to better serve customers through enhanced and customer-specific targeting.

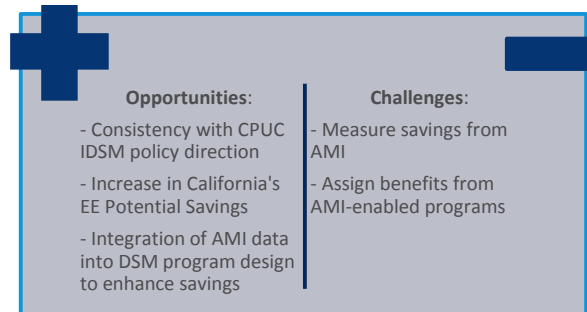
However, incorporating these savings may present operational challenges. For example:

- **Measuring Savings for AMI.** Because the PGS determines the goals, budgets and shareholder incentives from energy efficiency programs, experts indicated that should AMI-enabled devices be incorporated into future studies, the CPUC would need to develop a mechanism to accurately measure and determine impacts. More specifically, the models currently used to estimate potential savings do not reflect savings from conservation based efforts. Further, evaluation of net effects of feedback-based programs is necessary to accurately capture program influenced changes. Given these areas, the challenge is to create a module within PGS that allows conservation impacts to be robustly captured. Additionally, net-to-gross efforts would need to measure the influence of AMI data as a potential cause for equipment purchases, which may be distinct from existing influence assumptions.
- **Assigning Benefits.** Additional investigation will be required to determine which group realizes the savings benefits from these AMI-enabled pilots/programs. For example, because AMI Business Cases identified a series of costs and benefits expected to accrue from advanced metering infrastructure, the PGS likely cannot incorporate those benefits as this would double-count benefits already accounted for elsewhere. However, it is our understanding that the PGS could incorporate any incremental benefits from leveraging AMI-enabled devices into potential savings estimates. To date, our team does not have sufficient information from status reports to comprehensively trace incremental benefits and costs across funding streams. As such, future reporting would benefit from enhanced tracking requirements to support accounting for, and allocating, costs and benefits appropriately, to better inform cost-effective choices for future efforts.

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<sup>38</sup> Integrated Demand Side Management Program (2013-2014) Fact Sheet: <http://www.cpuc.ca.gov/NR/rdonlyres/1A990EF9-1D4F-4BE4-9B3E-0B8DE4700726/0/201314IDSMProgramFactSheet.pdf>

Figure 5: Opportunities and Challenges to Incorporating SG Projects into PGS



Next steps include working with the CPUC and the contractor developing the next PGS to identify opportunities to incorporate savings related to AMI-enabled devices. Additionally, policy guidance is needed across funding streams (EE, DR, AMI, others) to support determining how to measure benefits and allocate those benefits across funding streams.

## 1.7 Next Steps

As noted above, the PGS provides assessments of savings potential to help the CPUC frame and choose energy efficiency goals to meet CPUC policy objectives. Incorporating AMI-enabled project savings could potentially support realizing many of the customer empowerment and engagement benefits explicated in the AMI Business Case Decisions (Phase 1) and Smart Grid Deployment Plans (Phase 2). Additionally, integrating these projects into future planning and goals could also support enhancing quantification of anticipated benefits and results from these projects as they would require greater measurement and evaluation. Our review indicates that greater requirements for tracking costs and benefits from AMI-enabled efforts would support greater understanding of the benefits realized to date, and serve to inform future prioritization of projects.

Moving forward, Opinion Dynamics will report on the progress to date of the 23 customer engagement projects highlighted earlier. We have already described the number and types of projects funded by source. Depending on the availability of data, we will:










- Describe the intervention strategy for each project focusing on potential barriers and gaps
- Summarize the performance to date of each
  - Provide number of participating customers in each
  - Provide anticipated savings by project where available to identify potential savings and benefits











Importantly, in this memo and future memos, we will provide a snapshot of the status of AMI deployment for these in-scope 23 projects. Additionally, a review of current California projects, as well as similar national projects, will provide guidance regarding how the CPUC can cost-effectively allocate resources (relative to the costs of the most recent projects) to projects that will yield the anticipated benefits from the Smart Meter Business Cases, as well as any incremental benefits.

## Appendix A. Summary of AMI and SG Decisions






This attachment provides supporting data for the findings presented in the memo. Specifically, we reviewed the eight CPUC documents shown in Table 11. These included the initial Decisions approving funding for each of the four California IOUs' Advanced Metering Infrastructure (AMI; i.e., smart meter) projects, as well as Rulings and Decisions adopting frameworks for cost-effectiveness analysis and metrics for measuring the success of these projects.

Table 11: Smart Meter Business Case Decisions and Other Documents Reviewed

Phase	Proceeding Number	IOU/Org	Decision/Report Date	Title	Purpose of Document
AMI Deployment	R. 02-06-001		July 2004	Ruling Adopting a Business Case Analysis Framework for Advanced Metering Infrastructure	Establishes an analysis framework for estimating the costs/benefits of AMI projects
AMI Deployment	Filed in Compliance with R.02-06-001		January 2005	Advanced Metering Infrastructure Revised Preliminary Business Case Analysis – Volumes 1 through 4	Business case analysis of SCE's AMI project
AMI Deployment	Filed in Compliance with R.02-06-001		January 2005	Advanced Metering Infrastructure AMI Business Case Supplemental Filing	Business case analysis of SDG&E's AMI project
AMI Deployment	Filed in Compliance with R.02-06-001		March 2005	Updated Preliminary AMI Business Case Analysis of PG&E, U-39E, March 15, 2005	Business case analysis of PG&E's AMI project
AMI Deployment	D. 06-07-027		July 2006	Final Opinion Authorizing Pacific Gas and Electric Company to Deploy Advanced Metering Infrastructure	Approves PG&E's AMI project
AMI Deployment	A. 05-03-015		February 2007	Settlement Agreement Regarding San Diego Gas & Electric Company's Advanced Metering Infrastructure Application	Settlement Agreement revising SDG&E's AMI business case
AMI Deployment	D. 07-04-043		April 2007	Opinion Approving Settlement on San Diego Gas & Electric Company's Advanced Metering Infrastructure Project	Approves SDG&E's AMI project
AMI Deployment	A. 07-07-026		July 2007	Edison SmartConnect Deployment Funding and Cost Recovery: Exhibit 3: Financial Assessment and Cost Benefit Analysis	Presents the financial assessment and cost benefit analysis of SCE's AMI project
AMI Deployment	A. 07-07-026		July 2007	Application for Approval of Advanced Metering Deployment Activities – Appendix A Settlement Agreement	Settlement Agreement revising SCE's AMI business case

Phase	Proceeding Number	IOU/Org	Decision/Report Date	Title	Purpose of Document
AMI Deployment	D. 08-09-039		September 2008	Decision Approving Settlement on Southern California Edison Company Advanced Metering Infrastructure Deployment	Approves SCE's AMI project
AMI Deployment	R. 08-12-009		December 2008	OIR 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 the Smart Grid System	Initiates proceeding to consider strategies for IOUs to enhance the ability of the electric grid to support California's energy-related policy goals
AMI Deployment	D. 09-03-026		March 2009	Decision On Pacific Gas And Electric Company's Proposed Upgrade to The Smartmeter Program	Approves additional funding to PG&E's AMI program
AMI Deployment	D. 10-04-027		April 2010	Decision on Application of Southern California Gas Company for Approval of Advanced Metering Infrastructure	Approves SCG's AMI project
Smart Grid Development	D. 10-06-047		June 2010	Decision Adopting Requirements for Smart Grid Deployment Plans Pursuant to Senate Bill 17 (Padilla), Chapter 327, Statutes of 2009	Outlines the information that must be provided in Smart Grid Annual Reports
Smart Grid Development	Filed in compliance with R. 08-12-009		June 2011	PG&E's Smart Grid Deployment Plan	Comprehensive description of smart grid deployment strategy
Smart Grid Development	Filed in compliance with R. 08-12-009		June 2011	SDG&E's Smart Grid Deployment Plan 2011-2020	Comprehensive description of smart grid deployment strategy
Smart Grid Development	Filed in compliance with R. 08-12-009		July 2011	SCE's Application for Approval of Smart Grid Deployment Plan	Comprehensive description of smart grid deployment strategy
Smart Grid Development	D. 11-07-056		July 2011	Decision Adopting Rules to Protect the Privacy and Security of the Electricity Usage Data of the Customers of PG&E, SCE, and SDG&E	Adopts rules for IOUs and third parties regarding the privacy and security of customer usage data; orders IOUs to make CAISO wholesale price information available to customers
Smart Grid Development	n/a		December 2011	CPUC 2011 Smart Grid Report	Annual update on the status of the California smart grid

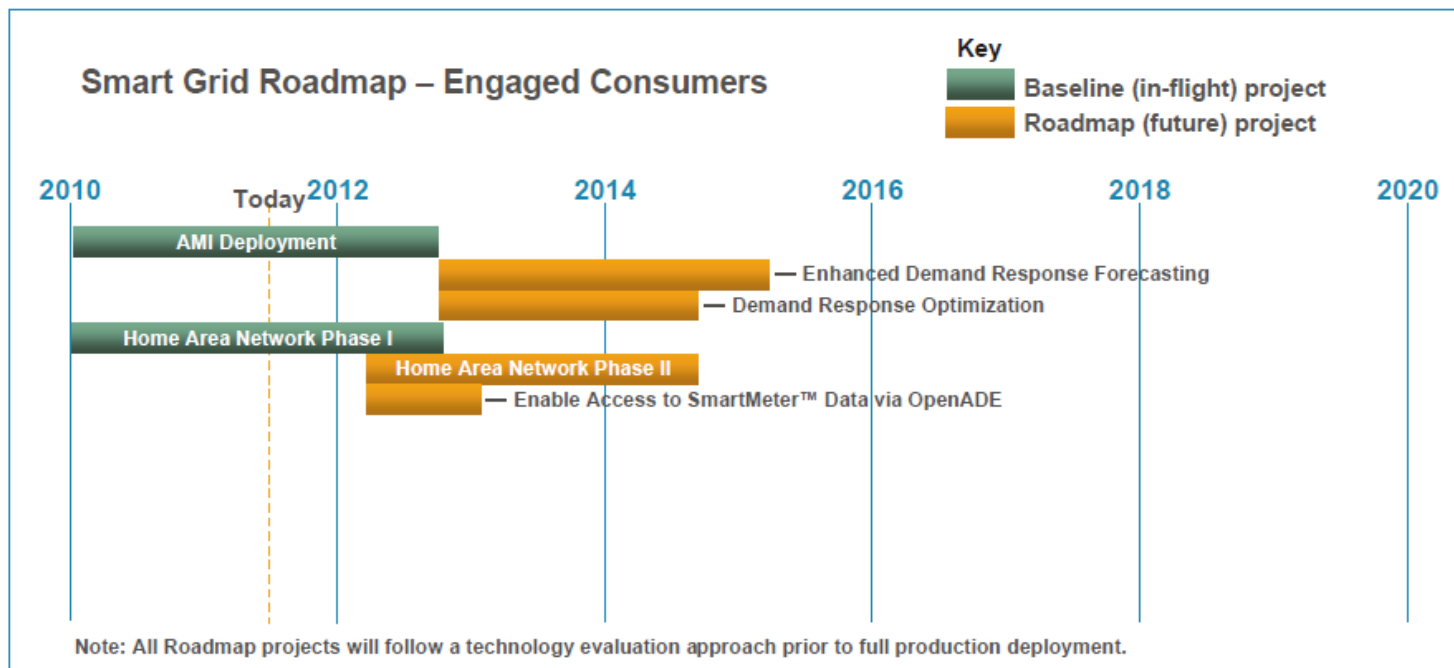


Phase	Proceeding Number	IOU/Org	Decision/Report Date	Title	Purpose of Document
Smart Grid Development	D. 12-04-025		April 2012	Decision Adopting Metrics to Measure the Smart Grid Deployments of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company	Adopts the metrics for measuring the progress of PG&E, SCE and SDG&E smart meter projects
Smart Grid Development	n/a		October 2012	PG&E's Smart Grid Annual Report	Annual update on AMI-enabled pilots and programs
Smart Grid Development	n/a		October 2012	SCE Annual Update – Smart Grid	Annual update on AMI-enabled pilots and programs
Smart Grid Development	n/a		October 2012	SDG&E Smart Grid Deployment Plan Annual Report	Annual update on AMI-enabled pilots and programs
Smart Grid Development	n/a		April 2013	2012 Program Year Smart Meter Program Enabled Demand Response and Energy Conservation Annual Report	Report on demand response, energy efficiency, and other financial benefits from 2012 AMI-enabled programs
Smart Grid Development	n/a		October 2013	PG&E's Smart Grid Annual Report	Annual update on AMI-enabled pilots and programs
Smart Grid Development	n/a		October 2013	SCE Annual Update – Smart Grid	Annual update on AMI-enabled pilots and programs
Smart Grid Development	n/a		May 2014	Annual Report to the Governor and the Legislature, California Smart Grid	Annual update on the status of the California smart grid
Smart Grid Development	n/a		October 2013	SDG&E Smart Grid Deployment Plan Annual Report	Annual update on AMI-enabled pilots and programs

## Appendix B. Smart Grid Deployment Plan Roadmaps

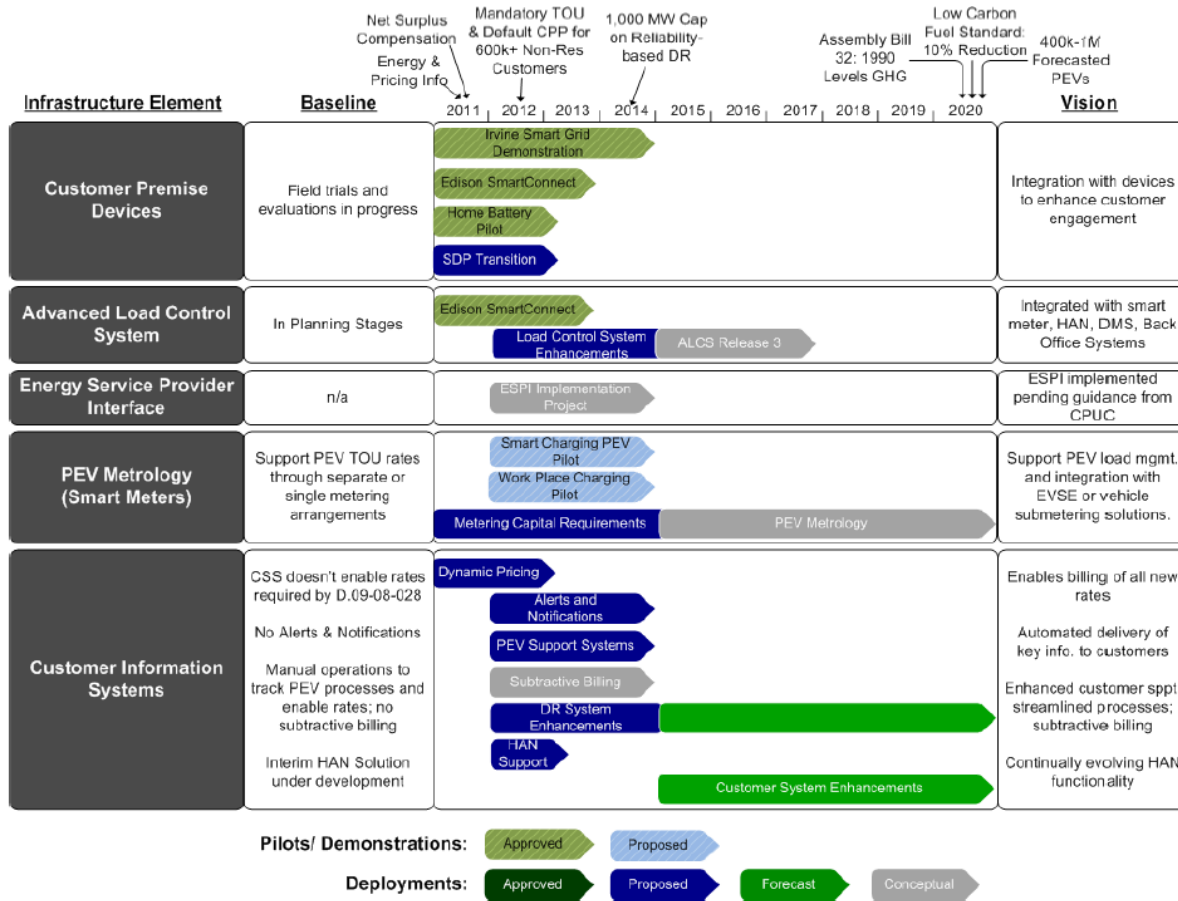
Below we provide each IOU's Smart Grid Deployment Plan Roadmaps specific to Customer Engagement projects. These roadmaps provide an overview of anticipated efforts through 2020.

Figure 6: PG&E Smart Grid Roadmap – Engaged Customers



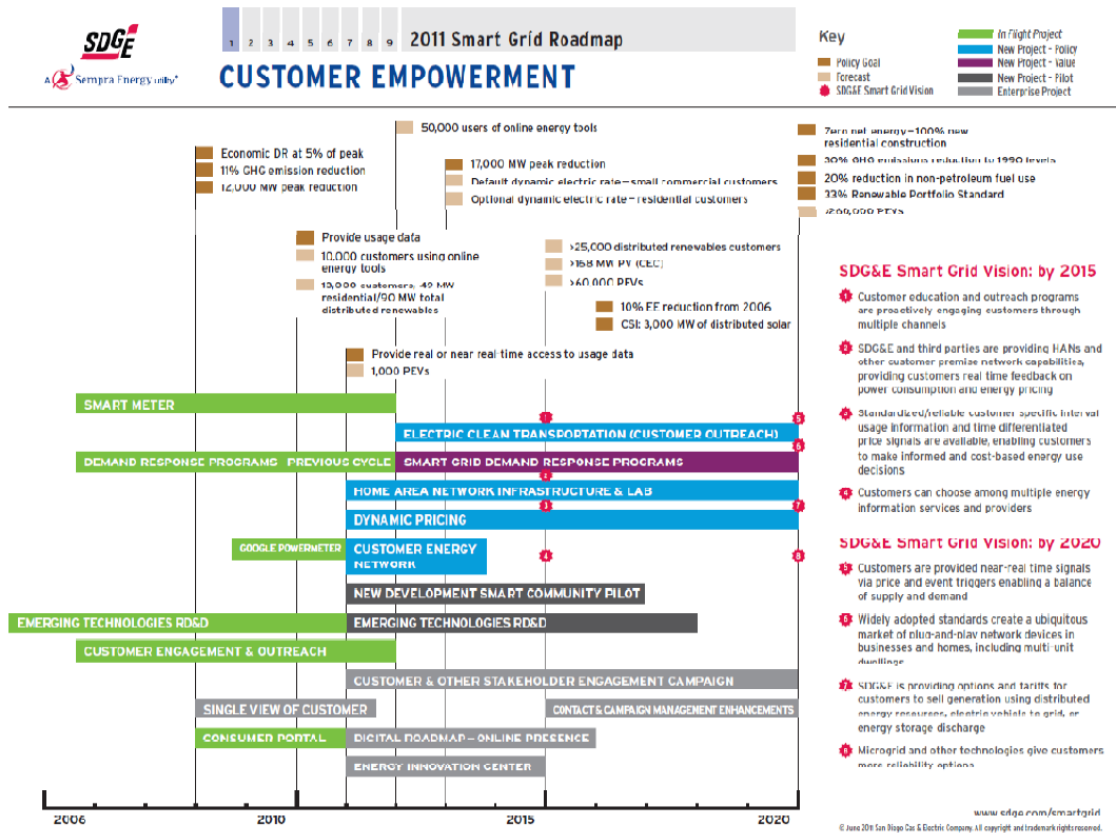
Source: PG&E's Smart Grid Deployment Plan, pp. 126.

Figure 7: SCE's Smart Grid Deployment Plan – Customer Empowerment Baseline and Roadmap Summary



Source: SCE's Smart Grid Deployment Plan, pp. 107.

Figure 8: SDG&E 2011 Smart Grid Roadmap – Customer Empowerment



Source: SDG&E's Smart Grid Deployment Plan, pp. 231

## Appendix C. Summary of Budget and Benefits Information Collected from AMI Deployment Business Case Decisions and Smart Grid Deployment Plans

### Costs and Benefits of AMI Deployment Business Case Decisions

The table below present the final budget allotments approved by the CPUC for each of the IOUs.

Table 12: Approved Phase 1: Building AMI Infrastructure Budgets, by IOU

IOU	Budget (millions)
PG&E <sup>(1)</sup>	\$2,256.6
SCE	\$1,633.5
SDG&E	\$1,050.7
SCG	\$572.0
(1) Includes initial budget of \$1,684.6 plus an additional \$572 approved later for AMI upgrades	

The IOUs estimate costs and benefits for AMI projects in 2004 present value revenue requirement (PVRR). The table below presents estimated savings for each of the IOUs' projects.

Table 13: Potential Costs and Benefits Phase 1: Building AMI Infrastructure, by IOU

IOU	Estimated Cost (PVRR millions)	Estimated Benefits (PVRR millions)	Net Benefits (Benefits-Cost) (PVRR millions)	Estimated Benefits to Cost (B/C) Ratio
PG&E	\$2,258	\$2,258 <sup>(1)</sup>	\$0 <sup>(1)</sup>	1.00 <sup>(1)</sup>
SCE	\$1,981	\$1,990	Between \$9 and \$304 <sup>(3)</sup>	Between 1.00 and 1.11 <sup>(2)</sup>
SCG	\$1,040	\$1,067	\$27	1.03
SDG&E	\$652	Between \$692 and \$703	Between \$40 and \$51	Between 1.06 and 1.08 <sup>(2)</sup>
(1) Number are assumed based on our review; in D. 06-07-027, the CPUC agreed that 90% of the project cost would be recouped in operation benefits, with the remaining 10% recouped with demand response benefits				
(2) Calculated by the Evaluation Team				
(3) \$9 million is without societal benefits; \$304 is inclusive of \$295 in societal benefits				

## Costs and Benefits Associated with AMI-enabled Customer Empowerment and Engagement Projects

The initial Phase 1: Building AMI analysis, which focused on operational benefits from the infrastructure, initially found that AMI deployment was not cost-effective. Notably, according to interviews with staff, AMI replaced what in some cases were 50 to 60 year old meters, suggesting that AMI was a worthwhile project regardless of cost-effectiveness. In the second round of analysis, the Business Cases incorporated customer empowerment and engagement benefits (which by nature are difficult to quantify). The IOUs based these proposed benefits on four categories within the original CPUC ruling: 1) systems operations, 2) customer service benefits, 3) demand response benefits, and 4) management and other benefits. From this long-term perspective, operational benefits were the primary focus, with the intention of having a “reliable and resilient”<sup>39</sup> grid, followed by the ancillary benefits of providing data to enhance customer empowerment and engagement.

The table below presents the cost and benefit estimates for the various smart grid projects identified in the AMI deployment decisions and Smart Grid Deployment Plans, respectively.

**Table 14: Costs and Benefits of Customer Empowerment and Engagement Projects in AMI Deployment Business Case Decisions**

Document	IOU	Customer Engagement Project C/B Item	Cost Amount (Million \$)*	Benefit Amount (Million \$)*	Decision Page
D.06-07-027	PG&E	No relevant projects associated with this Decision	No associated costs	No associated benefits	n/a
D.09-03-026	PG&E	HAN Retrofits	\$25	No associated benefits	151-152
		IT	\$50	No associated benefits	151-152
		EE Conservation	No associated costs	\$ 269	151- 152
		PTR	\$28	\$ 263	151-152
		PCT	\$26	\$83	180, 193
		A/C Cycling	No associated costs	\$129	24
D.08-09-039 (Settlement Agreement)	SCE	Near Real Time Technology/SCE Web Portal	\$4	\$164	7, A-1
		PCT	\$58	\$32	11, B-2
D.07-04-043	SDG&E	DR	No associated costs	\$33	70
		PCT	No associated costs	\$13 to 24	73
		Information Feedback	No associated costs	\$19	70
<b>Total Costs and Benefits</b>			<b>\$191</b>	<b>\$1,005 to \$1,016</b>	<b>n/a</b>

\*PG&E and SCE estimate costs and benefits in PVRR (discounted) terms. While it is likely that SDG&E also uses PVRR (per the AMI Deployment analysis framework stipulated by the CPUC), we could not confirm this with certainty.

<sup>39</sup> 2013 Smart Grid Report, April 2014.

**Table 15: Costs and Benefits of Customer Empowerment and Engagement Projects in Smart Grid Deployment Plans**

Document	Customer Engagement Project C/B Item	Cost Amount (Nominal Million \$)	Benefit Amount (Nominal Million \$)	Plan Page
PG&E Smart Grid Deployment Plan	Integration of Enhanced DR Forecasting	\$5-9	Total customer engagement benefits ranged from \$596 to \$1,404*	161, 176-177
	Demand Response Optimization	\$10-18		161, 176-177
	HAN Phase II -- Pricing and Load Control Signals	\$27-51		161, 176-177
	Enable Access to Smart Meter data via Open Automated Data Exchange	\$8-15		161, 176-177
SCE Smart Deployment Plan	Metering Capital Requirements (2nd Meter for PEV)	\$11	No associated benefits	129
	EE Conservation (HAN)	No associated costs	250,000 MWh/year**	129, 133
	Dynamic Pricing	\$33	370 additional MW/year**	129, 132
	Alerts and Notification Projects	\$20	No associated benefits	129
	PEV Support Systems	\$8	No associated benefits	129
	HAN Support and Troubleshooting	\$8	No associated benefits	129
	SDP Transition	\$27	No associated benefits	129
	ALCS System Enhancements	\$2	No associated benefits	129
	Other Load Control System Enhancements	\$3	No associated benefits	129
	Smart Charging Plug-In Electric Vehicle Pilot	\$1	No associated benefits	129
	Workplace Charging Pilot	\$1	No associated benefits	129
DR System Enhancements	\$3	No associated benefits	129	
SDG&E Smart Grid Deployment Plan	Customer Empowerment Programs	\$1.26-1.27	\$0.81 to \$1.01	273, 303
<b>Total Costs and Benefits</b>		<b>\$168 to \$211</b>	<b>\$597 to \$1,405</b>	<b>n/a</b>

Note: Across the SGDP's, cost and benefits are estimated in nominal (non-discounted) terms. However, estimates may not be comparable across IOUs given differing timeframes.

\* Benefits were bundled with non-Customer Engagement projects, and thus these amounts may not reflect benefits solely attributable to Customer Engagement projects.

\*\*Benefits were not quantified into monetary values. Benefits were also bundled, and thus may include benefits from non-Customer Engagement projects.

## Appendix D. Costs and Benefits Assumptions

In Table 16 below we present the inputs used in benefits calculations for Phase 1: Building AMI, for each IOU.

Table 16: Phase 1 Benefits Inputs to Benefits Calculations, by IOU

Assumptions	PG&E	SCE	SCG	SDG&E
<b>Assumptions for Benefit Calculations</b>				
Benefits presented as 2004 present value dollars	✓	✓	✓	✓
Demand response savings based on weighted average of savings under average hot weather conditions	✓	✓	✓	✓
Discount rate=utility cost of capital	✓	✓	✓	✓
Avoided peak demand cost: \$85/kW-year	✓	✓	✓	✓
Avoided energy cost: \$63/MWh	✓	✓	✓	✓
Avoided capacity generation cost: \$52/kW-year	✓	✓	✓	✓
2006-2021 analysis period	✓	✓	● (1)	✓
Effective Useful Life (EUL) of AMI: 20 years	✓	✓	✓	● (2)
<b>Legend:</b>				
✓: Included				
●: Included, but slightly different from other IOUs				
✗: Not included				
<b>Notes:</b>				
(1) SCG uses an analysis period of 2016-2034				
(2) SDG&E uses a useful life value of 17 years				

In Table 17 below, we present the types of costs included for determining the cost-effectiveness of Phase 2: Deploying Smart Grid Projects.

Table 17: Phase 2 Costs, by IOUs

Type of Costs Included	PG&E	SCE	SDG&E
Asset Management, Safety and Operational Efficiency	✓	✓	✓
Customer Empowerment and Engagement	✓	✓	✓
Distribution Automation and Reliability	✓	✓	✓
Integrated and Cross-Cutting Systems	✓	✓	✓
Security	✓	✓	✓
Transmission Automation and Reliability	✓	✓	✓
<b>Legend:</b>			
✓: Included			
✗: Not included			
<b>Source:</b> May 2014. CPUC. Annual Report to the Governor and the Legislature, Smart Grid.			



## Appendix E. List of AMI Deployment and Smart Grid Projects

The tables below present, by IOU, the Smart Grid Projects we have identified. We also include brief descriptions of each program and funding source. We collected projected cost information from the 2013 Annual Smart Grid Annual Updates.

Table 18: List of 2013 PG&E Customer Empowerment and Engagement Projects

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
<b>Projects Included in the Study</b>			
Time Varying Rates (TVR)	N/A	\$18,500,000	Time varying pricing products, such as Peak Day Pricing (PDP) and Time-of-Use (TOU), take advantage of SmartMeter™ capabilities that are now largely available across PG&E's service territory. Charging customers different rates based on varying system conditions is intended to more closely align retail and wholesale electric prices for generation, as well as create economic incentives for customers to actively manage their energy costs by shifting electricity use from when it costs more to when it costs less. There are a number of pricing programs implemented today and others envisioned for the future. The SmartMeter™ has enabled PG&E to cost-effectively offer all customers these types of rate programs which provide significant customer and societal benefits.
Home Area Network (HAN) Demand Response (DR) Integration Pilot Project	N/A	\$11,940,000	PG&E's HAN DR Integration Project builds upon the HAN IT infrastructure by delivering price signals and load control messaging to expand the DR opportunities for residential and Small & Medium Business (SMB) customers. This pilot evaluation project will involve approximately 2,000 residential and SMB SmartRate™ and Peak Day Pricing (PDP) customers, allowing PG&E to identify issues, obtain feedback, and learn from its customers. It will include HAN devices that provide real-time energy prices and respond to DR notifications of critical pricing events.
Home Energy Reports	N/A	\$5,500,000	Home Energy Reports is a behavior-based energy efficiency initiative, under the Residential Energy Advisor (EA) program, that provides customers with normative neighborhood comparisons to similar households and personalized energy saving recommendations. The key features of the report include raising awareness of customer energy usage, using social norms to influence customer behaviors,

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			and motivating customers to further engage with PG&E programs and resources such as registering to use My Energy Web Tools and the Universal Audit Tool.
Universal Audit Tools (UAT)	N/A	\$3,700,000	PG&E provides the Home Energy Checkup and Business Energy Checkup (Universal Audit Tools) for residential and small and medium business customers through My Energy. These tools utilize SmartMeter™ data along with other customer insights to make it easy for our customers to find energy savings ideas that are particular to how they use energy. The tools are progressive in nature, continually learning based on the information the customer provides, and include recommendations across energy efficiency, demand response, distributed generation, and behavioral changes
My Energy Web Tools	N/A	\$2,000,000	PG&E's customer website – My Energy – allows residential, small and medium business, and small agricultural customers to view usage, price and cost, and take advantage of various rate analysis tools. The usage information is displayed in a variety of formats including year to year comparison, peak/off peak, hourly and 15 minute interval data (depending on the granularity of the SmartMeter™ data), bill to date and monthly bill forecast. The “My Energy” website will also include a rate calculator which will calculate the customer bill under a variety of available rate plans
HAN Enablement Program – Phase 1 & Phase 2	N/A	\$1,840,000	PG&E's HAN Enablement program is an infrastructure that allows customers to register and commission a standards compliant device with PG&E's AMI network to receive near real-time data from their SmartMeter™. In HAN Phase 1 (Initial Deployment), which ran from March 1, 2012 through April 30, 2013, PG&E installed and supported 430 In Home Displays (IHDs) with residential customers. Starting in January 2013, PG&E launched HAN as a platform, making the capability to register a device and received near real time usage information from a customer's electric SmartMeter™ available to all eligible customers across its service territory. Phase 2 of the HAN Enablement Program provides customers with a list of five PG&E validated devices that can be purchased through retail channels. As part of this project, PG&E issued a Request for

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			Information (RFI) to the retail market to identify devices and technologies (IHDs, gateways, and repeaters) that are interoperable with PG&E's SmartMeter™. After purchasing a validated HAN device, customers will be able to self-register their device through PG&E's My Energy (self-registration launching at the beginning of 2014) and receive near real-time usage information directly from their SmartMeter.
Green Button Connect (GBC) Beta	N/A	\$540,000	With Green Button Connect (GBC) Beta, PG&E gives customers greater control over SmartMeter™ enabled energy usage data. Green Button Connect is a software interface that allows PG&E customers to easily share their energy usage data with other energy service providers. These developers can then "mash up" the data in unique ways to provide valuable insights to customers.
Opower/Honeywell Smart Thermostat Assessment /Pilot	N/A	\$390,000	PG&E is conducting a Smart Thermostat Pilot with OPower and Honeywell to evaluate the energy benefits that accrue to customers who utilize internet-enabled thermostats, when exposed to behavioral energy saving messaging. This trial is a component of the Energy Efficiency Portfolio's Emerging Technologies Program, and will include a pilot group of approximately 500 residential customers
Energy Alerts	N/A	\$100,000	The PG&E Energy Alerts program notifies customers when their energy consumption crosses into higher rate Tiers or is forecasted to cross into higher rate Tiers by the end of a billing period. This program is currently being offered to residential customers with electric SmartMeters™ and who are on electric Rate Schedules E1, E6, E7 and E8.
The Green Button Initiative	N/A	\$0	In PG&E's Green Button Initiative, the Green Button tool provides customers with a means of easily accessing and downloading their energy use online in a standardized format that can be shared with energy service providers.
<b>Projects Excluded from the Study</b>			
SmartMeter™ Program	Smart meter deployment	\$2,319,000,000 <sup>40</sup>	In the SmartMeter™ Program, PG&E installed SmartMeter™ technology that enables PG&E's customers to understand how and when they

<sup>40</sup> Expenditures are since project inception.

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			use energy. This technology serves as the foundation for tools that allows customers to automate their home energy management and enable multiple future technologies. The SmartMeter™ system improved infrastructure integrity, helped PG&E manage energy demand and supply, and also enabled PG&E to provide more reliable service. Through these functionalities, the SmartMeter™ Program has been a vital foundational step toward the creation of a Smart Grid, which in turn fosters a clean energy economy and sustainable economic expansion
Energy and Carbon Management System (ECMS)	Non-residential	\$5,000,000	In the ECMS, PG&E has developed tools specifically for PG&E's large Commercial and Industrial (C&I) customer account representatives to identify opportunity customers and enable a consultative energy discussion with those customers using advanced usage analytics and financial metrics for proposed energy efficiency projects.
Automated Demand Response (AUTO-DR) Program	Non-residential	\$1,900,000	PG&E's Automated Demand Response (AutoDR) program offers small, medium and large commercial, industrial and agricultural customers an incentive to install automated equipment that enhances their ability to reduce load during DR program events. Specifically, AutoDR is an automation-based communication infrastructure that links PG&E's designated third party hosted solution servers to customer-owned Energy Management Control Systems (EMCS). PG&E helps its customers to develop pre-programmed energy management and curtailment strategies to automate their facilities when PG&E calls a DR event day.
Proxy Demand Resources (PDR) Program Phase 1	Non-residential	\$1,060,000	As part of the Commission's vision of integrating retail-wholesale DR programs, in the PDR Program Phase 1 PG&E is in the process of enabling its retail DR programs to directly participate in the CAISO's wholesale market - PDR product. Phase 1 of this project is focused on assembling the proper tools (i.e., telemetry, forecasting) and integrating interfaces (procurement back end systems to schedule, notify and settle) that PG&E needs to operate when bidding available DR resources in the CAISO market.
Business Energy Reports	Non-residential	\$650,000	Business Energy Reports is a behavior-based energy efficiency emerging technologies pilot,

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			similar in concept and experimental design to the residential Home Energy Reports program, that provides small to medium (SMB) commercial customers with printed energy assessment reports with normative comparisons to similar businesses and offers personalized energy saving recommendations. The key features of the Business Energy Report include raising awareness of the energy usage and cost at the business premise, using social norms to influence customer behaviors, informing customers of new and existing PG&E energy efficiency programs, offering downloadable guides and checklists to help businesses take action to conserve energy, and motivating customers to go online and engage with PG&E such as registering for MyEnergy Web Tools and the Universal Audit Tool
Plug-in Hybrid Electric Vehicle/Electric Vehicle (PHEV/EV) Smart Charging Pilot	Customers not involved in study	\$210,000	In the PHEV/EV Smart Charging Pilot, PG&E and the Electric Power Research Institute (EPRI) tested baseline functionalities of PEV charging hardware by conducting an end to end system connectivity to evaluate potential residential smart charging capabilities utilizing the load management software over the SmartMeter™ network
Intermittent Renewable Resource Management (IRRM) Pilot Phase 2	Back-office/operations	\$57,000	In the IRRM Pilot Phase 2, PG&E will leverage the 2009 2011 IRRM Pilot Phase 1 and continue to explore the integration of DR resources into the CAISO market to help with renewable resource integration. In this pilot, PG&E specifically will address unlocking the value streams that new and existing DR resources might be able to provide when utilized for system operations, and, more importantly, when there is a greater penetration of renewable resources in the grid. IRRM Pilot Phase 2 is structured to allow for the inclusion of third party DR providers which is a step closer for integrating DR retail programs into the CAISO wholesale market.
Demand Response Transmission & Distribution (T&D) System Integration	Back-office/operations	\$36,000	In T&D System Integration, PG&E will evaluate areas where existing DR programs can support PG&E's T&D utility planning and operations. In addition, this project will evaluate how future DR programs can be designed and implemented to support the needs and objectives of PG&E's T&D operations

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
Customer Data Access Project	Back-office/operations	\$0	Under the Customer Data Access (CDA) project, PG&E will develop a platform that will provide authorized and secure data to customer-authorized third parties registered with the Commission. Upon authorization, energy service providers will have access to customer meter data, including electric internal energy usage data, in a standardized format. Phase 2 of the CDA project will focus on increasing the types of customer data that will be supported. Possible additional data include DR events, pricing information, and public/directed messages for third parties.
Intermittent Renewable Resource Management (IRRM) Pilot Phase 1	Back-office/operations	\$0	In the IRRM Pilot Phase 1, PG&E leveraged work performed under the Commercial and Industrial (C&I) DR Participating Load Pilot to provide regulation services to the CAISO. The objective of the IRRM Pilot Phase 1 was to demonstrate whether customers can provide second by second frequency-regulation service needs to the CAISO.
Demand Response Plug-In Electric Vehicle (DR PEV) Pilot	Customers not involved in study	\$0	In the DR PEV Pilot, PG&E intends to evaluate the feasibility of utilizing PEV batteries, when they are in the vehicle and after they are removed from the vehicle, to provide grid services to the utility
Smart Grid Customer Outreach and Education Pilot	Workshop/Outreach	\$0	In its Smart Grid Customer Outreach and Education pilot, PG&E proposed to will test new messaging and customer outreach materials to determine how best to communicate the Smart Grid to customers in a way that meets the overall objectives of the Smart Grid deployment. The results of this pilot would have been used to develop strategies to mitigate areas of potential customer concern or confusion prior implementing a larger, territory wide outreach campaign

Table 19: List of 2013 SCE Customer Empowerment and Engagement Programs

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
<b>Projects Included in the Study</b>			
Edison SmartConnect Field Trials – HAN with Load Control (LC)	N/A	\$9,500,000	HAN with LC involved upgrading systems and automating processes from IHS Phase 1 to enable self-registration of HAN devices via sce.com My Account. Customers have been able to purchase HAN devices through retailers and service providers and register the devices through the web. Customers who register a new HAN device are eligible to receive a HAN device rebate (\$25 for IHDs, dongles or gateways, \$125 for PCTs (\$50 towards the device purchase and \$75 for the installation). This project also included a limited launch of 500 programmable communicating thermostats that were provided by SCE and installed by an SCE contractor. Customers who choose to participate are enrolled in the Summer Discount Plan (SDP) program and have the capability to override the load control event on the thermostat (depending on the SDP option they choose). This limited launch enables SCE to evaluate the technology and processes before offering this option to a broader set of customers.
HAN Phase IV- Advanced Load Control System and Enhancements	N/A	\$5,200,000	HAN Phase IV will enable customers (residential and business) to register SEP 2.0 Wi-Fi enabled HAN devices to communicate with SCE back office systems so they may enroll in SCE demand response and energy efficiencies programs. This project will require enhancements to the infrastructure that supports registration of SEP 1.x ZigBee enabled HAN devices and the enrollment in demand response programs, as well as, system updates to support HAN operations. This additional HAN communication channel will enable SCE to support customers who prefer to leverage internet-based devices (e.g., their mobile devices) versus ZigBee-enabled HAN devices and enable SCE to offer new HAN programs (e.g., TOU price signals) to help customers manage their energy usage and costs.
Edison SmartConnect Field Trials – Interim HAN Solution (IHS) Phase 1	N/A	\$20,000	The Interim HAN Solution was a limited launch to 500 eligible residential, SmartConnect, “program ready” customers. Eligible customers were invited by email and enrolled using a simple form on sce.com. Participation included enrollment in the Save Power Day Incentive Plus

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			(PTR-ET) program, receiving a free SEP 1.0 in-home display device and the customer calling SCE to register the device. Registered HAN devices displayed near real-time energy information from the meter, daily bill-to-date, bill forecast and price and tier text messages and Save Power Day event notifications. This project implemented a new Advanced Load Control system for device registration, which will be leveraged in the future for HAN load control using programmable communicating thermostats.
Edison SmartConnect Field Trials – HAN Real-time Cost Pilot (RTCP)	N/A	\$10,000	The RTCP, implemented pursuant to D.11-07-056, leveraged the IHS Phase 1 project. The only difference was that 250 of the 500 customers received a HAN device that was capable of calculating near real-time cost using SCE's daily cost/price HAN text message. The purpose of the RTCP was to determine how SCE can convey cost information to customers and gain insight as to how customer's value cost information relative to energy usage information.
Edison SmartConnect Field Trials – HAN Third Party Limited Launch	N/A	\$0	This pilot enabled customers to purchase SCE-compatible HAN devices via a retail provider or service provider. The pilot included the same features as the IHS Phase 1 project, including enrollment in Save Power Day Incentive Plus and daily cost/price messages sent to the HAN devices. SCE evaluated customer experiences with SCE and third parties to adjust the processes and customer education materials appropriately for the next HAN project (HAN with Load Control).
Edison SmartConnect Field Trials – Long Beach Field Trial	N/A	\$0	Through this pilot program, SCE installed two different in-home display devices in customer homes to learn how customers interact with the devices, how they value the information, and what features they feel are important to effectively manage their energy usage. The devices were deployed to 38 customer homes and customers completed surveys to provide feedback.
Green Button Initiative	N/A	\$0	In September 2011, the White House challenged utilities to enable customers to download their usage data in a consistent format by clicking a "Green Button" on the utility's website



Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
<b>Projects Excluded from the Study</b>			
Dynamic Pricing System Modifications	Back-office/operations	\$11,268,000	SCE will modify existing systems to support the additional dynamic pricing rates and associated rate analysis and energy management tools. These new rates are required by D.09-08-028.
Irvine Smart Grid Demonstration	Workshop/Outreach	\$8,914,787	The ISGD project will provide an end-to-end demonstration of Smart Grid technologies. It will investigate the use of phasor measurement technology to enable deep, substation-level situational awareness. It will also evaluate the latest generation of distribution automation technologies, including looped 12 kV distribution circuit topology utilizing universal remote circuit interrupters. Advanced Volt/VAR Control capabilities will be used to demonstrate customer energy consumption savings through conservation voltage reduction. The project scope includes customer homes, where the integration, monitoring, control, and efficacy of home area network devices such as energy management systems, smart appliances, energy storage, and photovoltaic systems will be demonstrated. The impact of device-specific DR, load management capabilities involving energy storage devices and plug-in electric vehicle charging equipment will also be assessed. DR events will use the protocol standards being adopted by AMI programs such as Edison SmartConnect®. The project will demonstrate SCE's next generation of Substation Automation (SA-3), a design based on the open standard IEC-61850. This is expected to provide measurable engineering, operations, and maintenance benefits through improved safety, security, and reliability. SA-3 is designed to meet or exceed current generation NERC CIP compliance requirements and will demonstrate interoperability among multiple vendors' existing equipment. ISGD's Secure Energy Network will enable end-to-end interoperability and provide the cybersecurity essential to Smart Grid development and adoption. ISGD will be deployed at the University of California, Irvine and at SCE's MacArthur substation.
Summer Discount Plan (SDP) Transition	A/C Cycling Program	\$7,400,000	SCE modified its residential Summer Discount Plan (SDP), an air conditioner load control cycling program, from a reliability-based DR program to a price-responsive program that

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			offers customers the choice of override or cycling options to mitigate the potential inconvenience and discomfort of curtailment events.
HAN Phase III- Automate Back Office Processes (Formerly HAN Support Systems)	Back-office/operations	\$1,200,000	HAN Phase III will automate manual back office processes to enable SCE to support forecasted customer HAN adoption forecasts, enable customer HAN self-service tools, support DR and pricing programs load reduction goals, and begin marketing HAN capabilities to customers.
Home Battery Pilot	Solar/DG/renewables	\$1,015,111	Deploy residential energy storage units in up to 18 different customer locations to assess their performance in a variety of environments and applications.
Metering Capital Requirements	Back-office/operations	\$16,500	SCE plans to deploy additional ESC meters to accommodate customer adoption of time-variant PEV rates through 2014. These meters will leverage the AMI network and back office systems deployed as part of Edison SmartConnect to acquire and manage PEV load data.
Alerts and Notifications System	Back-office/operations	\$0	The alerts and Notifications system will automate the delivery of important information to help customers manage their bill and payments, prepare for planned outages, and successfully adopt a smart energy lifestyle by taking advantage of dynamic pricing, DR, and EE programs.
Demand Response Systems Enhancements	Back-office/operations	\$0	SCE owns and licenses a variety of systems used to dispatch and measure demand response events. These systems primarily consist of notification systems, load control dispatch systems, event status webpages, customer enrollment and reporting systems, and demand response bidding platforms. During the 2012-2014 funding cycle, SCE proposes various changes and enhancements to these systems to increase self-service, prepare for integration with the CAISO markets, and incorporate Edison SmartConnect-enabled programs.
Energy Service Provider Interface	Back-office/operations	\$0	Pursuant to D.11-07-056, on March 5, 2012, SCE filed an Application (A.12-03-004) proposing a technology platform and infrastructure to enable third parties, when authorized by a customer, to receive that customer's usage data in a secure, automated manner. SCE's proposal uses the data format from the Energy Service Provider Interface (ESPI) national Smart Grid standard (adopted by

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			the North American Energy Standards Board in October 2011). This platform will support customer authentication and authorization, data exchange from SCE to a technically eligible third party, and customer revocation of authorization. (The Commission may order SCE to revoke a third party's access to customer data in appropriate circumstances.) On September 23, 2013, the Commission issued Decision (D.) 13-09-025. That Decision approved SCE's ESPI Application. The Decision authorizes SCE to spend \$7.588 million in capital and \$1.512 million in O&M through 2014
Ongoing Customer System Enhancements (Future GRCs)	Back-office/operations	\$0	Ongoing customer system enhancements were included in SCE's Smart Grid Deployment Plan as an indicator of future funding requests beyond 2014.
PEV Support Systems	Back-office/operations	\$0	SCE plans to upgrade customer information systems in the 2012-2014 time period to support a more efficient and transparent process by which customers can enroll in dynamic rates for PEVs.
Subtractive Billing	Back-office/operations	\$0	The purpose of this project is to develop a protocol for customer-owned submetering, pursuant to D.11-07-029 and to execute submetering pilots pursuant to a pending Decision in Phase 4 of the AFV OIR (R.09-08-009). The pilots will demonstrate emerging technologies such as data communication between customer-owned submeters and utility systems, test current and future meter technologies and evaluate back office processes including subtractive billing.
Smart Charging Plug-In Electric Vehicle Pilot	Customers not involved in study	\$0	The Smart Charging PEV Pilot investigates utilization of the utility's AMI to effectively manage plug-in vehicle loads. Through this pilot, SCE will explore DSM programs that aim to reduce overall system demand along with programs that decrease the impact of vehicle charging on distribution infrastructure such as transformers
Work Place Charging Plug-In Electric Vehicle Pilot	Non-residential	\$0	The Work Place Charging PEV Pilot deploys Electric Vehicle Service Equipment (EVSE) at SCE facilities to test, monitor, and analyze the impacts of PEV workplace charging. This pilot will test impacts to building or facility electric supply systems and help to determine user preferences in pricing options and DR capabilities.

Table 20: 2013 SDG&E Customer Empowerment and Engagement Program

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
<b>Projects Included in the Study</b>			
Smart Pricing Program (Dynamic Pricing)	N/A	\$17,580,000	SDG&E's smart pricing program was proposed via application A.10-07-009 filed on July 6, 2010 and modified as described in the Joint Party Settlement Agreement filed on June 20, 2011. The application and Settlement Agreement describe SDG&E's plans to implement TOU and dynamic rates for residential and small business customers, along with the system upgrades and customer outreach and education efforts necessary to successfully transition SDG&E's electric customers to smart pricing. On Dec. 12, 2012, the CPUC adopted D.12-12-004 approving TOU and dynamic rates for SDG&E's residential and small business customers.
Green Button Connect My Data	N/A	\$1,127,000	: Energy Services Provider Interface (ESPI – CEN Phase 3a) - Green Button Connect My Data is the automated sending of Green Button data to third parties (per customer request/consent) via a standard interface (NAESB/ESPI). Customers' data will be sent using one of two models: One and done (one-time data transmission of up to 13 months of customer consumption depending on customer data availability) and Ongoing (customer data to be transmitted on an ongoing basis as long as customer is enrolled with third party).
HAN Projects	N/A	\$868,000	DRCA Phase 1: The first phase implementation of a HAN Demand Response Control Application (HAN DRCA) will achieve the functionality required by resolution (R.)E-4527 and will allow customers to provision a HAN device to their Smart Meter. Reduce Your Use IHD Pilot: The objective of this pilot is to study the impact of customer energy savings during Reduce Your Use events when provided with an IHD. DRCA/HAN Pilot & Study: The objective of this project was to implement a back-office system (DRCA) to manage and control HAN devices, study the HAN technology and customer's response to the technology. Demand Response Signaling: Provide an interim solution to send demand response signals to ZigBee enabled thermostats connected to Smart Meters in

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
			support of the demand response programs deploying thermostats.
Smart Grid Demand Response Programs	N/A	\$649,000	Smart Grid related demand response programs are a subset of the programs included in SDG&E's demand response application (A.11-03-002) filed on March 1, 2011. Specifically, these include SDG&E's Reduce Your Use program (referred to as 'Peak Time Rebate' [PTR] in A.11-03-002) and new construction programs (NCDRP).
PEV Rate Experiment (Study)	N/A	\$252,000	The objective of this project is to examine PEV consumer TOU charging preferences, the use of smart-charging enabling technology, and other relevant factors through a study that includes the use of CPUC approved experimental PEV rates. SDG&E is conducting this research in collaboration with ECotality's EV Project and Nissan during the introduction of the Leaf PEV to the greater San Diego region, which began in December 2010. This study will examine the price elasticity of demand for electricity by time-of-day among PEV vehicle consumers as an indicator of the sensitivity of electricity demanded to its change in price.
Digital Roadmap	N/A	\$0	The digital roadmap provides for six initiatives that supply 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 My Account website; (b) eServices; (c) digital research; (d) including social media into two-way communications; (e) digital advertising; and (f) mobile applications.
<b>Projects Excluded from the Study</b>			
Smart Meters	Smart meter deployment	\$33,344,000	The SDG&E Smart Meter project was approved by the CPUC in D.07-04-043 in April 2007. Smart electric meters are solid state, digital devices that record energy usage data and, unlike traditional meters, transmit and receive data. Smart Meters record hourly electric consumption for residential customers and 15-minute consumption for commercial customers. Daily consumption is recorded for natural gas usage.
Electric Vehicle (Clean Transportation)	Workshop/Outreach	\$612,000	The objective of this project is to provide educational outreach to all customers and electric transportation stakeholders through various means (printed and digital/online

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
Education and Outreach			collateral, website, web tools, call center, utility-hosted seminars), at SDG&E's Energy Innovation Center, community events, in-person meetings, and training on the following topics: 1) Rates, metering, and billing analysis (service choices), 2) Safety and reliability, 3) Line extension rules, 4) Basic information about PEVs, information resources, PEV supply equipment, and support services, and 5) Environmental and financial benefits (AB32, off-peak charging). In addition to addressing the information needs of SDG&E customers and various PEV stakeholders, the overarching outcome of these education and outreach efforts (as well as the projects listed below) leads to broader PEV market developmental and support.
Connected...to the sun	Solar/DG/renewables	\$100,000	In January 2012, SDG&E filed an application with the CPUC for a pilot program called "Connected.....to the Sun," which will give all SDG&E customers two options to buy solar power, even if they do not own a home, cannot afford the upfront cost of solar, or do not have the ability to put PV panels on their roof. Customers could lock in their solar energy cost and take solar service with them if they relocate within SDG&E's service area. A brief overview of the two solar options are as follows: 1. Share the Sun a. Solar provider constructs projects in San Diego for purchase by SDG&E customers b. Customers purchase energy rights from a participating solar provider c. Customers receive solar energy and a credit on their monthly bill from SDG&E 2. Sun Rate a. SDG&E sets aside local solar projects under contract for customers b. Customers can subscribe to pay the SunRate price for 50%, 75%, or 100% of their electricity use c. Customers receive solar energy from SDG&E
Centralized Calculation Engine	Back-office/operations	\$0	The development of a centralized calculation engine which will take data passed in from multiple data sources and provide price and cost calculations as output. The calculation engine will be flexible and all comprehensive rate, price, and cost modeling, as well as the ability to manipulate curved, types of charges (consumption, demand, fixed, etc.) peak moves, event hour shifts, and more. It will ensure consistency of calculations and output across many operations and users.

Program Name	Reason Excluded	Annual Expenditures (July 1, 2012 to June 30, 2013, unless otherwise noted)	Program Description
Vehicle to Home (V2H) Pilot	Customers not involved in study	\$0	There is ongoing activity to track the progress and findings of the Vehicle-to- Home pilot sponsored by Nissan in Japan to determine if a parallel pilot should be conducted in SDG&E's service territory. Although frequency and voltage characteristics of the utilities between the two countries are different, the applications introduced by Nissan and others are being evaluated for U.S. application and potentially limited testing. The investigation of the safety features of the applications is paramount. For example, understanding the safety precautions embodied in the application in islanding and re-closing of the circuits of the home from the utility grid can be safely accommodated during a period of outage or a planned interruption of service.
Smart Meter Operations Center	Smart meter deployment	\$0	The Smart Meter operations center, network monitoring, and visualization project will provide the tools to determine system status and availability of network devices (meter endpoints). The Smart Meter network monitoring and visualization project is proposed as a precursor to a separately proposed, larger effort for applied data analytics, exception management, asset management, and predictive modeling.
Community & Stakeholder Engagement:	Workshop/Outreach	\$0	SDG&E's community and stakeholder engagement effort is intended to provide campaign-level coordination in the utility's engagement effort and ensure that the overarching connections between programmatic outreach and education efforts are present. Encompassed in this effort is a wide variety of stakeholder-focused efforts, all significantly associated with Smart Grid and specifically SDG&E's Smart Grid efforts. SDG&E has actively worked with business association and residential groups to educate them on the changing landscape of the energy industry. After the Smart Meter deployment education effort, SDG&E recognized the need to continue community and business outreach on energy issues. SDG&E is working hard to ensure its stakeholders - in particular, customers - look to SDG&E as a trusted energy advisor

## Appendix F. Glossary of Terms















Acronym	Definition
ALCS	Advanced Load Control System
ALJ	Administrative Law Judge
AMI	Advanced Metering Infrastructure
B/C	Benefit-to-Cost
CAISO	California Independent System Operator
CEC	California Energy Commission
CPUC	California Public Utilities Commission
CSS	Customer Service System
DMS	Distribution Management System
DOE	Department of Energy
DR	Demand Response
E3	Energy Environment Economic (E3) Calculator
EE	Energy Efficiency
EPRI	Electric Power Research Institute
ESPI	Energy Service Provider Interface
EUL	Effective Useful Life
EVSE	Electric Vehicle Supply Equipment
GBC	Green Button Connect
GHG	Greenhouse Gas
HAN	Home Area Network
IOU	Investor-Owned Utility





















Acronym	Definition
kW	Kilowatt
kWh	Kilowatt-hour
LBNL	Lawrence Berkeley National Laboratories
LC	Load Control
MW	Megawatt
MWh	Megawatt-hour
OIR	Order Instituting Rulemaking
PC	Personal Computer
PCT	Programmable Communicating Thermostat
PEV	Plug-in Electric Vehicle
PG&E	Pacific Gas & Electric
PGS	Potential and Goals Study
PTR	Peak Time Rebate
PVRR	Present Value of Revenue Requirement
RD&D	Research, Development & Demonstration
SCE	Southern California Edison
SCG	Southern California Gas
SDG&E	San Diego Gas & Electric
SDP	Summer Discount Plan
SG	Smart Grid
SGDP	Smart Grid Deployment Plan
SMB	Small and Medium Business
T&D	Transmission & Distribution
TOU	Time-of-Use













## Appendix G. List of Green Button Connect Applications Developed for California IOUs

Table 21: Green Button Connect Applications Available in California as of August 2014

Third Party Application	IOU	Description	Web Link
 Active Energy by Power TakeOff		<ul style="list-style-type: none"> <li>Energy data analysis and reporting web-based application that allows customers to track their energy consumption</li> </ul>	<a href="http://www.powertakeoff.com/">http://www.powertakeoff.com/</a>
 Bidgely		<ul style="list-style-type: none"> <li>Energy management application that monitors energy use of appliances in customers' homes and is capable of comparing energy usage between or among similar homes close to each other</li> </ul>	<a href="https://www.bidgely.com/">https://www.bidgely.com/</a>
 BuiltSpace		<ul style="list-style-type: none"> <li>Provides detailed, up-to-date information on energy usage to customers</li> </ul>	<a href="http://www.builtspace.com">www.builtspace.com</a>
 EEme by EEme, LLC		<ul style="list-style-type: none"> <li>Provides personalized energy-efficiency recommendations based on each customer's home profile through analyzing meter data</li> </ul>	<a href="http://www.energyefficiency.me/">http://www.energyefficiency.me/</a>
 EnACT (Beta) by enACT Systems, Inc		<ul style="list-style-type: none"> <li>Free application that provides cost-saving energy solutions for customer homes</li> </ul>	<a href="http://www.enact-systems.com/">http://www.enact-systems.com/</a>
 Energy Independence Program - Action Plan Tool		<ul style="list-style-type: none"> <li>An energy analysis tool that allows home owners to maximize cost savings, minimize carbon footprint, improve comfort and health conditions, and evaluate home projects through upgrade recommendations and energy saving tips</li> </ul>	<a href="http://sonoma.planetecosystems.com/?url=action-plan">http://sonoma.planetecosystems.com/?url=action-plan</a>
 Energy Usage Management by IncentForce		<ul style="list-style-type: none"> <li>Monitors and provides information to help customers understand their energy use and consumption costs, the application also alerts customers by email, mobile application or text messaging</li> <li>Features a social energy application that encourages behavioral changes in energy consumption by promoting energy conservation as positive behavior that helps the community</li> </ul>	<a href="http://www.incentforce.com/index.html">http://www.incentforce.com/index.html</a>

Thrd Party Application	IOU	Description	Web Link
 EnergyAI™		<ul style="list-style-type: none"> <li>Provides users with information on how to save energy by analyzing historical energy use data from meters and identifying usage patterns and abnormalities</li> </ul>	<a href="http://www.energyai.com/EAIWeb/">http://www.energyai.com/EAIWeb/</a>
 <a href="#">EnergyElastics by San Diego State University</a>		<ul style="list-style-type: none"> <li>Forecasts future energy consumption, predicted energy expenses and provides information on the best times to run household appliances</li> </ul>	
 EnergyHub		<ul style="list-style-type: none"> <li>Cloud-based application that allows customers to monitor and manage their thermostat/s either within the home or remotely</li> </ul>	<a href="http://www.energyhub.com/">http://www.energyhub.com/</a>
 ERA CPP by Joule Assets, Inc.		<ul style="list-style-type: none"> <li>Market analysis tool that performs billing analysis under current rate schedule and compares to bill under CPP rate schedule</li> </ul>	<a href="http://www.jouleassets.com/joule-assets-openadr-partnership/">http://www.jouleassets.com/joule-assets-openadr-partnership/</a>
 ERGY by Echo Labs		<ul style="list-style-type: none"> <li>Allows two-way communication between retail customers and energy products and analyzes data to enable customers to monitor and manage their resources more efficiently</li> </ul>	<a href="http://www.echolabs.net/energy-management">http://www.echolabs.net/energy-management</a>
 Gridium		<ul style="list-style-type: none"> <li>Monthly subscription to smart meter data that provides non-residential customers with demand forecasting, fault detection, cost forecasting and variance analysis, performance tracking and energy savings calculations</li> </ul>	<a href="http://www.gridium.com/">http://www.gridium.com/</a>
 Leaffully		<ul style="list-style-type: none"> <li>Monitors how customers use energy and sends information to customers on their energy usage weekly</li> <li>Notifies customers of unusual energy usage behavior via alerts</li> </ul>	<a href="https://leaffully.com/">https://leaffully.com/</a>
 MRPRO™ by Papros, Inc		<ul style="list-style-type: none"> <li>Gathers energy data allowing customers to track their energy usage, which can be used to control energy consumption and cost</li> <li>Calculates carbon footprint</li> </ul>	<a href="http://www.papros.com/">http://www.papros.com/</a>
 PEV4Me by True Labs		<ul style="list-style-type: none"> <li>Calculates the cost of electricity to charge electric vehicles and cost savings on gas</li> </ul>	<a href="http://www.pev4me.com/">http://www.pev4me.com/</a>
 PowerTools by Candi Controls		<ul style="list-style-type: none"> <li>Application that allows customers to view energy usage data and provides energy saving tips</li> </ul>	<a href="https://www.candicontrols.com/powertools.html">https://www.candicontrols.com/powertools.html</a>

Commented [KMS12]: Added - website appears to be under construction but the app is already available via Android Market

Third Party Application	IOU	Description	Web Link
 SCP™ - Smart Customer Portal by Smart Utility Systems		<ul style="list-style-type: none"> <li>Application that provides customers tools and relevant information to manage individual energy needs</li> </ul>	<a href="http://smartusys.com/smart-solutions/scp.aspx">http://smartusys.com/smart-solutions/scp.aspx</a>
 Smart leak detector™ by PowWow Energy		<ul style="list-style-type: none"> <li>Software for farmers and ranchers that monitors leaks in irrigation systems to minimize water loss, energy use and cost by tracking water pumps</li> </ul>	<a href="https://www.powwowenergy.com/">https://www.powwowenergy.com/</a>
 Stem		<ul style="list-style-type: none"> <li>Cloud-based predictive software for non-residential customers that lowers energy bill by reducing peak loads, predicting patterns in energy use, and deploying stored energy at precise time periods</li> </ul>	<a href="http://www.stem.com/">http://www.stem.com/</a>
 UnPlug Stuff by Home Energy Analytics		<ul style="list-style-type: none"> <li>Informs residential customers with regard to how much energy is wasted when idle.</li> </ul>	<a href="http://www.unplugstuff.com/pge.html">http://www.unplugstuff.com/pge.html</a>
 WeatherBug Home		<ul style="list-style-type: none"> <li>Provides reliable information on home energy use as it correlates to weather data in real-time and predicts how much heating or cooling energy is needed in a timely manner to help customers save money and energy</li> </ul>	<a href="http://weatherbughome.com/">http://weatherbughome.com/</a>