Application of San Diego Gas & Electric Company (U902M) for Authority, Among Other Things, to Increase Rates and Charges for Electric and Gas Service Effective on January 1, 2012.	A.10-12-005 (Filed December 15, 2010)
Application of Southern California Gas Company (U904G) for authority to update its gas revenue requirement and base rates effective on January 1, 2012.	A.10-12-006 (Filed December 15, 2010)

Application 10-12-005
Exhibit No.: SDG&E-211

PREPARED REBUTTAL TESTIMONY OF

THOMAS BIALEK, PH.D., P.E.

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

OCTOBER 2011

TABLE OF CONTENTS

Summary of Request

SDG&E's request is shown in Table 1 below. After conducting a cost benefit analysis on all its smart grid deployment plan (SGDP) projects, which includes these GRC projects, SDG&E withdrew the condition based maintenance (CBM) expansion because at this time it appears costs will exceed benefits. At a July 20, 2011 presentation meeting held in SDG&E's San Francisco Opera Plaza offices with DRA and interested GRC interveners, SDG&E presented a plan comparison and discussed the relationship between the SGDP and GRC projects. This presentation is provided in Attachment A.

Table 1 – SDG&E's Smart Grid Portfolio of Projects

Project	2011	2012	Total
Renewable Growth - Energy Storage	$25,193	$29,790	$54,983
Renewable Growth - Dynamic Line Ratings	$1,963	$1,963	$3,926
Renewable Growth -Phasor Measurement Units	$1,475	$2,581	$4,056
Renewable Growth - Capacitor SCADA	$2,902	$2,902	$5,804
Renewable Growth - SCADA Expansion		$5,964	$5,964
Electric Vehicle Growth - Plug-In Electric Vehicles			$0
Electric Vehicle Growth - Smart Transformers	$2,047	$521	$2,568
Electric Vehicle Growth - Public Access Charging Facilities		$5,230	$5,230
Reliability - Wireless Faulted Circuit Indicators	$1,302	$2,199	$3,501
Reliability - Phase Identification	$1,184	$4,027	$5,211
Reliability - Condition Based Maintenance Expansion		$752	$752
Smart Grid Development - Integrated Test Facility	$502	$1,340	$1,842
Total	**$36,568**	**$57,269**	**$93,837**
Total w/o CBM Expansion		**$56,517**	**$93,085**

PREPARED REBUTTAL TESTIMONY OF
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I. INTRODUCTION

The following rebuttal testimony regarding smart grid infrastructure portfolio of projects addresses the intervener testimony dated September 2011 of:

- Laura Krannawitter, Division of Ratepayer Advocates (DRA);
- Ralph C. Smith, CPA, Federal Executive Agencies; and
- Dale Pennington, Utility Consumers' Action Network.

In the timeframe available to respond to DRA and intervener testimony, SDG&E does not address each and every DRA and intervener proposal item. However, it should not be assumed that failure to address any individual issue implies any agreement by SDG&E with the DRA or other intervener proposals.

As noted in Exhibit SDG&E-210, the rebuttal testimony of Mr. Krevat, DRA, FEA and UCAN do not dispute the need to invest in Smart Grid but rather recommend waiting. In addition, UCAN also offers alternative solutions that are not feasible as will be discussed in detail later in this rebuttal. SDG&E customers are not waiting; however, so neither can SDG&E. This rebuttal testimony begins with a description of San Diego Smart Grid drivers.

A. San Diego Smart Grid Drivers

SDG&E's smart grid portfolio of projects is needed to meet the State of California's ambitious energy policy goals. These projects are grouped to meet four main drivers. The first driver is the need to mitigate the impacts of renewable generation development that is planned and occurring in the San Diego region. The second driver is the arrival of Nissan Leaf all-electric vehicles and Chevy Volts which increases the immediate need for Smart Grid technologies on the electric grid in San Diego. The third driver is SDG&E's aging infrastructure and the increased complexity of grid operations that require Smart Grid solutions. Lastly, the fourth driver is a need for SDG&E to test the function of new consumer focused technologies on the installed smart meters and associated systems to enable Smart Grid characteristics. These drivers are described in greater detail below:

1. Renewable Growth

When SDG&E originally drafted its opening testimony, its electric distribution circuits needed to accommodate year-end 2009 levels of photovoltaic generation by customers (PV) of approximately 65 MW_{ac} (megawatts of alternating-current, one MW for one hour is about enough energy to supply 650 homes for one hour). This had to be accomplished without impacting grid voltage operating limits or creating any operations and maintenance issues. However, as shown in Figure 1 there are now approximately 110 MW_{ac} installed, a change of approximately 69% in less than two years. Figure 1 also shows that the actual growth of PV in the SDG&E service territory exceeds the California Energy Commission, CEC, forecast. Figure 1 includes a blown-up portion of the curves with the calculated actual growth exceeding the CEC forecast by 75%. No party disputes this growth of customer owned PV is occurring.

In addition to rooftop PV, SB32 was signed into law by the Governor which created a feed-in-tariff program for PV unit up to 3 MW_{ac} in size, with SDG&E's allocation expected to be 60.2 MW_{ac}. The Commission, in D.10-12-048, also approved a renewable auction mechanism for PV systems sized 1-20 MW_{ac} with the total in SDG&E's service area to be 80 MW_{ac}. These larger systems will likely be sited in the rural areas of San Diego County where SDG&E's

system is the weakest and trigger the need for infrastructure upgrades to accommodate their interconnection.

When SDG&E compares its original prediction of high penetration PV circuits utilizing year end 2009 actual data and adjusted for the CEC forecast of future growth with high penetration circuits based upon actual 2010 data, as shown in Figure 2, once again there is a significant shift to the right. This means the amount of PV on SDG&E circuits is higher than originally predicted, and this trend is expected to continue. Figure 3 presents a different view of the PV penetration data over time for circuits with penetration levels greater than 20 and 30 percent with their actual predicted levels. Once again no party disputes the high PV penetration level on circuits is occurring.

SDG&E also presented real measured data of the impact of a PV system on SDG&E's primary distribution circuit voltage.[1] The measured changes in voltages are outside SDG&E's design tolerance limits with a resultant negative impact on operations and customers. Again no party disputes this measured data and even take pains to avoid discussing it.

SDG&E's case is compelling and the data provided above is not disputed by any intervening party. Therefore, from the data and forecast currently available, SDG&E believes investment in mitigation of intermittent photovoltaic generation is necessary and the integrating renewable portfolio of projects should be funded at the requested levels.

[1] Exhibit SDGE-11, TOB-10.

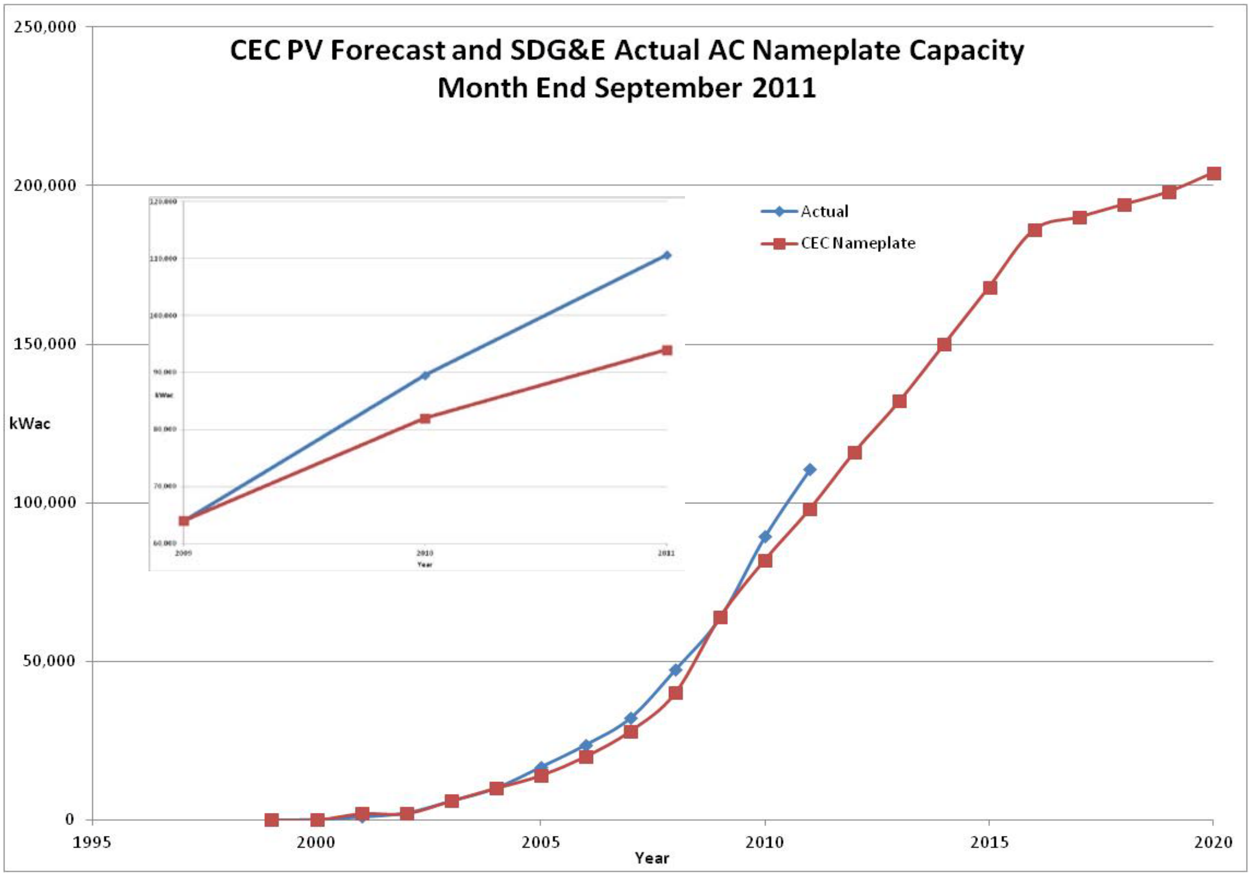

Figure 1 – PV Forecast and Actual Installed Nameplate Capacity by Year

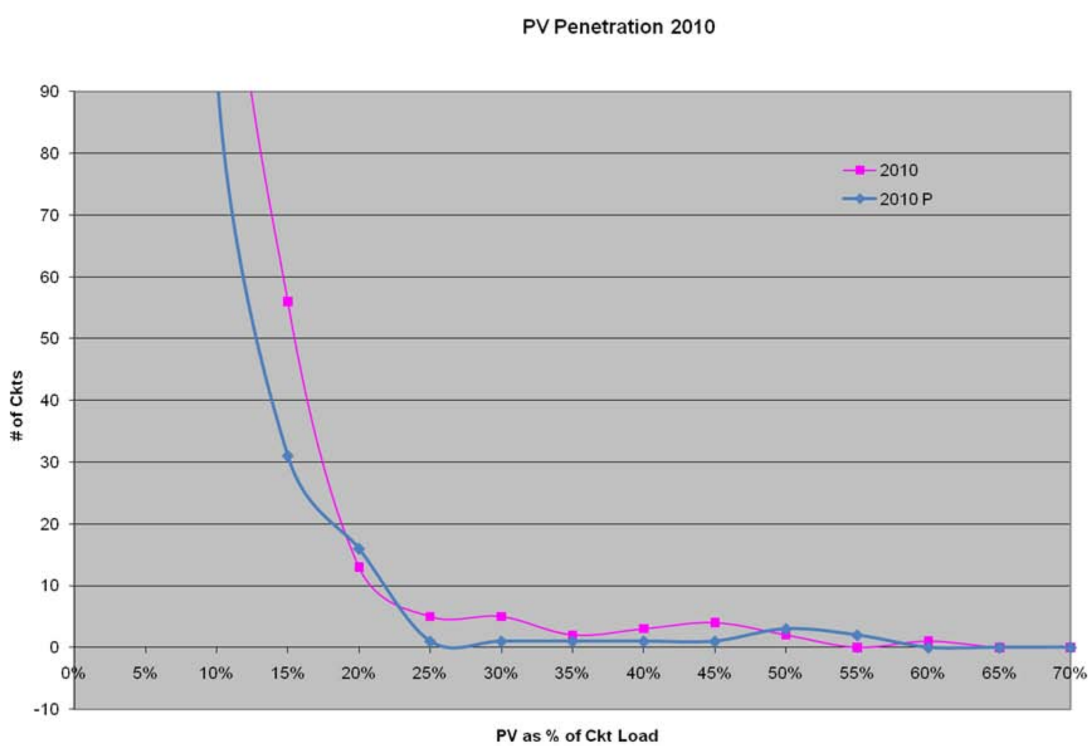

Figure 2 – 2009 Predicted Versus 2010 Grid PV Penetration Levels

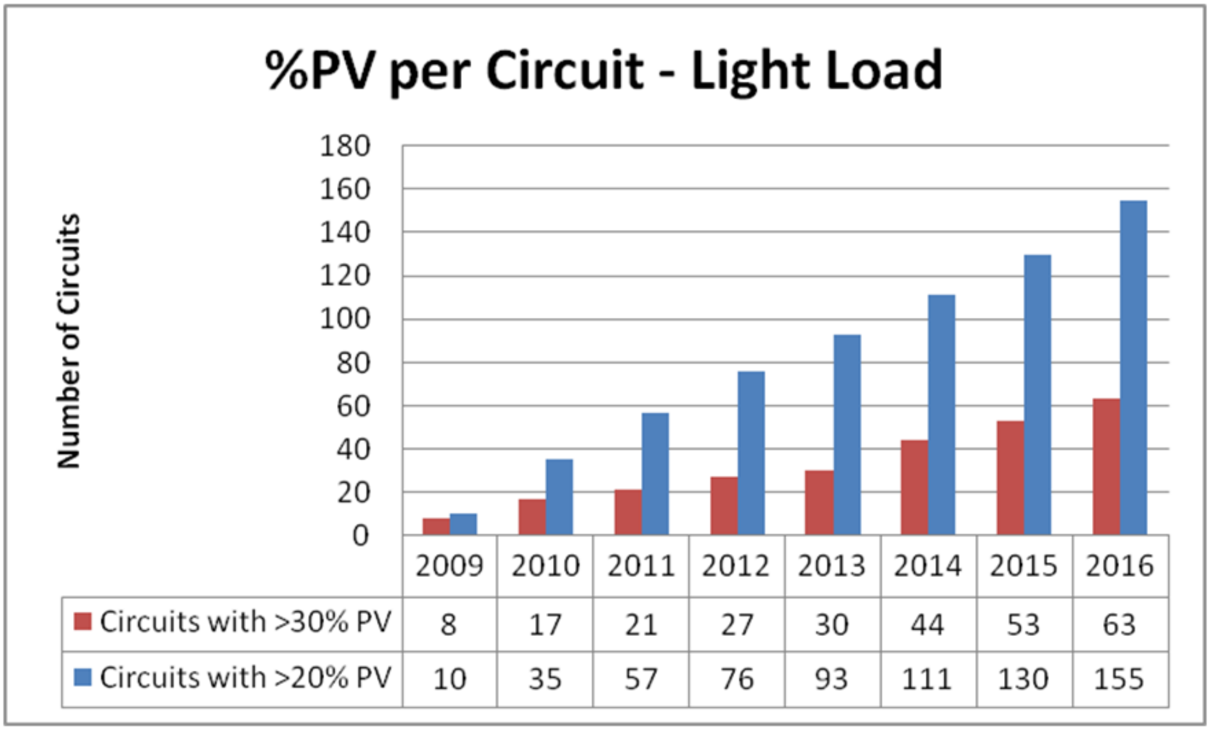

Figure 3 – High PV Penetration Circuit Growth Versus Time

2. Plug-In Electric Vehicle (PEV) Growth

When SDG&E originally drafted its opening testimony it believed that the impact of PEVs on SDG&E's system would be significant. As of 9/30/2011, elements of PEV deployment include the following:

- Vehicles: Total 820 or approximately 20% of all US sales of Nissan Leafs[2]
- Residential Chargers Installed: 549
- Public Chargers Installed: 23 with more than an order of magnitude more chargers in the installation process.

A number of major national chains (national accounts) that have already committed to install Electric Vehicle Supply Equipment (EVSE) charging facilities includes:

[2] Electric Drive Transportation Association, Deutsche Bank presentation, September 27, 2011. See Attachment B.

- Best Buy
- Macy's
- Cracker Barrel
- Fred Meyer
- Walgreens
- CVS
- Ace Parking
- IKEA
- Kohls
- 7-Eleven
- Enterprise Rent-a-Car
- Hertz
- BP (Arco)

This is not a complete list of names. Also the Electric Drive Transportation Association, EDTA, is currently focused on developing support for such major customers, so much so that Best Buy Corporation is now represented on their Board of Directors.

The Mitsubishi "i" and Ford Focus will be coming to San Diego now through November and, Car2Go (Daimler) is bringing 300 all electric SmartCars to San Diego by year end. So this increased demand is firm and will put upward pressure on our service requirements.

Although the take up rate of PEVs is a little slower than originally expected, much of this was due not to weak consumer demand, but to production delays realized by the impact of tsunami and earthquake in Japan, the deliveries of the Leaf have just been delayed; the demand for the PEVs remains strong, and the PEV releases in 2012 are on schedule and by YE 2012 there will be 57 models of PEVs available.[3] No one disputes electric vehicles are here and that the number is predicted to increase.

The EPRI Transportation Electrification Technology Overview report concludes: "But again, given the likely variability in customers' PEV choices, car types, varied charging patterns, varied charging speed preferences, and variable participation in utility-centric TOU charging options, we believe that the utility will not be able to manage this risk in an ex post fashion. In many cases, the utility will likely not be notified or aware of a PEV addition, or a unique charging pattern. As such, a proactive risk mitigation strategy is recommended to remove localized risk to the distribution system."[4]

SDG&E's case is compelling and the data provided above is not disputed by any intervening party. It is imperative to fund the electric vehicle growth portfolio of projects at the level requested in order address the coming PEV consumer demand and to reduce potential market barriers to PEV adoption.

3. Reliability

SDG&E has an obligation to provide reliable service to its customers. Intermittent renewable resources and electric vehicles will impact that reliability. SDG&E also has an aging infrastructure and a need to continue to improve its fire preparedness. No one disputes these issues or the supporting data.

In a response to a DRA data request,[5] SDG&E provided the following response:

"In R.99-10-025, the CPUC held a series of workshops that resulted in a Distribution System Operations and Planning Workshop report.[6] The report listed factors influencing

[3] Ibid.
[4] EPRI Transportation Electrification, A Technology Overview, July 2011, page 5-33.
[5] DRA –SDGE-060-LLK, Q.2.
[6] R.99-10-025, Distribution System Operations and Planning Workshop Report, April 17, 2000.

DG impacts on both Distribution Operations and Planning.[7] Issues include power quality, protection, out-of-tolerance voltage, increased O&M, decreased ability to comply with conservation voltage reduction guidelines, customer complaints and customer claims."

In a response to another DRA data request,[8] SDG&E provided the following response

"…it is imperative to monitor service transformer loads, avoiding transformer overloads and failures which allows for a safer and more reliable system operation especially when clustering takes place (i.e. multiple neighbors with PEVs served from same side of a service transformer). These large loads will also be mobile potentially requiring non-home charging and necessitating widespread deployment of smart grid technologies. Lastly, if not appropriately monitored and controlled, charging of vehicles on peak can result in significant additional loads and overload of other system equipment resulting in their failure; impacting service to other customers."

State energy policy goals are recognized by DRA as important drivers:[9]

"At the state level, smart grid policies have been the subject of California legislation. Governor Schwarzenegger, on October 11, 2009, signed Senate Bill (SB) 17 (Padilla) into law. This bill, along with others regarding conservation, greenhouse gases, renewable energy goals, and electric vehicles, set a very high standard for the delivery and use of electricity."

Therefore, it is imperative to fund the reliability portfolio of projects at the level requested in order meet these challenges.

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[7] Ibid, System Operations Section B, Systems Planning Section B.
[8] DRA –SDGE-060-LLK, Q.6.
[9] Exhibit DRA-14, page 7, lines 8-14.

4. Smart Grid Development

Smart Grid technologies, solutions and standards are rapidly evolving. SDG&E needs a Smart Grid test facility to address equipment standards, integration and interoperability challenges for these technologies. SDG&E has chosen communication, IT systems and grid equipment that are specific to its grid, and new products and systems must integrate with this environment. Therefore, it is imperative to fund the Integrated Test Facility project at the level requested to respond to the changes in the utility environment.

The remainder of my testimony is organized as follows:

- Section II – Smart Grid Portfolio Rebuttal To DRA (DRA-14 witness Laura Krannawitter);
- Section III – Smart Grid Portfolio Rebuttal to FEA and Ralph C. Smith;
- Section IV – Smart Grid Portfolio Rebuttal to UCAN and Dale Pennington;
- SUMMARY AND CONCLUSION;
- ATTACHMENT A – SG GRC-SGDP Presentation 7/20/11; and
- ATTACHMENT B - EDTA Presentation – EV's (09/27/11).

II. SMART GRID PORTFOLIO REBUTTAL TO DRA (DRA-14 WITNESS LAURA KRANNAWITTER)

DRA has recognized the need for SDG&E's Smart Grid Portfolio Projects: [10]

> "While the need for improvement and upgrades is there, what is in question, however, is how we go about the business of creating the optimal result."

However, DRA recommended that SDG&E's incremental request of $93,387,000 (labor and non-labor combined) be reduced by $73,695,000 based upon a philosophical approach.

[10] Exhibit DRA-14, page 1, line 12.

SDG&E's approach is based upon engineering judgment and undisputed facts as discussed in Section I. SDG&E will now rebut specific issues raised by DRA which include their admonition to 'slow down', technology adoption by low income customers, and then lastly each individual project.

A. Slow Down and Wait

A major theme for DRA and the other interveners is "slow down and wait". DRA claims there is no hurry, especially given all the ARRA stimulus projects. However, DRA's arguments are flawed given consumer adoption of photovoltaic systems, the State's aggressive renewable policy, which projects are actually provided ARRA funding, SDG&E's alignment with regards to standards and the direction of the Commission in the Smart Grid Deployment Plan rulemaking.

1. <u>Consumer Adoption</u>

Customers are not waiting for rulemaking workshops or for American Recovery and Reinvestment Act (ARRA) funded projects to be completed; customers are continuing to install distributed energy resources and renewable energy projects at high rates and are purchasing electric vehicles. As shown in Section I, in SDG&E's service territory over 14,000 customers have installed photovoltaic generation capability totaling 110 MW at a rate that exceed the CEC forecasts.

SDG&E is not alone is pointing out the challenges associated with integrating renewables. EPRI in a recent article points out the challenges that all utilities face with the impact of renewables.[11]

[11] Measuring Smart Distribution, Robert Uluski, Power Grid International, September 2011, page 21.

> "Volt-VAR control strategies face new challenges from ever-increasing penetrations of distributed generation sources….can produce voltage rise problems that might be difficult to address using conventional mechanisms"

The author goes on to state some of the impacts of on utility operations:

> "Such voltage swings might impact service quality and might increase voltage regulation operations greatly, resulting in increased maintenance and loss of life for this equipment. Inability to deal effectively with such variations limits the amount of DERs a feeder can accommodate."

It is clear that slowing down is not an option.

2. Renewable Portfolio Standards

Of all the states that have adopted a Renewable Portfolio Standard (RPS), California is the most aggressive with a goal of 33% of energy sales coming from renewables by 2020. Rooftop photovoltaic systems that customers install under net-energy metering tariffs do not count towards this goal. Additionally, Governor Brown has a stated goal of an additional 12,000 MW of distributed renewables by 2020 which appears to be in addition to the RPS mandate.

To put this in perspective, given the capacity factor of PV at approximately 20%, and wind at roughly 30%, to produce one MWh of energy during the course of the day it would take 5 MW of PV alone and 3 MW of wind capacity alone. This means at periods of low SDG&E system load the generation capacity of Imperial Valley and Baja California renewable resources could exceed local SDG&E load. This is a potential real life scenario that will have to be addressed by 2020.

3. American Recovery and Reinvestment Act (ARRA) Projects

The DRA has proposed that SDG&E should slow down its plans for smart grid investments. They cite in excess of $4 billion in ARRA funding for smart grid projects as justification that "California is not falling behind." However, it is important to consider that of the $4+ billion in ARRA funding, more than half[12] is going to support smart meter projects. SDG&E has recently completed installation of smart meters across its service territory, so the benefits SDG&E will receive from the ARRA funding of smart meter projects will be very limited. Additionally, only approximately 9% of the ARRA funded projects bear any resemblance to SDG&E's portfolio of smart grid projects and are located in states outside of California.

4. The Role of Standards

DRA is concerned about stranded investments due to the lack of standards. While a defined list of smart grid standards is not fully developed, this is true of any industry. Waiting for consensus standards to be developed and adopted is counter-productive and will impact SDG&E's ability to maintain a reliable grid in the face of the challenges presented by implementing California's energy policy goals. As noted in its Smart Grid Deployment Plan, SDG&E approach to standards is to align to existing and developing standards where it would achieve the greatest benefit for customers.[13]

[12] Of the $4+ billion in ARRA funding, $785 million is going exclusively to projects installing AMI meters, with another $1,971 million going toward integrated projects that include installation of AMI meters and networks and only $414 million, or approximately 9% is going to projects that have a remote connection to SDG&E's portfolio of smart grid projects.

[13] A.11-06-06, Smart Grid Deployment Plan Application of San Diego Gas & Electric Company, Section 4.11, page 123.

5. R.08-12-009 Smart Grid Deployment Plan

DRA recommends "We should be further along in this rulemaking before authorizing the sums of money requested by SDG&E."[14] However, the Commission has just released a scoping memo in the Smart Grid Deployment Plan proceeding.[15] As stated in that scoping memo "The scoping memo also clarifies that the utilities' Smart Grid Deployment Plans are guidance documents only, and approval of a Smart Grid Deployment Plan does not constitute a determination of the reasonableness of a specific plan." Additionally, the Commission decided on where a utility should request funding for smart grid projects: "We also conclude that deployment plans are not a substitute for a Commission review of specific infrastructure investments that will take place just prior to the time of deployment."[16] So waiting for completion of this rulemaking has no impact on SDG&E's GRC application which includes its GRC smart grid portfolio of projects. It is also noteworthy that the Commission project is moving post -haste to conclude this rulemaking by July 2012.

B. Technology Adoption by Low Income Customers

DRA asserts the following:

> "The backlash and the non-adopters (i.e., the "opt out" crowd) ought to be considered. Age and education are significant factors to consider when designing policies that will potentially affect every household. To quote a National Technology Scan survey, "one in five US households has never used email."***** Another statistic shows that 18 percent of US households do not have Internet access;***** the percentage was 29% in 2006."[17]

Furthermore, DRA asserts:

[14] Exhibit DRA-14, page 5, lines 14-16.
[15] R.08-12-009, Scoping Memo and Ruling of the Assigned Commissioner, October 4, 2011.
[16] D.10-06-047, Decision Adopting Requirements for Smart Grid Deployment Plans Pursuant to Senate Bill 17 (Padilla), Chapter 327, Statutes of 2009, page 22.
[17] Exhibit DRA-14, page 3, lines 12-23.

"The pace at which SDG&E seeks to implement all the aforementioned technology is not only faster than the penetration rates of the various technologies, but much faster than the general public can understand and accept."

"…referring to the outcry against smart meters. Smart meters have had a mixed reception from consumers. The reasons are many, and since SDG&E is nearly fully deployed in smart meters, it would be wise to take inventory of consumers (both pro and con) before pushing the fast forward button on the remaining segments of the smart grid/smart management of electricity. Before SDG&E takes the next step, it would be better for utilities and policy-makers to address the consumer concerns of 1) product compatibility*****; 2) consumer differentiation towards all things technical*****; 3) privacy; 4) protection of personal information; 5) national security;***** and 6) being overwhelmed with information, decision making and defenses. If the ultimate goal here is to deliver value to the customer, the utilities, vendors and policy-makers need to do a better job of communicating with the public about what is happening. If policies are driving this effort more than cost savings, it is important then not to delude the public about it."

"Better answers are needed that are tailored to a non-homogeneous ratepayer constituency. For the early adopter, technologically savvy group, greater involvement, details, and choices make sense when designing a product that will require the customer to cut demand when supplies are not available or are costly. For those customers without internet, a different solution will be required in order to better manage the electric system. For busy customers who have smart meters, a simple budget-based option might make sense."[18]

[18] Ibid, page 20, lines 14-20.

First, by DRA's own admission, 82% of US households have Internet service. DRA implies or infers that because 18% of US household do not have Internet service, SDG&E has ignored the diminishing minority of non-Internet customers. DRA cannot be more wrong, the exact opposite is true. In fact, SDG&E maintains a customer service infrastructure that responds to approximately 2.5 million customer telephone calls and processes approximately 1.3 million walk-in payment transactions per year. SDG&E is estimated to spend, in TY 2012, nearly $12 million in customer contact center operating expenses and $1.9 million in branch office and authorized payment location expenses.[19] SDG&E is not assuming "one size fits all" and believes that a diversity of customer channels be made available for all customers. SDG&E is obligated to service all customers, not just technologically savvy customers. However, SDG&E recognizes that a large segment of the customer base is Internet capable and conducting customer transactions via the Web, mobile technologies and other electronic devices. To facilitate those customers, SDG&E has requested additional funds for its Customer Service Information activities in Exhibit SDG&E-15. SDG&E witness Ms. Cordova's prepared direct testimony supports those efforts to serve the large customer base that has adopted Internet communications.

Second, DRA implies that SDG&E is "pushing" or "imposing" technologies (e.g., Internet) on SDG&E customers. SDG&E is not forcing or imposing on-line (Internet) transactions on its customers. Consumers have chosen their preferred communications and contact channels. SDG&E has little influence in the overall adoption of the Internet by 82% of US households. Rather, SDG&E consumers have chosen to be "on-line" and to use mobile communication technologies (e.g., Smart Phones and PDAs). SDG&E must continue to invest in customer interface technologies because that is what the customer has chosen. DRA's appears to be advocating that SDG&E preserve and maintain the legacy customer contact channels for 18%

[19] Exhibit SDGE-13-R, page EF-28, Table SDG&E-EF-12 and page EF-33, Table SDG&E-EF-16.

of the households and ignore the 82% of households who have adopted (by their choice) the electronic channels. If DRA believes that 82% is too low of an adoption rate to justify SDG&E expenditures on SDG&E Web services, then DRA needs to explain why 18% of population should continue to with their current legacy channels while 82% must revert back to non-Web transactions and communications. Simply, DRA's position is unclear, does not make logical sense and effectively discounts the 82% of the population that is using Internet. Although DRA states that SDG&E's smart grid implementation pace is "much faster than the general public can understand and accept", DRA offers no support for that assertion. On the contrary, with the already demonstrated PV installation rates, the PEV growth, and 82% electronic communication selection in its service territory, SDG&E customers would seem to be at the leading edge of the adoption curve, and certainly in a better position to know what they "can understand and accept".

Third, DRA has presented no evidence that SDG&E customers have an "outcry against smart meters". SDG&E has not experienced the public reaction that has been reported for PG&E customers. SDG&E's smart meter deployment has been both quiet and efficient, and as DRA states, "SDG&E is nearly fully deployed". The Commission should not be trapped by DRA's assertion or implication that SDG&E's smart meter deployment is similar to PG&E's smart meter experience. It is not. SDG&E has received a very small number customer complaints regarding smart meter deployment. In fact, as of October 9, 2011 only 0.16% of customers have complained about SDG&E's deployment.[20] Additionally, at a 9/2/2010 Commission meeting presenting the results of the Structure Group's review of PG&E's AMI deployment, an exchange between Commissioner Ryan and Stacey Wood took place that further rebuts DRA's concerns.

Commissioner Ryan: *"I'd be interested in hearing from you (Stacey Wood, Structure Group), who you think which of the utilities that you have worked with or whose work you are*

[20] SDG&E Internal Report, "Smart Meter D&O Report for Week Ending 10-09-11."

familiar with, are really the gold standard that PG&E and our other utilities should be emulating."

Stacey Wood: "*Certainly. One of the things to answer that question about the utilities that we see that are currently deploying similar type infrastructures around advanced metering that have done a very good job and are at what we would consider best practices would be San Diego Gas & Electric. I believe they have over a million meters installed, very low complaints. Customers…their meter infrastructure, their customer engagement, their meter deployment has all gone very well, so we would put them at the top of the list."*

Fourth, the Commission has already addressed Smart Grid customer privacy and security concerns in Decision (D.) 11-07-056, "Decision Adopting Rules to Protect the Privacy and Security of the Electricity Usage Data of Consumer s of Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company." SDG&E's proposed smart grid projects comply with this Decision.

Fifth, SDG&E TY 2012 GRC submittal includes estimated expenses for ensuring consumer Home Area Network (HAN) device compatibility with SDG&E's AMI network and other IT systems.[21] Of course, DRA proposed to disallow the very expenditures needed to ensure consumer HAN device compatibility with SDG&E systems.

Finally, SDG&E recognizes the diversity of its customer base and different preferences. The spectrum of technology options for customer communications and contact is ever expanding. SDG&E cannot just ignore 82% of the population and address only the needs of the remaining 18%. A strategy to stay the "status quo" with current legacy systems means that SDG&E will be even further removed from our customer base. SDG&E must be able to reach all of our customers, the 18% without Internet, as well as the 82% that have Internet. DRA's

[21] Exhibit SDGE-13-R, pp. EF-49 to EF-59.

ramblings and philosophical Luddite position regarding customer technologies is extremist, illogical and makes little sense in today's world.

C. Electric Energy Storage

SDG&E requested a total of $54,983,000 while DRA recommends $10,700,000. DRA acknowledges the important role that storage can play in smart grid and integrating renewables.[22] The DRA has accurately asserted that extensive project work is taking place in energy storage at other utilities. However, most of these utilities are outside of California and have different system topologies; renewable energy growth is higher in SDG&E's service territory than most utilities, customer PV growth is occurring at an annual growth rate of 36%.[23] Therefore, SDG&E cannot wait for the results and lessons learned by other utilities. Additionally, while shared knowledge is valuable, it does not substitute for the detailed learning and procedural development that takes place through internal project engineering and ownership.

D. Dynamic Line Ratings, DLR

SDG&E requested a total of $3,926,000 while DRA recommends $784,000. This project is proposed by SDG&E to optimize capital investments and operate the grid at higher efficiencies. This project will install DLR technologies on critical distribution circuits with renewable energy penetration and energy storage. The installed equipment will monitor wind speed, conductor tension, and solar heating to calculate conductor capability. DRA recommends approval of only 20% of the proposed funding of this project with the recommendation that SDG&E leverage its efforts through other projects in the nation. However, other projects in the nation will not provide any site specific information that will support higher conductor ratings in

[22] Exhibit DRA-14, page 10, lines 11-15.
[23] Over the 12 month period from September 1, 2010 to August 31, 2011 period SDG&E has seen growth of customer owned PV systems from 79.8MW to 108.5MW.

San Diego. Reducing the funding for this project by 80% will result in a reduction of the number of conductors that SDG&E can dynamically rate.

E. Synchrophasors

SDG&E requested a total of $4,056,000 while DRA recommends $732,000. This project will install Synchrophasors (Phase Measurement Units, PMU) on circuits with high PV penetration in conjunction with energy storage devices in order to mitigate the intermittency issues associated with distributed renewable resources. DRA recommends slowing down and waiting for the transmission PMU projects to complete. However, this distribution project utilizes PMUs as a sensor to assist in the dispatch of energy storage units to deal with PV intermittency; the two efforts complement each other. Reducing the scope of the proposed distribution project to one circuit per year as recommended by DRA will restrict the benefits of this project and impact SDG&E's ability to mitigate the impact of power output fluctuation as PV penetration increases and voltage and phase-angle fluctuations also occur at various points on the system.

F. Capacitor SCADA

SDG&E requested a total of $5,804,000 while DRA recommends $2,900,000. The Capacitor SCADA project will install System Control and Data Acquisition (SCADA) with remote data-read and switching capability on all of SDG&E's 1,404 line capacitors. This project offers numerous benefits including improved control of voltage and reactive power in order to mitigate the impact of distributed PV, as well as remote monitoring of equipment status and early identification of potential system problems.

The benefits offered by this project in operability and reliability offer compelling justification for the project. If the implementation time for this project is doubled (spread out) as proposed by DRA, it will also double the time in which the benefits from this project can be realized.

G. SCADA Expansion

SDG&E requested a total of $5,964,000 while DRA recommends $2,980,000. The SCADA Expansion project will install SCADA on line switches and substation circuit breakers. This project was proposed to facilitate expanded operability of the distribution system as the penetration of renewable generation sources increases. This will allow better utilization of circuits with high PV penetration and energy storage. This SCADA Expansion project will also support automatic operation of switches as SDG&E's new DMS (Distribution Management System, a computer-based control system to be rolled out in 2012) can interface automatically with the new SCADA switches. This automatic or self-healing operation will minimize the outage duration for those customers fed by the un-faulted section of a circuit that is experiencing an outage.

Once again, the benefits offered by this project in operability and reliability offer compelling justification for the project. If the implementation time for this project is doubled, as proposed by DRA, it will also double the time in which the benefits from this project can be realized.

H. Smart Transformers

SDG&E requested a total of $2,568,000 while DRA recommends $1,042,000. This Smart Transformer Project proposed by SDG&E will install monitors on distribution transformers that will measure and report loading on the transformer that is suitable for real-time operations. This additional monitoring capability will be important to help SDG&E manage its assets and avoid replacing transformers before necessary. The average load for a residential customer without air conditioning during system peak is 1.4 kW, while a single Nissan Leaf charges at over 3 kW, and the charge levels on 2012 Nissan Leafs will double to over 6 kW. In essence, each PEV electric car added to the system more than doubles the existing average load. It is also expected that those PEVs will not be adopted uniformly throughout the service territory, but will likely be adopted in geographic clusters. The impacts will be compounded if multiple customers fed from the same transformer acquire PEV's. Smart transformers will help mitigate the impacts of this added load, by relaying load and condition data so that it can be acted upon before the transformer fails.

The DRA is suggesting funding for this project based on a reduced projection of PEV rollout due to factors such as the high initial price of PEVs, plus temporary factors such as the current economic conditions in California, and the impact to the auto industry due to the earthquake and tsunami in Japan. Despite these downward factors on PEV penetration (attributable to production capacity rather than market demand as discussed earlier), SDG&E has seen substantial growth of electric vehicles. SDG&E customers have purchased 790 plug-in electric vehicles from December 1, 2010 through September 30, 2011. SDG&E customers have already installed 549 residential PEV charging stations. Additionally, 23 public charging stations have already been installed to support the local electric vehicles with many more companies committing to public charging as discussed in Section IC. The current adoption rates of plug-in electric vehicles and charge stations by SDG&E customers indicate that these vehicles are increasing in popularity and could have a significant impact on utility operations. It would be reasonable to assume that adoption rates will be even higher than forecasted once the current negative factors cited by the DRA, such as the bad economy in California, and the impacts of the earthquake and tsunami in Japan, have passed.

I. Charging Stations

SDG&E requested a total of $5,230,000 while DRA recommends $0. This project as proposed by SDG&E would install publically accessible charging stations in underserved areas. DRA opposes this project, and recommends no funding for it in this rate GRC cycle. DRA justifies their position by referencing the EPRI Transportation Electrification report,[24] saying the report demonstrates how much more information is needed. It is true that more information is needed. However, delaying this project will not provide the needed data. In fact, it is the scope of this project to install charging infrastructure in underserved areas that would not otherwise have sufficient public access to electric vehicle charging stations, thus removing barriers to adoption of PEVs. EPRI in that same report goes on to describe the role of a utility: "Utility engagement in appropriate areas can help to reduce uncertainty, positively impacting the adoption of electric vehicles."[25] "The concept of critical infrastructure and services involves a utility actively guaranteeing a minimum 'safety net' of vehicle and infrastructure support services within its service territory. A critical infrastructure and services program would consist of one or more of the following features: Critical charging infrastructure – establishment of secure and reliable charging locations throughout the utility service territory where privately owned charging facilities are not available…."[26] Contrary to DRA's assertions, EPRI most decidedly envisions a role for the utility. Constructing this project would help to provide information about PEV owner behaviors in underserved areas, which the DRA states is needed.

J. Wireless Faulted Circuit Indicators

SDG&E requested a total of $3,501,000 while DRA recommends $0. The DRA has proposed $0 investment on the Wireless Faulted Circuit Indicator project, characterizing the

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[24] EPRI Transportation Electrification, A Technology Overview, July 2011.
[25] Ibid, page 7-1.
[26] Ibid, page 7-3.

project as "it would be nice."[27] This project as proposed by SDG&E will provide substantial benefits to utility customers, by shortening outage locating and troubleshooting time, and expediting customer restoration times. It will take advantage of wireless communication technology to allow remote and immediate monitoring of distribution lines without having to dispatch field personnel, wait for them to drive to the location of the fault, and then visually observe the condition of equipment, often at night during inclement weather conditions, which further delays outage locating and customer restoration using conventional non-wireless fault indicators. It is noteworthy that AMI 'last-gasp' notification will be used by SDG&E to help identify outage locations, particularly single transformers and single customer service. However, AMI meters do not record or report fault data and this feature is not effective for locating faults on branches and feeders that have a multitude of customers and service transformers.

K. Phase Identification

SDG&E requested a total of $5,211,000 while DRA recommends $0. DRA's recommendation is based upon not understanding the project scope. As the project title simply states, the scope of the project is verifying the phase to which each single or two-phase piece of equipment, including meters, is connected, a non-trivial task. While SDG&E marks or identifies much of its equipment in the field, mapping each of the three phases (Phase A, B, C) that exist in most distribution circuits to the individual pieces of line equipment to which they are connected into a geographic information system, GIS, has not been accurately completed. Knowledge of that phase identification assists in preventing load imbalances, faster service restoration, and future system load planning. This field-checked data is compiled and inputted into the SDG&E facilities database, where it ultimately will be used by SDG&E's geographic information system, and other enterprise planning and support tools.

[27] DRA-14, page 16, line 7.

L. Integrated Test Facility

SDG&E requested a total of $1,842,000 while DRA recommends $1,000,000. This project will provide the testing and integration of hardware and software for new smart grid technologies and equipment. The DRA has proposed a reduction in funding this project because the SDG&E already has a test facility and the delays in the National Institute of Standards and Technology, NIST, consensus standards. However, the scope of the test facility is very different than the scope and capabilities of the HAN test facility which is focused exclusively on in-home devices. SDG&E intends to test the interoperability of various vendors' equipment and software with the systems that SDG&E utilizes to run, operate and plan its grid. The fact that the NIST consensus standards are delayed makes it all that more important that SDG&E test vendor products to ensure safe operation prior to deployment.

III. FEA

The Federal Executive Agency witness provides the Commission with little information or basis for any change to SDG&E's request other than the slow down and wait perspective and defer any funding to another proceeding.

A. Slow Down and Wait

As SDG&E pointed out in Section I, it cannot afford to slow down and wait. Regardless of the interveners unsubstantiated recommendations to slow down, no one disputes the data the customers continue to adopt PV, the State continues to pursue its ambitious energy policy goals and not only are electric vehicles here, the amounts continue to increase. FEA references a smart meter project by Baltimore Gas and Electric (BG&E) and a smart grid pilot project by XCEL Energy (an electric and gas utility serving Colorado, Michigan, Minnesota, New Mexico, North Dakota, South Dakota, Texas and Wisconsin), both of which bear little resemblance to SDG&E's

smart grid portfolio of projects. FEA also does not mention that XCEL received approval from its state regulator to install the original scoped project. Ironically, while FEA provides a Washington DC perspective, SDG&E has met with both the Navy and Marine Corps in San Diego who are also being driven to adopt technologies such as microgrids and renewables from a policy perspective and exploring partnering opportunities with SDG&E. As discussed in response to DRA in Section II, the Commission has determined that a General Rate Case is the appropriate location for a request for funding. Slowing down and waiting is not an option.

IV. **UCAN**

UCAN recommends that SDG&E's incremental request of $93,387,000 (labor and non-labor combined) be reduced by $73,156,311, or more than 78%, based upon a philosophical approach and flawed understanding of SDG&E's AMI deployment. SDG&E's approach is based upon engineering judgment and undisputed facts as discussed in Section I. SDG&E will now rebut specific issues raised by UCAN which include the decision making process, 'slow down', UCAN's unique view of photovoltaic generation impacts and then lastly each individual project including post-test year funding.

UCAN as a technical advisory panel member on SDG&E's AMI project should know the scope and limitations of SDG&E's AMI deployment. For the $572 million dollar AMI deployment, SDG&E has obtained a state-of-the art metering and billing system that provides residential customers and SDG&E with (typically) hourly consumption data on a daily basis. That $572 million does include the Home Area Network (HAN) chip which enables providing real time information from the meter. Additional functionality that is espoused by Mr. Dale

Pennington on behalf of UCAN comes at an additional cost beyond the original price and still needs to be developed as noted by Mr. Pennington in his testimony.[28]

A. Decision Making Process

Another major theme of UCAN is that the funding should be reduced due to the lack of a clearly defined decision making process and any cost benefit analysis. However, UCAN notes that a decision making process is defined in the direct testimony of Mr. Jeffrey Nichols[29] and in SDG&E's Smart Grid Deployment.[30] Then UCAN goes on to state "Each of these steps represents sound business planning and aligns to our recommended approach."[31] For the smart grid projects SDG&E has conducted requests for proposals for technology solutions[32] and also utilized an asset investment strategy tool that is discussed in the testimony of Mr. Rick Phillips to prioritize projects.[33] UCAN also recognizes that SDG&E withdrew its Condition Based Maintenance Expansion[34] (CBM) and references the July 20, 2011 SDG&E and intervener meeting which they attended; however, UCAN conveniently forgets to mention that SDG&E's decision was based upon a cost benefit analysis of all smart grid projects in its deployment plan including all the smart grid portfolio of projects in this application which was discussed at the aforementioned meeting. However, UCAN does contradict itself on the need for cost effectiveness tests.[35] UCAN goes on to state the need for pilots and recognizes that SDG&E also believes in pilots.[36]

[28] Exhibit, Mr. Dale Pennington on behalf of UCAN.
[29] Ibid, page 8, lines 12-26.
[30] Ibid, page 13, line 21 to page 14, line 11.
[31] Ibid, page 8, lines 27-28.
[32] SDG&E chose not to proceed with a winning storage bidder because the company could not pass tests and SDG&E chose to conduct another request for proposals.
[33] Exhibit SDGE-19, page RP-5.
[34] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 78, line 12.
[35] Ibid, page 10, lines 24-29.
[36] Ibid, page 13, line 21-23.

So fundamentally, SDG&E adheres to a decision making process that incorporates pilots that UCAN finds acceptable, and SDG&E has performed the cost benefit analysis that UCAN believes is important. Therefore, SDG&E's processes are in alignment with UCAN's approach, UCAN's argument is moot and SDG&E's Smart Grid Infrastructure portfolio of projects should be funded at the levels requested in this application.

B. Slow Down and Wait

As discussed in Section I, SDG&E showed the need to move forward with data that no one disputes. In its rebuttal to DRA, Section IIA, SDG&E addressed the flaws of this slow down approach. Consumer adoption of photovoltaic systems is not waiting, the State's aggressive renewable policy is not waiting, California continues to press forward with the implementation of AB32, the greenhouse reduction program and PEVs are here and increasing in amount now! UCAN recognizes the need for promoting PEV adoption[37] and the EPRI report which is the foundation for their slow down approach recommends that utilities need to be proactive.[38] Ironically, UCAN argues 'slow down' but then denies the accelerated post year cost recovery requested by SDG&E which would be worsened by this 'slow down and wait' approach.

C. Photovoltaic Generation Impacts

UCAN presents a lengthy and flawed eight page discussion of distributed generation (DG) and in particular PV that has been espoused by the DG and PV community since 1998. SDG&E believes that it is important to provide factual information to aid the Commission not only in this GRC but in other proceedings. It is noteworthy that UCAN did not intervene in any of the four past rulemakings, and now five, regarding DG to protect consumers. While DG can reduce capacity and energy requirements, ironically, the majority of benefits cited will not

[37] Ibid, page 64, lines 17-19.
[38] EPRI Transportation Electrification, A Technology Overview, July 2011, page 5-33.

become a reality unless smart grid projects rejected by UCAN are funded and rates that reflect cost causation are implemented. In the course of these four DG rulemakings the Commission decided the four criteria that are required for DG to provide a benefit to the grid.

> "SDG&E outlines the criteria distributed generation must meet to allow the utility to defer capacity additions and avoid future cost. The distributed generation must be located where the utility's planning studies identify substations and feeder circuits where capacity needs will not be met by existing facilities, given the forecasted load growth. The unit must be installed and operational in time for the utility to avoid or delay expansion or modification. Distributed generation must provide sufficient capacity to accommodate SDG&E's planning needs. Finally, distributed generation must provide appropriate physical assurance to ensure a real load reduction on the facilities where expansion is deferred. There is potential that distributed generation installed to serve an onsite use will also provide some distribution system benefit, however, unless it meets the four planning criteria describe by SDG&E, such benefits will be incidental in nature."[39]

UCAN claims "However, SDG&E has not shown that actual issues are occurring on its distribution system as a result of these concerns."[40] Just because UCAN doesn't understand the measured data presented in Exhibit SDGE-11, starting at page TOB-4 does not mean there is a real and immediate impact. On the other hand, UCAN a few pages later acknowledges the issues "If the penetration of PV on a given circuit is high and solar output drops dramatically, demand on that circuit will increase unexpectedly unless the utility has robust methods of forecasting and

[39] D.03-02-068, pg. 18.
[40] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 20, line 9-10.

control systems in place to manage the impact."[41] The projects in the renewable growth portfolio are intended to address these issues.

UCAN recommends a solution to manage PV, "First and foremost, we recommend that SDG&E perform a target impact study to determine what extent PV is actually causing system stability and reliability issues."[42] Next, UCAN recommends "SDG&E should also regulate voltage using their SCADA enabled line switches and SCADA capacitors."[43] Lastly, UCAN suggests "As part of the impact study, SDG&E should measure how much PV generation is consumed at the source and how much is sold back to the grid. "Smart Meters" allow SDG&E to monitor, at a granular level, exactly how much PV is added to the grid."[44] Once again UCAN ignores the data from targeted analyses performed by SDG&E and presented in Exhibit SDGE-11, starting at page TOB-4 which has resulted in SDG&E performing studies with Quanta Technologies, the Electric Power Research Institute and General Electric. However, as pointed out earlier, UCAN should know better the capabilities of SDG&E's AMI system. While the meters at a customer's point of service can measure consumption in and power put back on the grid, they are incapable of determining exactly how much PV generation is consumed at the source and the PV system nameplate capacity that is added to the grid since the meters are not directly measuring the PV system's output. Operating the remote disconnect in the meter as part of a non-existent, non funded control system will result in an outage to the customer and not turn off just the PV system, and may require a manual disconnect which must be reset by the customer. As to UCAN's 'regulating voltage' recommendation, SDG&E typically does not have it capacitors connected to SCADA for remote control operations. SDG&E currently only has a

[41] Ibid, page 23, lines 6-9.
[42] Ibid, page 24, lines 5-7.
[43] Ibid, page 24, lines 12-13.
[44] Ibid, page 24.

few capacitors on SCADA and one of the smart grid portfolio of projects is designed to put all capacitors on SCADA; however, the funding level for this project recommended by UCAN is trivial. While SDG&E does have a significant portion of its line switches on SCADA, opening these switches would have two impacts: it would cause an outage to all customers downstream of the sectionalizing device, and customers on a net-energy metered tariff would suddenly have their PV system power production reduced to zero when their utility power is cut along with their household consumption, impacting their bills. Lastly, the decision-making process and system recommended by UCAN does not currently exist in any form. The timing requirements to accomplish improvements in voltage and power quality would not exist in any standard SCADA environment. Any efforts to mitigate fluctuating voltages and VAr flow due to PV would necessitate "smart" equipment in the field with the capability to make control decisions and take independent action within seconds if not sooner. SCADA communication systems in any standard utility application perform instead in the 20 – 30 second range at a minimum. And in some instances up to a minute or more is required for 'round trip' communications. The system that SDG&E would have to design and implement does not exist and would require significant investment in both IT and communications infrastructure for real time data processing.

Lastly in this area, UCAN goes on to discuss Germany and Spain as the poster children for high PV penetration greater than California. UCAN raises the point of utility operational control of PV systems 100 kW and greater, which would be beneficial, but is currently not allowed in California. There are significant differences in the European system design and regulatory model that have facilitated this "apparent seamless integration". Their distribution system delivers 3 phases to the home (U.S. systems typically deliver one), and includes a large capacity transformer and large conductors at the primary voltage. Two to three hundred customers are fed from a single 300-500 kVA service transformer and service is provided by a large secondary network. SDG&E typically serves eight to ten customers from a 25 kVA transformer with much smaller conductors. In layman's term the larger system is more robust and less likely to experience voltage fluctuation issues for the same size PV system. The German utility is obliged to provide a technically appropriate point of common coupling, PCC, for PV connection with only recovery of 25% of the cost for interconnect. Therefore, the distribution company often interconnects PV systems as part of an overall circuit capacity upgrade. The Europeans are not measuring granular voltage and current data but are only looking at a 10 minute increments. Contrary to popular belief, they are experiencing voltage regulation issues on secondary network at periods of low load and high PV output, with the solution being network upgrades, and do have power quality problems that impact PV system operations.[45] The Germans have adopted a new Grid Code that requires PV systems to support the grid with a goal of minimizing their socialized network upgrade costs. Additionally, much to their chagrin, the Germans have just realized that with their 18 GW of PV, a single significant transmission event that causes a large frequency excursion will result in the loss of the entire 18 GW of PV and they do not have enough regulation reserves to recover from such an event. Additionally, the Germans estimate future distribution system upgrades requirements to integrate renewables will be between €13 and €27 billion.[46] So while there are lessons to be learned from the Europeans, it is important for SDG&E to be proactive as it has been, appearing before the Commission to advocate for regulatory solutions that seek to minimize costs.[47]

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[45] http://www.energy.ca.gov/2011_energypolicy/documents/2011-05-09_workshop/presentations/04_KEMA_Morning_5-9-11.pdf, slide 14.
[46] Ibid, slide 17.
[47] http://www1.eere.energy.gov/solar/pdfs/highpenforum1-06_bialek_sdge.pdf
http://www.energy.ca.gov/2011_energypolicy/documents/2011-05-09_workshop/presentations/03b_San_Diego_Gas_and_Electric_Avery.pdf

D. Storage

SDG&E requested a total of $54,983,000 while UCAN recommends $12,136,758. UCAN advocates pilot programs followed by no funding. UCAN recognizes that SDG&E will be utilizing pilots to manage risk and identify the best and least cost solution;[48] however, UCAN's next implicit suggestion is to wait for the next GRC cycle with a 2016 test year. Waiting is not an option. As shown in Figure 3 the amount of circuits with high penetrations will be significant, circuits with 20 percent or greater PV penetration are predicted to be 218. Adverse impacts to the electric grid as a result of high penetration PV have been shown to exist now as described in Exhibit SDG&E-11, TOB-9. SDG&E cannot wait for operational problems to become widespread before implementing mitigation solutions such as energy storage. SDG&E addresses UCAN's concerns and misinformation regarding reliability, studies, AMI capabilities and the European experience in Section IV D.

E. Dynamic Line Ratings, DLR

SDG&E requested a total of $3,926,000 while UCAN recommends $0. UCAN advocates no pilots and no funding. UCAN's arguments are based upon safety, the evaluation effort which UCAN claims is not accounted for and most interestingly, the capacity increase may only serve as a temporary solution to traditional SDG&E capacity upgrades.

UCAN acknowledges the use of DLR at the transmission level but basically claims that the distribution lines have been built without significant engineering and therefore dynamic line ratings for distribution lines are unsafe.[49] SDG&E adheres to both General Order 95 and 128 as a minimum standard for its design and construction practices. These orders were developed by

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http://www.energy.ca.gov/2011_energypolicy/documents/2011-06-22_workshop/presentations/10_Tom_Bialek_SDGE_-_Inverter_Functions_PV_062211.pdf.

[48] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 13, lines 21-29.

[49] Ibid, page 17, lines 16-25.

distribution engineers and provide the engineering basis for both the overhead and underground systems, respectively. Sag of the line conductors is a function of pole spacing, line tension, conductor size, the current load, the ambient temperature, wind speed and other atmospheric conditions to name a few. For underground systems sag is not an issue (although heat buildup and temperature are). Dynamic line ratings take these factors into consideration as compared to the static design case to develop a rating based upon actual conditions in the field. The engineering phase of the technology pilot and future deployments would include field inspection of all spans where DLR technology will be installed to ensure no clearance violations would occur. This includes field inspection of other attachments in spans where DLR technology will be installed.

UCAN's alternative to DLR would utilize load profile data based on AMI and SCADA plus weather station reports to evaluate line capacity issues.[50] UCAN states that this data could be used to monitor and control system conditions making DLR redundant. This assertion is a dangerous proposition since it cannot be utilized for real time operations since the system that SDG&E would have to design and implement does not exist and would require significant investment in both IT and communications infrastructure for real time data processing. UCAN professes concerns numerous times about safety hazards resulting from clearance violations as a result of DLR which measure the limiting span versus UCAN single line solution. DLR is a much more precise tool for calculating line sag and line clearance by using actual conductor tension than the suggestion by UCAN.

Lastly UCAN asserts "There are alternative solutions (to DLR) that are less risky and more cost effective."[51] These are presumptuous conclusions. To determine the preferred

[50] Ibid, page 38, lines 24-26.
[51] Ibid, page 36, lines 3-4.

alternative and whether alternative solutions exist that are less risky and more cost effective, it is necessary to review individual cases. In some cases it may be more cost effective to install DLR and delay an expensive system upgrade one or more years since the DLR solution is less than the time value of money for the infrastructure upgrade. In the implementation of the DLR project, SDG&E will evaluate each case where DLR is being considered and determine whether cost effective alternatives exist.

F. Phasor Measurement Units

SDG&E requested a total of $4,056,000 while UCAN recommends $1,769,891. UCAN advocates pilots followed by no post test year funding. While UCAN agrees with SDG&E recognizes that SDG&E will be utilizing pilots to manage risk and identify best and least cost solution,[52] UCAN's next implicit suggestion is to wait for the next GRC cycle with a 2016 test year. SDG&E's request to install PMU's on 11 circuits with 10 PMU devices on each circuit is driven by a real need and real data that no one disputes. UCAN continues its philosophical opposition; however, customers are not waiting and UCAN's position puts their reliable service at risk.

G. Capacitor SCADA

SDG&E requested a total of $5,804,000 while UCAN recommends $58,040. UCAN advocates pilots followed by limited future funding. UCAN seems to misunderstand the purpose of this project[53]which is to place all capacitors on SCADA control which provides numerous benefits not related to PV additions, as stated Exhibit SDG&E-11, TOB-24 and 25 and as recognized by UCAN.[54]

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[52] Ibid, page 13, lines 21-29.
[53] Ibid, page 48, lines 19-20.
[54] Ibid, page 44, line 8 to page 45, line 7.

Interestingly, UCAN then proceeds question SDG&E's planning practices with regards to locating fixed capacitors and the need to switch these on and off regardless of PV generation.[55] First, the majority of the circuits and fixed capacitor placement design occurred prior to customers installing PV system. Second, UCAN cites to the German experience where they control PV system greater than 100 kW as good control model which allows the Germans to control the PV system when needed.[56] Third and most importantly UCAN proposes such a scheme to mitigate voltage regulations by controlling SCADA line switches and SCADA capacitors.[57] However, SDG&E's SCADA deployment has been focused on switches and circuit breakers and has only begun on a limited basis to put capacitors on SCADA. So UCAN's approach to opposing SDG&E's smart grid portfolio of projects, and suggest alternatives that either will not work or that require funding they do not support, continues.

H. PEV Infrastructure

SDG&E requested funding for PEV infrastructure in the testimony of Mr. Alan Marcher (SDG&E-06 page ABM-21) of a total of $6,403,850 (represented in standard GRC form as direct-only constant 2009 dollars), while UCAN recommends disallowing $6,403,850 in the testimony of Mr. William Marcus versus the fully-loaded 2009 dollars in the un-redacted confidential testimony of Mr. Dale Pennington (page 18). Thus, UCAN is mixing apples and oranges with the dollar amounts it uses, the correct value should be $6,403,850. UCAN advocates no pilots followed by no future funding. UCAN references the EPRI Transportation Electrification Technology Overview report, citing various suggestions to mitigate PEV impacts

[55] Ibid, page 48, lines 20-23.
[56] http://www.energy.ca.gov/2011_energypolicy/documents/2011-05-09_workshop/presentations/04_KEMA_Morning_5-9-11.pdf, slide 29.
[57] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 24, lines 12-14.

as if they were firm solutions specifically for the SDG&E system.[58] However, the EPRI report concludes

"But again, given the likely variability in customers' PEV choices, car types, varied charging patterns, varied charging speed preferences, and variable participation in utility-centric TOU charging options, we believe that the utility will not be able to manage this risk in an ex post fashion. In many cases, the utility will likely not be notified or aware of a PEV addition, or a unique charging pattern. As such, a proactive risk mitigation strategy is recommended to remove localized risk to the distribution system."[59]

UCAN also attempts to down play the impact of PEVs by comparing them to personal hair dryer, air conditioner and electric dryers.[60] While some EV battery packs presents a similar load magnitude to an A/C unit, others are much larger.[61] In response to a DRA data request SDG&E explained the significant differences between air conditioners and EVs.[62]

"EVs introduce the potential for much less defined addition of load and they will also be added to areas that when they were built they were sized without A/C units. Even in areas sized for A/C loads the addition of EVs will have a significant impact and create the possibility of equipment overloads if charging is conducted coincident with local system peaks. The load duration curve can also be different with an EV versus A/C. Unique properties of the battery pack are the power electronics interface that does not exist with an A/C unit and the dual operation mode; not only does it present a load to the system but

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[58] Ibid, page 54, line 26 to page 55, line 26.
[59] EPRI Transportation Electrification, A Technology Overview, July 2011, page 5-33.
[60] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 55, lines 11-14 and lines 23-26.
[61] The second generation Nissan Leaf will be able to charge at 6.6 kW and a Tesla is able to charge at 17 kW.
[62] DRA SDGE-060-LLK, Q.11.

it can also act as a generator which results in unique challenges and opportunities to the grid."

In a confusing turn UCAN acknowledges their cited studies report large vehicle-charging loads.[63] UCAN again turns around and again points to the EPRI report and other efforts as the basis to dismiss the impact of PEVs on the grid.[64] However, the devil is in the details and UCAN ignores other sections of the report which state:

"Initial studies mainly focused on the adequacy of generation to supply the increased load levels associated with increasing customer adoption of PEV. The overall ability of distribution networks to reliably supply this additional load was typically not considered nor was the influence of localized PEV concentrations, or clusters, on the system. Furthermore, these studies also concluded that the initial PEV demand could be contained within off-peak evening hours. However as system wide controls will be unavailable for the first generation of PEV, the actual demand will most likely be driven by customer behavior and therefore unlikely to be contained within off-peak evening hours."[65] The EPRI report then goes on to state "Initial findings concerning total additional feeder loading, asset overloads, and services transformer insulation aging are addressed in terms of PEV characteristics and circuit configuration. Assuming a radial configuration, typical for most North American distribution circuits, the level of PEV load diversity experienced by each feeder asset will vary based on the number of customers served off that asset. For instance, substation equipment which serves large numbers of PEVs will

[63] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 59, lines 14-19.
[64] Ibid, page 56, line 18 to page 61, line 11.
[65] EPRI Transportation Electrification, A Technology Overview, July 2011, page 5-8.

benefit the most from diversity in the load characteristics while those assets closest to the point of PEV interconnection will experience the least diversity."[66]

Selective quoting of reports will not make the local impact of PEVs go away not matter how convoluted UCAN's arguments. UCAN acknowledges the importance of SDG&E approach[67] and even goes as far as recommending that "SDG&E should monitor circuits for overload, as is done in the normal course of business and upgrade infrastructure if the data shows it to be necessary."[68] and recognizes "it is likely that certain transformers and other components will need to be upgraded in order to support PEV charging"[69] but not surprisingly, even though this project is requesting funds for upgrading infrastructure, UCAN rejects any funding.

I. Smart Transformers

SDG&E requested a total of $2,568,000 while UCAN recommends $0. UCAN advocates no pilots followed by no post test year funding. UCAN recommends that no funding be allocated for the Smart Transformer Project because SDG&E has not vetted the alternative of using AMI data to manage transformer loading. Unfortunately this alternative is not feasible for real-time operational control. AMI data is collected for residential customers on an hourly basis, which will provide a rough approximation of transformer loading on a day behind basis. AMI data will not provide the real-time loading required to allow real-time load assessment identifying when a transformer reaches critical load level that could result in failure, upon which load curtailment should be implemented.

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[66] Ibid, page 5-8.
[67] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 54, lines 18-19.
[68] Ibid, page 53, lines 10-12.
[69] Ibid, page 60, lines 10-15.

J. Charging Stations

SDG&E requested a total of $5,230,000 while UCAN recommends $0. UCAN advocates no pilots followed by no post test year funding. UCAN's denial of SDG&E's request is based upon five tenets: the data does not support this project resulting in a risk of stranding assets, there is no analysis on where these charges would be installed, PEV penetration low, there are few public chargers currently installed and this project provides no benefit analysis.

UCAN is concerned about the availability of data based on a review of the EPRI Transportation Electrification Report that "… demonstrates how much more information needs to be gleaned about EV owners, their homes, and habits…."[70] However, despite UCAN's conclusions, the EPRI report states

> "The rapidly approaching commercialization of plug-in hybrid and electric vehicles has created an urgent need for utilities to support the adoption of electric vehicles by their customers, to prepare for the installation of residential, commercial, and private infrastructure in their service territories, and to manage the impact of these new loads on the electric distribution system."[71]

The EPRI Transportation Electrification Technology Overview report goes on to conclude:

> "But again, given the likely variability in customers' PEV choices, car types, varied charging patterns, varied charging speed preferences, and variable participation in utility-centric TOU charging options, we believe that the utility will not be able to manage this risk in an ex post fashion. In many cases, the utility will likely not be notified or aware

[70] Ibid, page 68, lines 7-12.
[71] EPRI Transportation Electrification, A Technology Overview, July 2011, page 1-1.

of a PEV addition, or a unique charging pattern. As such, a proactive risk mitigation strategy is recommended to remove localized risk to the distribution system."[72]

UCAN has also agreed with SDG&E's proactive approach[73] and recognizes the need for promoting PEV adoption.[74]

With regards to stranded assets, this project will install publically accessible charging stations ahead of demand, which is essential in order to support the early stages of PEV market development. There will be some communities and housing configurations (such as multi-unit residences) where access to on-site Electric Vehicle Supply Equipment (EVSE) is not acceptable and as such, "at-home" charging is not possible. In such cases, it will be an important sensitivity to test the need for the development of charging facilities near or adjacent to such locations. Because the individual expense per EVSE unit is relatively low, some charging stations can be installed in such locations to test the demand for the EVSE in a specific location. This demand and be monitored and the EVSE density can be expanded in particular locations should increased demand materialize. This will minimize the risk of stranded, unneeded assets.

Site selection will also be guided by a multi-stakeholder process to identify underserved areas ahead of a market failure to serve these areas. SDG&E asserts that this diverse stakeholder process will provide better results than a study of charger usage in well-served areas recommended by UCAN.

SDG&E is proposing to own the publically accessible charging stations, and to contract with third parties to build, operate, and maintain the charging facilities.[75] UCAN suggests that because SDG&E has not yet defined the processes for payment transactions, branding, and

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[72] EPRI Transportation Electrification, A Technology Overview, July 2011, page 5-33.
[73] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 54, lines 18-19.
[74] Ibid, page 64, lines 17-19.
[75] Exhibit No: SDGE-11, TOB-29-30.

maintenance, the project should not be implemented. These issues and other project implementation details will be addressed during the detailed engineering and implementation phase of this project and are not a sufficient reason to disallow this project.

Although the take-up rate of PEVs is a little slower than originally expected, much of this was due to production delays realized by the impact of tsunami and earthquake in Japan, the deliveries of the Leaf have just been delayed; the demand for the PEVs remains strong, and the PEV releases in 2012 and beyond are on schedule and significant as discussed previously in Section IA4.

UCAN points out that Costco recently decided to remove electric vehicle charge stations from its stores.[76] While it is true that Costco has decided to remove charge stations, a number of other large retailers have decided to install electric vehicle chargers. These retailers include: Best Buy, Macy's, Cracker Barrel, Fred Meyer, Walgreens, CVS, ACE Parking, IKEA Kohls, 7-Eleven, Enterprise Rent-A-Car, Hertz, and BP (Arco).

SDG&E provided a cost benefit analysis as part of its Smart Grid Deployment Plan,[77] which was described to UCAN at the July 20, 2011 presentation and is publicly available. Another benefit of this project is to provide more available access to PHEV's, which generally have smaller energy storage capacities than battery electric vehicles. While PHEV's may not be completely dependent on electricity, they will have more availability to use electricity as the chosen fuel source. This choice is also in compliance with the state's environmental goals to reduce GHG through electric transportation.

[76] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 70, lines 9-16.
[77] A.11-06-06, Smart Grid Deployment Plan Application of San Diego Gas & Electric Company, Section 4.11, page 264.

K. Wireless Faulted Circuit Indicators, WFI

SDG&E requested a total of $3,501,000 while UCAN recommends $0. UCAN advocates no pilots followed by no post test year funding. UCAN asserts that "An operational AMI system coupled with an OMS and GIS system can be used to achieve the same results that SDG&E is looking to achieve with FCI.",[78] that "The OMS program receives the outage information from the meter and compiles it with other outage information and SCADA information to provide a precise location of a faulted device or line section."[79] and that "Outage information received from a wireless fault indicator will not provide any additional information that a system dispatcher does not already have to dispatch linemen to a specific location."[80]

While it is certainly true that SDG&E's AMI meters will provide a last-gasp/power outage notification and this information will accessed by SDG&E's new OMS/DMS, the notification will only provide a precise location if the outage is a located a single transformer or single service. For a feeder or branch outage all the meters that are capable will send a notification and the operator will only know that the outage is beyond a sectionalizing device. If this sectionalizing device is on SCADA the operator has obtained no additional information.

Now UCAN proceeds to rebut its own argument when it says "…should be able to isolate the faulted phase with existing electro-mechanical fault indicators."[81] Indeed, the dispatched linemen will utilize the existing electro-mechanical fault indicators, FI's, as part of their fault location strategy. However, existing electromechanical FI's do not provide communication capability. The electromechanical FI's must be read visually by field personnel who must be called out from home or another work location, then must travel to the site of the fault indicator,

[78] Exhibit, Testimony of Mr. Dale Pennington on behalf of UCAN, page 73, lines 13-15.
[79] Ibid, page 73, line 24 to page 74, line 2.
[80] Ibid, page 74, lines 3-4.
[81] Ibid, page 74, lines 7-8.

often at night or during inclement weather, and then must gain access to the fault indicator taking extra time if the FI is located in an underground vault or on an overhead line that is not accessible by truck. In contrast, a WFI will have communication capability and can be read remotely by an operator from the operations control center that is manned 24 hours a day. Additionally, the WFI's that SDG&E is installing measure and record line current under normal load conditions which can also be utilized by the operators for load transfers. The WFIs will also be located to improve operator visibility on a circuit for better fault prediction location for feeder and branch outages the troubleshooting and fault locating would be significantly expedited when WFI's are utilized, allowing repair crews to be dispatched sooner, and repairs to be completed sooner, ultimately restoring power to customers sooner than if WFI's were not used. Clearly, wireless fault circuit indicators provide additional information to system operators which will speed restoration times compared to UCAN's solution.

L. Phase Identification

SDG&E requested a total of $5,211,000 while UCAN recommends $0. UCAN advocates no pilots followed by no post test year funding. UCAN denies the request because "Phase identification should already be part of the normal course of business at SDG&E"[82] and "Phase ID in the distribution of electric power is possible to achieve via an AMI system…."[83]

UCAN asserts that phase identification is possible by using SDG&E's AMI system. UCAN states "A simple method is to have a voltage regulator in a substation raise the voltage of one phase (of three). The "Smart Meters" will provide a very accurate voltage reading at a specific point in time. Review of the voltage readings will indicate what meters are on what

[82] Ibid, page 75, lines 19-20.
[83] Ibid, page 75, lines 23-24.

phase."[84] While this method sounds reasonable, it will not work on SDG&E system because SDG&E's substation load tap changers and voltage regulators are all three phase devices that have mechanically interlocked operating mechanism. Sending a raise or lower signal will result in all three phases simultaneously increasing or decreasing respectively. Second, approximately 40 percent of SDG&E's service transformers are connected phase-to-phase on the primary. So even if you could raise one phase you are still left with the unanswered question of "which phase is the meter on?"

The proposed Phase Identification project will use equipment specifically designed and constructed to verify the phase to which each single or two-phase piece of equipment, including meters, is connected, a non-trivial task. This field checked data is compiled and inputted into the SDG&E facilities database, where it ultimately will be used by SDG&E's geographic information system, and other enterprise planning and support tools. This equipment will identify phasing more safely, reliably, and faster than other methods of phase identification.

While SDG&E does mark phases in the field, the accurate transfer of the phase information to databases has not always occurred. SDG&E has initiated an ad-hoc study to attempt to identify potentially overloaded transformers system wide. When SDG&E began to look at transformers associated with EVs it was only able to find meter data for 93 of 616 transformers with EVs.

M. Integrated Test Facility

SDG&E requested a total of $1,842,000 while UCAN recommends $0. UCAN advocates no pilots followed by no post test year funding. UCAN denies the request because they support SDG&E collaborating with SCE and PG&E to develop a joint test facility that all three utilities use to evaluate smart grid equipment.

[84] Ibid, page 78, lines 4-7.

This alternative would result in additional testing and training expenses, and be less practical than the proposed project since the proposed project for a smart grid test lab in San Diego would be used for training SDG&E personnel. A joint test facility located in central or northern California would cost considerable travel time plus travel and lodging expenses, in addition to training expenses. Additionally, a shared test facility would provide less flexibility in scheduling and less availability than a test facility located in San Diego that would be solely operated by SDG&E. Lastly, the three California IOU's have different equipment, different operating practices, different training procedures and different IT and communication system which would result in minimal opportunities to share testing and training. SDG&E has chosen communication, IT systems and grid equipment that are specific to its grid and new products and systems must integrate with this ecosystem.

N. Post Test Year

SDG&E requested a total of $54,983,000 while UCAN recommends $10,700,000. UCAN cites limited support for these costs and no supporting calculations as the reason for denying cost recovery.[85] UCAN does note "the Post Test Year projects that are sponsored by Mr. Bialek are a continuation of the Projects in Mr. Bialek's testimony."[86] and "…The costs were calculated utilizing the same methodologies that were developed for the years 2011 and 2012."[87]

As stated in Section I, no intervener disputed the data supporting the drivers of SDG&E's smart grid portfolio of projects. SDG&E's project costs were developed based upon engineering defined quantities and unit costs from vendors or similar technology deployment costs. Even though UCAN recognizes the need to be proactive, they are philosophically opposed to fund

[85] Ibid, page 80, line 1.
[86] Ibid, page 80, lines 2-4.
[87] Ibid, page 79, lines 24-26.

anything other than pilots at reduced scope while recommending 'slow down and wait'. Given historical customer adoption of technology this is a mistake which results in even larger SDG&E capital expenditures in the post test years. However, UCAN ignore this reality and also limits the post test year funding

V. SUMMARY AND CONCLUSION

Table 2 is a summary and comparison of SDG&E's, DRA's and UCAN's positions on the total of 2011 and 2012 funding for SDG&E's Smart Grid Infrastructure Program in this General Rate Case Application. As SDG&E has clearly pointed out, SDG&E's case is compelling and the data substantiating its case is not disputed by any intervening party. SDG&E's rebuttal has shown the intervener position of "slow down and wait" to not be supported by data or the alternatives proffered. Therefore, SDG&E requests full funding of its Smart Grid Infrastructure portfolio of project.

- From the data and forecast currently available, SDG&E believes investment in mitigation of intermittent photovoltaic generation is necessary and the integrating renewable portfolio of projects should be funded at the requested levels.
- No party disputes that electric vehicles are here and that the number is predicted to increase. SDG&E's case is compelling and it is imperative to fund the electric vehicle growth portfolio of projects at the level requested in order address the coming PEV consumer demand and to reduce potential market barriers to PEV adoption.
- SDG&E has an obligation to provide reliable service to its customers. Intermittent renewable resources and electric vehicles will impact it reliability. SDG&E also has an aging infrastructure and a need to continue to improve its fire preparedness. No one

disputes these issues or the supporting data. Therefore, it is imperative to fund the reliability portfolio of projects at the level requested in order meet these challenges.

- Smart Grid technologies, solutions and standards are rapidly evolving. SDG&E needs a Smart Grid test facility to address standard, integration and interoperability challenges for new and existing technologies and system. Therefore, it is imperative to fund the Integrated Test Facility project at the level requested to respond to the changes in the utility environment.

Table 2 – SDG&E's Smart Grid Infrastructure Funding – Position of the Parties

Project	SDG&E	DRA	UCAN
Renewable Growth - Energy Storage	$54,983,000	$10,700,000	$12,136,758
Renewable Growth - Dynamic Line Ratings	$3,926,000	$785,200	$0
Renewable Growth -Phasor Measurement Units	$4,056,000	$737,464	$1,769,891
Renewable Growth - Capacitor SCADA	$5,804,000	$2,902,000	$58,040
Renewable Growth - SCADA Expansion	$5,964,000	$2,982,000	$5,964,000
Electric Vehicle Growth - Plug-In Electric Vehicles	$0	$0	$0
Electric Vehicle Growth - Smart Transformers	$2,568,000	$1,042,000	$0
Electric Vehicle Growth - Public Access Charging Facilities	$5,230,000	$0	$0
Reliability - Wireless FauIted Circuit Indicators	$3,501,000	$0	$0
Reliability - Phase Identification	$5,211,000	$0	$0
Reliability - Condition Based Maintenance Expansion	$752,000		
Smart Grid Development - Integrated Test Facility	$1,842,000	$1,000,000	$0
Total	**$93,837,000**	**$20,148,664**	**$19,928,689**
Total w/o CBM Expansion	**$93,085,000**	**$20,148,664**	**$19,928,689**

This concludes my prepared rebuttal testimony.

ATTACHMENT A

SG GRC-SGDP Presentation 7/20/11

Smart GRID

Lee S. Krevat, SG Director
Dr. Thomas Bialek, SG Chief Engineer

Smart Grid Projects in SDG&E 2012 GRC vs. SGDP

July 20, 2011

Agenda

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Purpose of the Presentation

- The purpose of today's presentation is to describe the impact to the Smart Grid (SG) proposed projects in A.10-12-005 (SDG&E 2012 GRC) as a result of additional analysis conducted during the development of the Smart Grid Deployment Plan (SGPD).
- As indicated in letter sent on June 20, 2011 to all parties of record in SDG&E's Test Year 2012 General Rate Case, the following is a summary of this impact:
  1. In the SGDP, SDG&E identified hard benefits for the proposed list of Smart Grid projects included in the GRC testimony of SDG&E witnesses Lee Krevat and Tom Bialek. These hard benefits amount to an annual average of approximately $600 thousand dollars during the period of 2012-2015. Since these hard benefits were not identified until after the filing of the SDG&E 2012 GRC application they are not currently contained in the testimonies of either Mr. Krevat or Mr. Bialek.
  2. SDG&E has decided not to pursue at this time the proposed project named "Conditioned Based Maintenance Expansion" which is currently included in the GRC testimony of Mr. Krevat and Mr. Bialek.
  3. The cyber security area reflects higher operating and capital costs than forecast in the SDG&E 2012 GRC due to incremental funding needs identified during the preparation of the SGDP. This planning approach was based on mapping security capabilities against the NIST 800/53 framework, and then considering what types of functional improvements would likely need to be made in specific security capabilities over the 10 year planning horizon.

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Overview of SGDP Vision

- The Smart Grid Deployment Plan is the same as the SDG&E Vision

  "SDG&E, in collaboration with key stakeholders, will create the foundation for an innovative, connected and sustainable energy future in the San Diego region."

- Focuses on customers and stakeholders, and their adoption of renewables, PEVs, other technologies, and environmental policy
  - SDG&E cannot wait for others to move forward – our customers are already moving forward.
- Incorporates stakeholder ideas, recommendations and priorities.
- SB 17 Alignment
  - Describes our vision of how the 11 SB17 smart grid goals will be realized by 2015/2020

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Mapping from the GRC to SGDP

- The SDGP included 9 programs that were derived, primarily, from the key drivers for Smart Grid proposed investments described in SDG&E 2012 GRC

Key SG Drivers in GRC[1]	9 Programs in SGDP[1]
Customer Empowerment	Customer Empowerment
	Operational Efficiency
Renewable Growth	Renewable Growth
Electric Vehicle Growth	Electric Vehicle Growth
Reliability	Reliability and Safety
Security	Security
SG Development	SG RD&D
	Integrated and Cross-Cutting Systems
	Workforce Development

1 Note: The SGDP included projects that were also included in SDG&E 2012 GRC and classified as Smart Grid projects (Testimonies of Lee Krevat and Dr. Thomas Bialek) and non-Smart Grid projects (other testimonies). For purposes of the SGDP, these projects were all classified as Smart Grid investments.

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Mapping from the GRC to SGDP

- The SDG&E 2012 GRC included 18 Smart Grid projects driven by six key drivers:

Renewable Growth	Reliability	Customer Empowerment
Energy Storage (ES)	Wireless Fault Circuit Indicators	HAN System Integration
Dynamic Line Ratings	Phase Identification	HAN Infrastructure
Phasor Measurement Units	Condition Based Maintenance Expansion	HAN DRCA Implementation
Capacitor SCADA		HAN Test Laboratory
SCADA Expansion		Distributed Energy Resource Management System

Electric Vehicle Growth	SG Development	Security Infrastructure
Plug-In Electric Vehicles	Integrated Test Facility	SG Cyber Security Infrastructure
Smart Transformers		
Public Access Charging Facilities		

- Cost Included in Testimony of Thomas Bialek (Exhibit SDG&E-11) and Testimony of Jeffrey C. Nichols (Exhibit SDG&E-18-R)
- Cost Included in Testimony of Edward Fong (Exhibit SDG&E-13-R) and Testimony of Jeffrey C. Nichols (Exhibit SDG&E-18-R)
- Cost Included in Testimony of Edward Fong (Exhibit SDG&E-13-R), Testimony of Jeffrey C. Nichols (Exhibit SDG&E-18-R) and Testimony of James Seifert (Exhibit SDG&E-20-R)
- Cost Included in Testimony of Thomas Bialek (Exhibit SDG&E-11), Testimony of Jeffrey C. Nichols (Exhibit SDG&E-18-R) and Testimony of Alan B. Marcher (Exhibit SDG&E-06-R)
- Cost Included in Testimony of Jeffrey C. Nichols (Exhibit SDG&E-18-R)

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Mapping from the GRC to SGDP

➢ **The SGDP included 22 projects that are comparable to the 18 Smart Grid projects proposed in SDG&E 2012 GRC**

	SG Projects in GRC 18 Projects	SG Projects in SGDP 22 Projects
Renewable Growth	1. Energy Storage 2. Dynamic Line Ratings 3. Phasor Measurement Units 4. Capacitor SCADA 5. SCADA Expansion	1. Energy Storage 2. Dynamic Line Ratings 3. Phasor Measurement Units 4. Capacitor SCADA 5. SCADA Expansion
Electric Vehicle Growth	6. Plug-in Electric Vehicles 7. Smart Transformers 8. Public Access Charging Facilities	6. Plug-in Electric Vehicles 7. Smart Transformers 8. Public Access Charging Facilities
Reliability & Safety	9. Wireless Faulted Circuit Indicators 10. Phase Identification 11. CBM Expansion	9. Wireless Faulted Circuit Indicators 10. Phase Identification 11. CBM Expansion
Smart Grid Development	12. Integrated Test Facility	12. Integrated Test Facility
Customer Empowerment	13. HAN System Integration 14. HAN Infrastructure 15. HAN DRCA Implementation	13. HAN Infrastructure (A)
	16. HAN Test Laboratory 17. DERMS	14. HAN Test Laboratory 15. DERMS
Security	18. SG Cyber Security Infrastructure (B)	16. Security Event & Incident Management Refresh 17. Subsation Physical Security Hardening 18. Security Metrics, Reporting & Awarness 19. Security Compliance Management 20. Security Threat & Vulnerability Management 21. Security Incident Management 22. Security DNP

Denotes changes from GRC to SGDP

A HAN System Integration, HAN Infrastructure and HAN DRCA Implementation were consolidated into one project in the SGDP

B The cyber security project changed as a result of a revised planning approach

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Description of Smart Grid Projects Proposed in GRC

➢ Renewable Growth Projects

Project	Description
Energy Storage (ES)	Two types of energy storage systems to assist in addressing intermittency issues created by the variable output of renewable energy resources. One solution will place distributed energy storage system on circuits with high penetration of customer photovoltaic systems. Additionally, ES systems will be strategically located in substations to mitigate the impact of multiple circuits with PV as the second budget item.
Dynamic Line Ratings	Implementation of dynamic ratings for distribution circuits. The implementation of dynamic line ratings has the potential for increasing circuit capacity and accommodating new renewable generation.
Phasor Measurement Units	Implementation of PMUs on the electric distribution system . Installation of PMUs on the electric distribution system are expected to improve reliability and market efficiency by employing high speed, time synchronized measurement devices
Capacitor SCADA	Implementation of SCADA control of all capacitors on SDG&E's distribution system. When coupled with energy storage, dynamic line ratings and phasor measurements new control schemes can be implemented which will mitigate the impact of PV system output fluctuations on system voltage.
SCADA Expansion	Expansion of SCADA to expand remote operability and automated operation of distribution SCADA capable switches. This will continue SDG&E's goal of promoting faster isolation of faulted electric distribution circuits and branches, resulting in faster load restoration and isolation of system disturbances

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Description of Smart Grid Projects Proposed in GRC

Electric Vehicle Growth Projects

Project	Description
Plug-in Electric Vehicles	Upgrade primary and secondary voltage infrastructure to accommodate the rollout of electric vehicles in San Diego County.
Smart Transformers	Installation of sensors and technology on distribution transformers. This project has the potential to allow increased transformer capacity utilization and accommodate future loads such as electric vehicle charging.
Public Charging Stations	Installation of utility owned public charging stations for electric vehicles. SDG&E will install and own the charging stations in under-served areas in order to broaden the coverage of public charging stations within its service territory.

Reliability Projects

Project	Description
Wireless Fault Circuit Indicators	Implementation of wireless faulted circuit indicators. This system is expected to provide rapid identification and location of faulted distribution circuits resulting in reduced outage and repair times.
Phase Identification	Accurate identification of phasing for implementation in the new distribution operating system.
CBM Expansion	Expansion of CBM to include distribution substation transformers 4 kV substations.

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Description of Smart Grid Projects Proposed in GRC

Smart Grid Development Projects

Project	Description
Integrated Test Facility	Construct facility upgrades and purchase and install equipment to create an integrated test facility. This will allow testing of the integration of multiple complex hardware and software systems comprising Smart Grid technologies.

Customer Empowerment Projects

Project	Description
HAN Infrastructure	HAN Infrastructure: IT infrastructure environments or platforms for DRCA development and deployment. HAN Systems Integration: Information technology hardware and Demand Response Control Automation (DRCA) system integration necessary to support and manage the enablement of two-way communication inside the home supporting automation. HAN DRCA Implementation: DRCA software will manage the commissioning, communications connectivity monitoring, communications verification, security, troubleshooting, and de-commissioning of HAN devices such as Programmable Communicating Thermostats (PCTs), In Home Displays (IHDs), smart appliances, Home Energy Management Systems (HEMS) and the like. DRCA will send demand response event signals, price signals and other short messages to the commissioned devices

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Description of Smart Grid Projects Proposed in GRC

Customer Empowerment Projects (Continue…)

Project	Description
HAN Test Laboratory	The HAN laboratory supports the compatibility verification of HAN devices with the SDG&E systems ensuring that the devices with the SDG&E systems ensuring that the devices perform the functionality as designed and describe by the device provider and inter-operate wit other HAN devices.
DERMS	This project will optimize resource utilization in response to system operational events, environmental and equipment conditions (collectively reliability events), and market price conditions. DERMS includes several different, but integrated, software components that incorporates advanced optimization algorithms to dispatch demand and supply side resources.

Security Infrastructure Projects

Project	Description
SEIM Refresh	Installation of Security Event & Incident Management (SEIM) technology to replace SDG&E's current SEIM infrastructure. The project will design and implement a SEIM service that supports current production and regulatory requirements and a foundation for strategic utility programs. This capability will streamline and enhance management, trend analysis, alert reporting and escalation processes.
Substation Physical Security Hardening	Installation of physical access control and monitoring for substations, and enhanced capabilities for network monitoring of alarm systems.

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Description of Smart Grid Projects Proposed in GRC

Security Infrastructure Projects (Continue…)

Project	Description
Security Metrics, Report and Awareness	This project will enhance internal and external security awareness, collaboration and training, as well as security and compliance metrics, and risk reporting.
Security Compliance Management	Implementation of a compliance control framework, security features and control baselines and configurations, as well as compliance control unification, attestation and testing automation for security and compliance requirements.
Security Threat and Vulnerability Management	Enhancements to the hardware/software security testing and vulnerability management program; testing and monitoring of Smart Grid security controls; operational compliance monitoring (SOX & NERC/CIP); data labeling and tagging; compliance management solution; cyber security testing & assessment program; CIS standards; audit and records retention.
Security Incident Management	Implementation of solutions for vulnerability assessment and management; hardware and firmware security assessment and code review. Implementation of processes and procedures for data classification, handling, marking and disposal. These capabilities will help ensure configuration and assurance verification and testing; threat and vulnerability collaboration.
Security Distributed Network Protocol Pilot	This project will develop SDG&E standards/guidelines for the implementation and use of secure SCADA technology for electric transmission and distribution. The technology will have proven reliability, security, robustness; meet latency and real-time applications requirements; and provide robust two-way communications.

Description of Smart Grid Projects Proposed in GRC

- SG Projects in SGDP were classified based on 4 types:
  - Policy – projects driven by state or federal policy, but potential customer and societal benefits are calculated
  - Value – projected benefits outweigh costs or are necessary to effectively communicate with customers
  - Pilots – mitigate risk, determine costs and benefits
  - Enterprise – projects that meet the broader needs of SDG&E's business but that are also related to Smart Grid. No cost and benefits included.

	Policy	Value	Pilot	Enterprise
1. Energy Storage	✓			
2. Dynamic Line Ratings	✓			
3. Phasor Measurement Units	✓			
4. Capacitor SCADA	✓			
5. SCADA Expansion	✓			
6. Plug-in Electric Vehicles	✓			
7. Smart Transformers	✓			
8. Public Access Charging Facilities	✓			
9. Wireless Faulted Circuit Indicators		✓		
10. Phase Identification				✓
11. CBM Expansion		✓		
12. Integrated Test Facility			✓	
13. HAN Infrastructure	✓			
14. HAN Test Laboratory	✓			
15. DERMS		✓		
16. Security Event & Incident Management Refresh	✓			
17. Subsation Physical Security Hardening	✓			
18. Security Metrics, Reporting & Awarness	✓			
19. Security Compliance Management	✓			
20. Security Threat & Vulnerability Management	✓			
21. Security Incident Management	✓			
22. Security DNP	✓			

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SGDP Roadmap for Smart Grid GRC Projects

- SDG&E's SGDP lays out the timeline for our 9 programs from 2011-2020 and their alignment to policy goals
- Shows by project, by year, and policy / value / pilot
  - Includes brief descriptions of all projects including "Enterprise" projects – those not being done because of smart grid, but including smart grid requirements.
- Total number of projects included in the SGDP are 82 projects:

	Policy, Value & Pilot[1]	Enterprise[2]	Total
Smart Grid Projects in SDG&E 2012 GRC	21 Projects	1 Project	22 Projects
Non-Smart Grid Projects Included In SDG&E 2012 GRC & SGDP	5 Projects	2 Projects	7 Projects
Projects in Other Proceedings & Incremental Projects	38 Projects	15 Projects	53 Projects
Total Projects in SGDP	64 Projects	18 Projects	82 Projects

1 Cost and Benefits included in the SGDP
2 Cost and Benefits *not* included in the SGDP

- Includes 2015 and 2020 Vision statements in Program timelines for context

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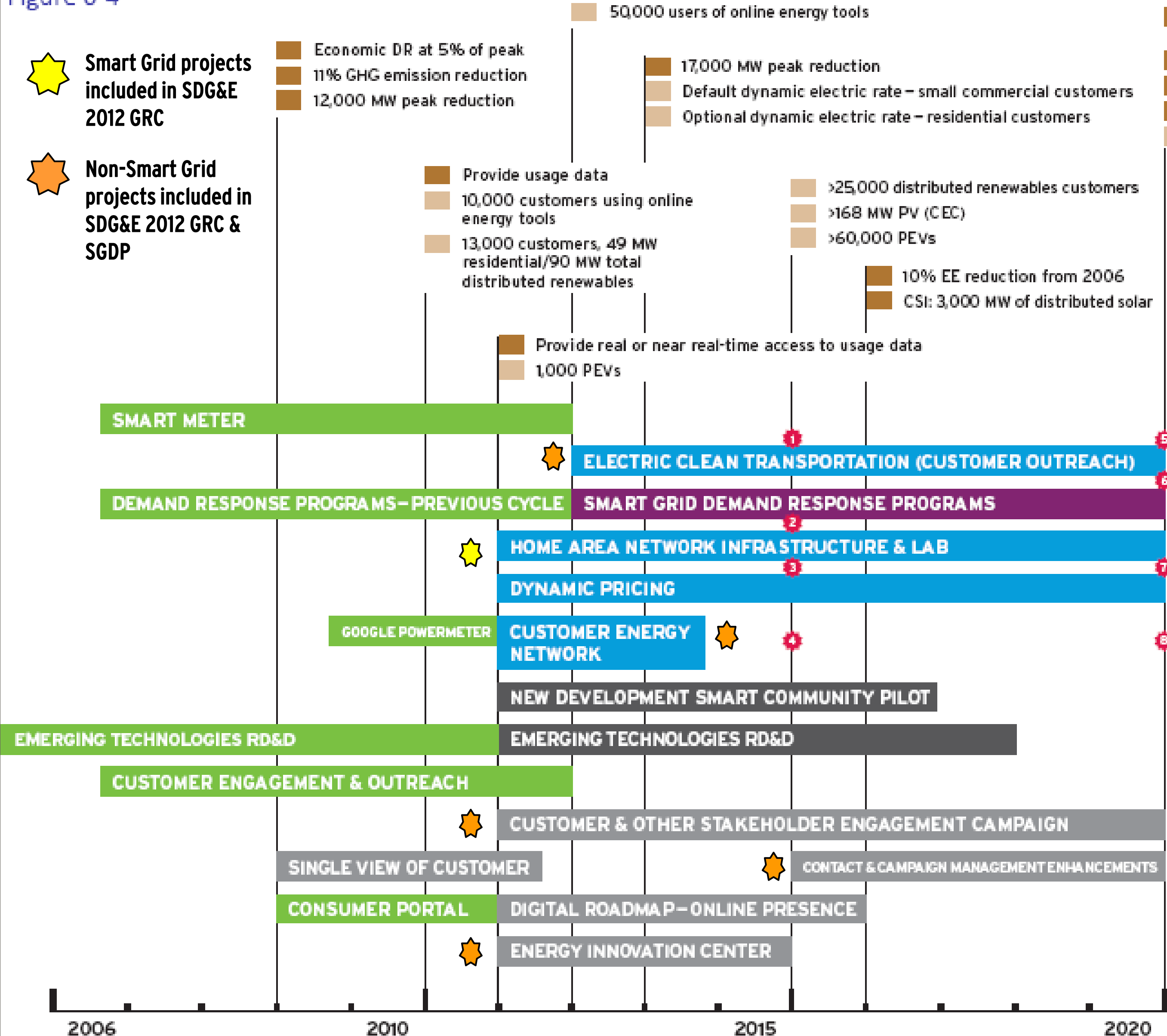
CUSTOMER EMPOWERMENT

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

Figure 6-4



SDG&E Smart Grid Vision: by 2015

1. Customer education and outreach programs are proactively engaging customers through multiple channels
2. SDG&E and third parties are providing HANs and other customer premise network capabilities, providing customers real time feedback on power consumption and energy pricing
3. Standardized/reliable customer specific interval usage information and time differentiated price signals are available, enabling customers to make informed and cost-based energy use decisions
4. Customers can choose among multiple energy information services and providers

SDG&E Smart Grid Vision: by 2020

5. Customers are provided near-real time signals via price and event triggers enabling a balance of supply and demand
6. Widely adopted standards create a ubiquitous market of plug-and-play network devices in businesses and homes, including multi-unit dwellings
7. SDG&E is providing options and tariffs for customers to sell generation using distributed energy resources, electric vehicle to grid, or energy storage discharge
8. Microgrid and other technologies give customers more reliability options

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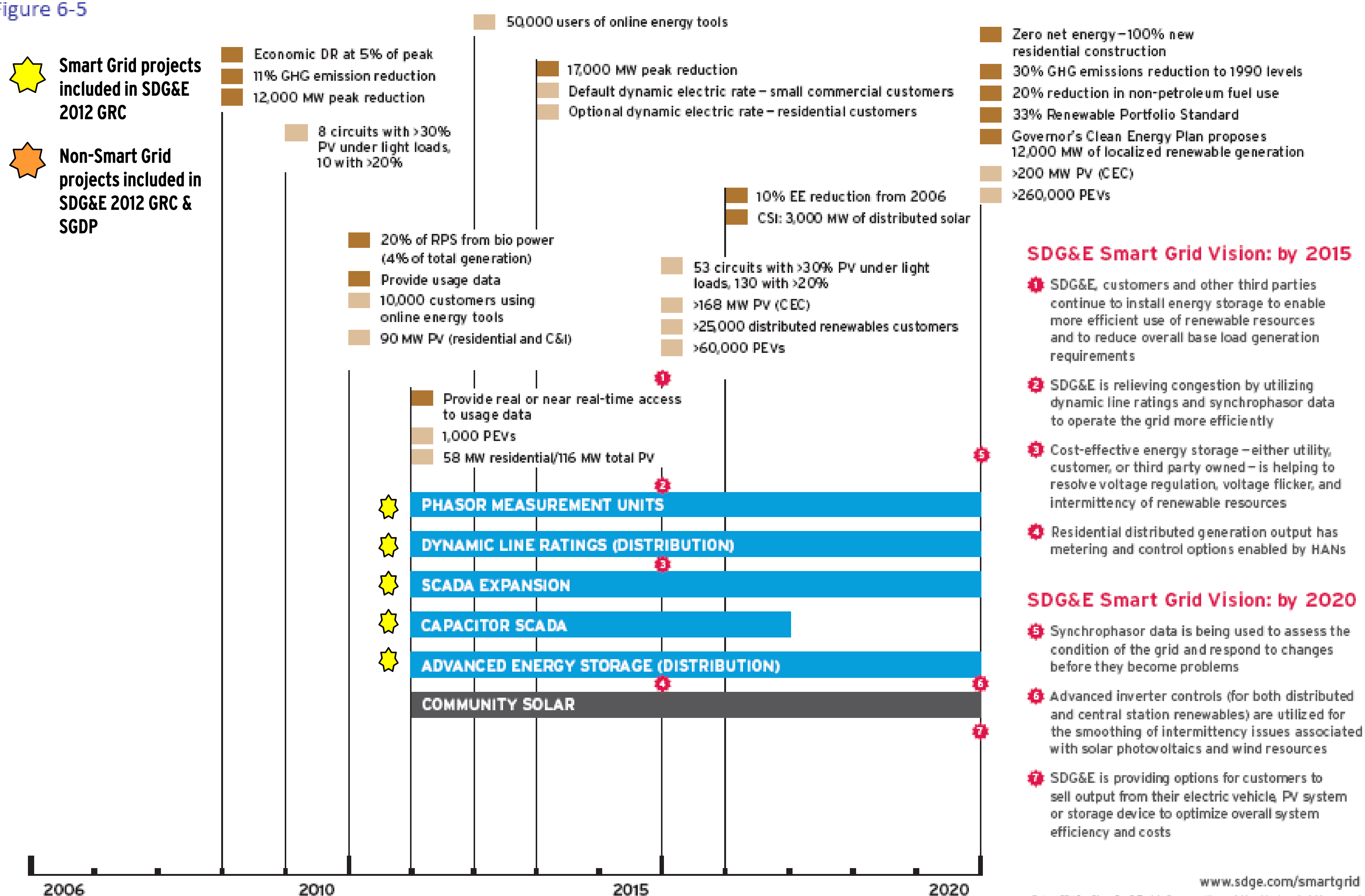
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

RENEWABLE GROWTH

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

Figure 6-5



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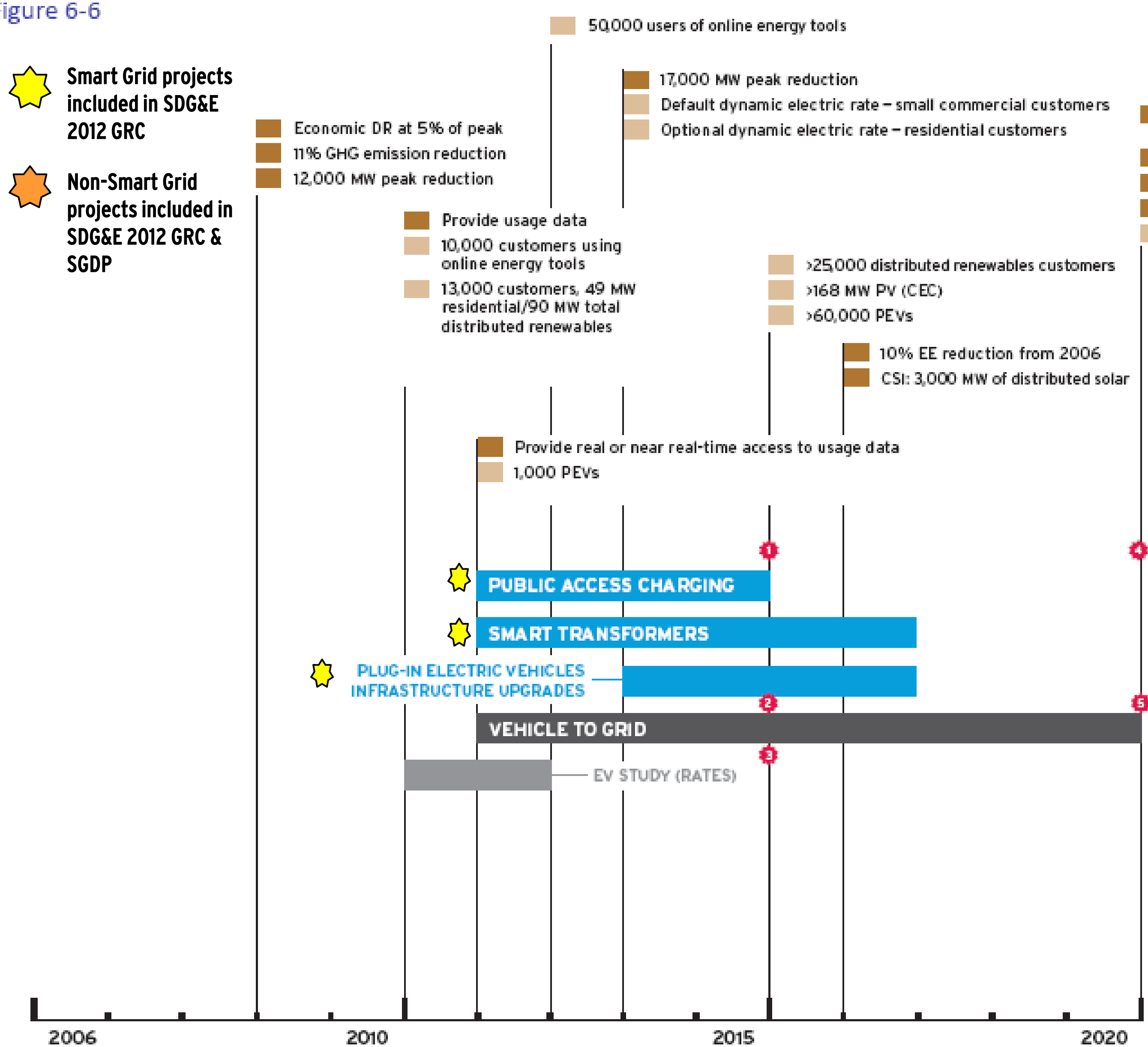
1 2 3 4 5 6 7 8 9 2011 Smart Grid Roadmap

ELECTRIC VEHICLE GROWTH

Key

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

Figure 6-6



SDG&E Smart Grid Vision: by 2015

1. PEV growth is supported and encouraged through the application of new technologies to manage customer load and facilitate EV charging to minimize impacts to the grid
2. SDG&E is providing options for customers to prioritize and control load to accommodate distributed intermittents and efficiently integrate plug-in electric vehicles
3. SDG&E, through metering and related measures, is tracking electricity used for transportation in order to earn Low Carbon Fuel Standard credits on behalf of customers

SDG&E Smart Grid Vision: by 2020

4. SDG&E is providing options for customers to sell energy from their electric vehicle, PV system, or storage device to optimize overall system efficiency and costs
5. The market continues to integrate the aggregation of distributed resources, plug-in electric vehicles, and energy storage

www.sdge.com/smartgrid

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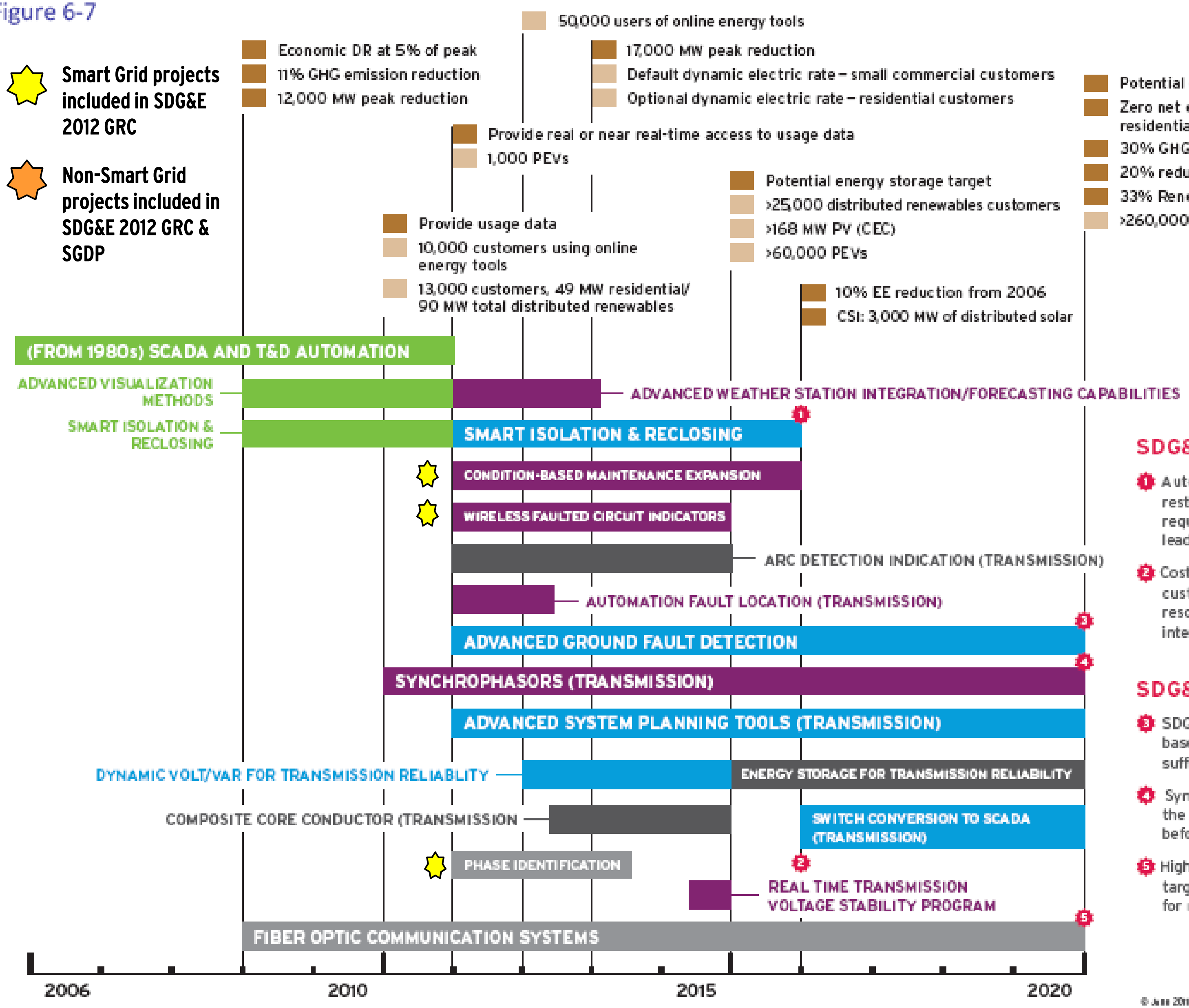
RELIABILITY AND SAFETY

Key

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

Figure 6-7



SDG&E Smart Grid Vision: by 2015

1. Automatic fault detection, isolation, and service restoration capabilities are being enabled, requiring minimal human intervention and leading to improvement in outage restoration
2. Cost-effective energy storage – either utility, customer, or third party owned – is helping to resolve voltage regulation, voltage flicker, and intermittency of renewable resources

SDG&E Smart Grid Vision: by 2020

3. SDG&E is enabling differing levels of reliability, based on customer needs/preferences for self sufficiency (particularly for C&I customers)
4. Synchrophasor data is being used to assess the condition of the grid and respond to changes before they become problems
5. Highly reliable network services are deployed to targeted areas to ensure continued availability for mission critical applications

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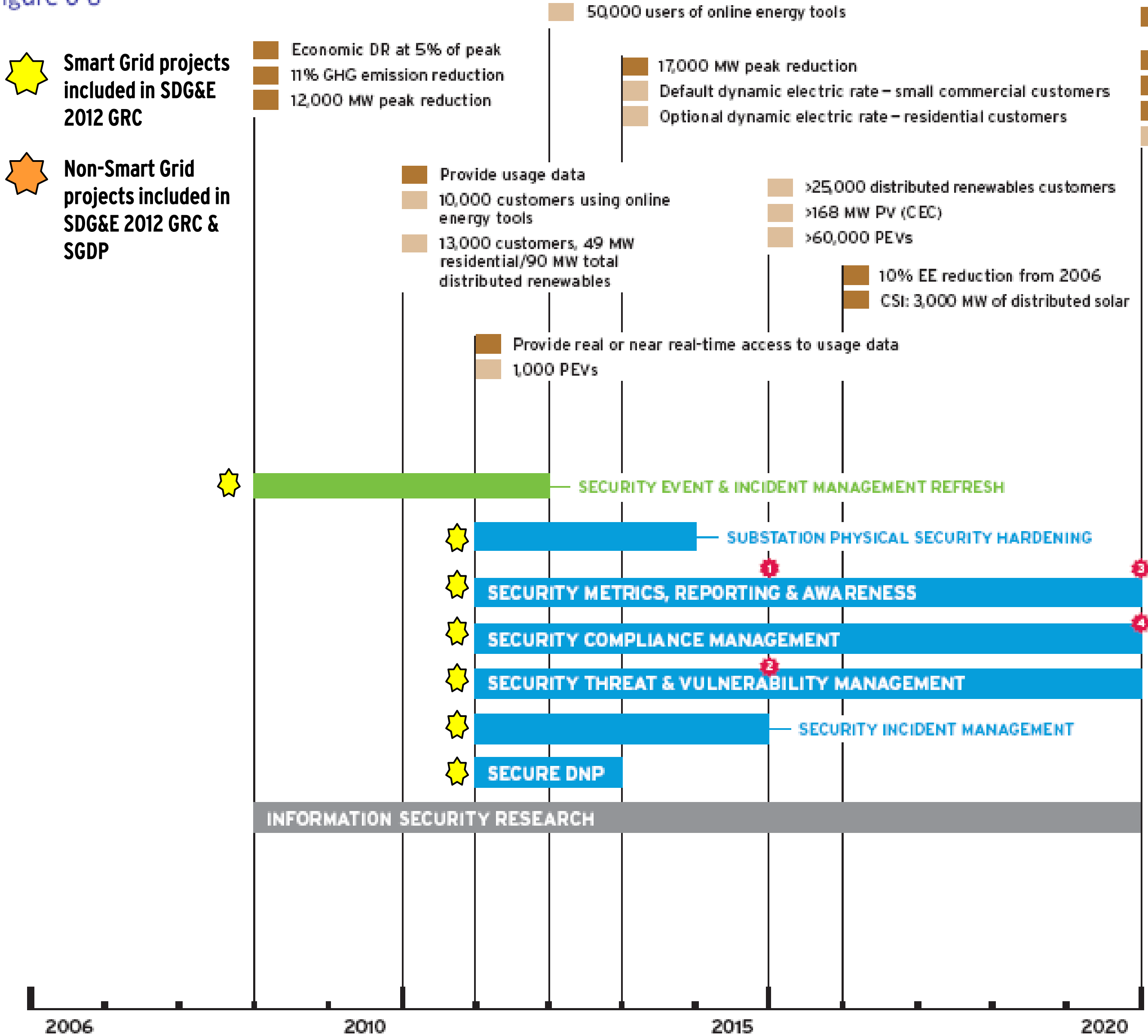
SECURITY

Key

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

Figure 6-8



SDG&E Smart Grid Vision: by 2015

1. SDG&E continues to ensure that secure Smart Grid technologies are being applied to the electric distribution system that are highly resistant to outside intrusion or other unauthorized uses
2. Smart Grid network security continues to improve, further preventing unauthorized access and incorporating responsive intrusion detection and prevention measures

SDG&E Smart Grid Vision: by 2020

3. SDG&E continues to work with technology providers to develop new control systems that automatically detect attacks and reconfigure to resist attack
4. Smart Grid applications provide detailed logging of events enabling tracing and correlation for improved security, problem resolution, and performance monitoring

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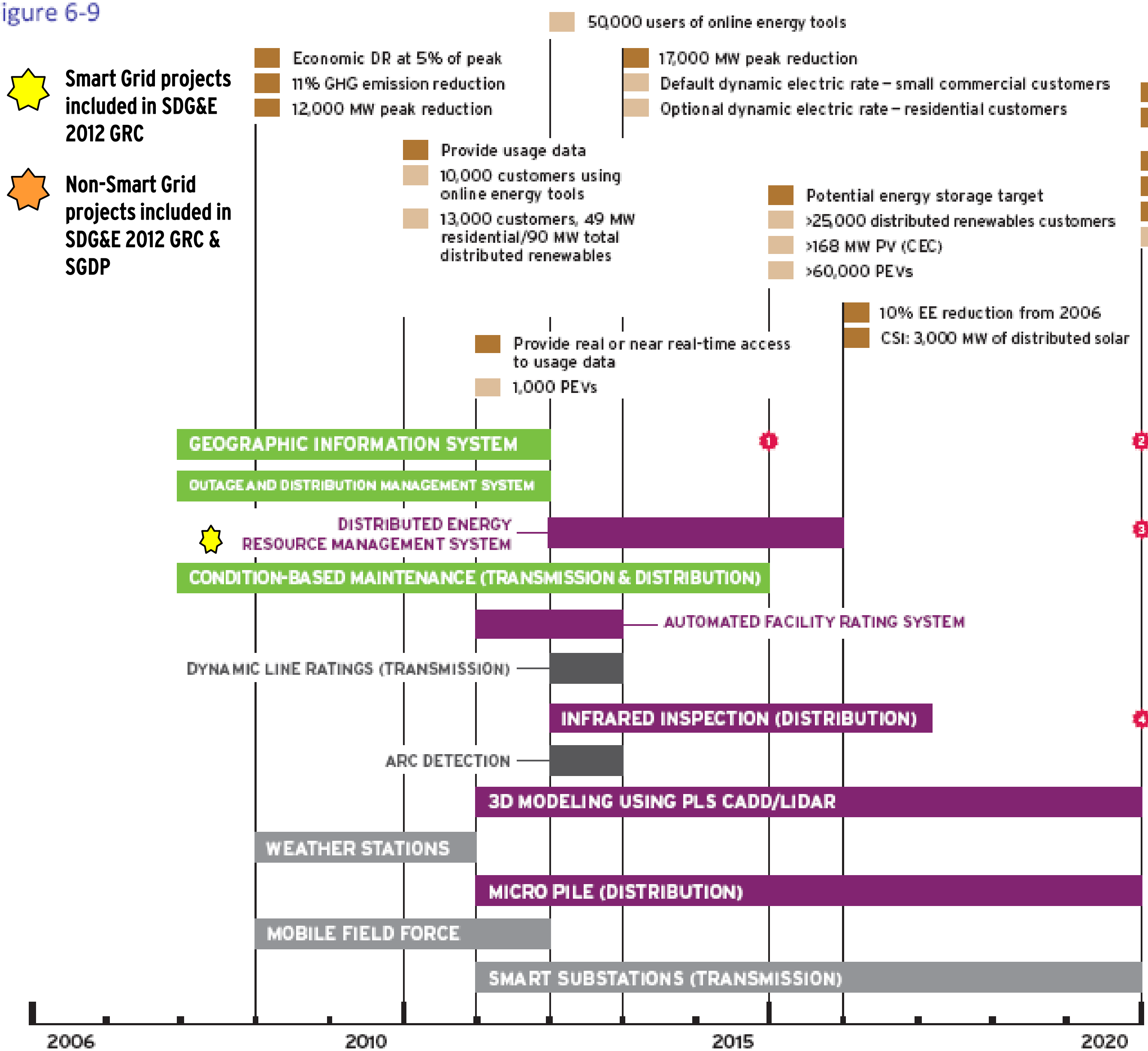
OPERATIONAL EFFICIENCY

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

Figure 6-9



SDG&E Smart Grid Vision: by 2015

1. Improved distribution system voltage regulation through energy storage, automated capacitor switching, and other devices results in lower system losses

SDG&E Smart Grid Vision: by 2020

2. Ancillary service markets allow use of distribution level resources supporting the transmission system and resulting in improved system performance
3. SDG&E's Distributed Energy Resource Management System is fully functional and interfacing with customer loads and resources, supporting efficient utilization of distributed energy resources
4. SDG&E is utilizing time series data and event correlations to provide predictive capabilities that improve asset management, system operating performance, and health

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SMART GRID RD&D

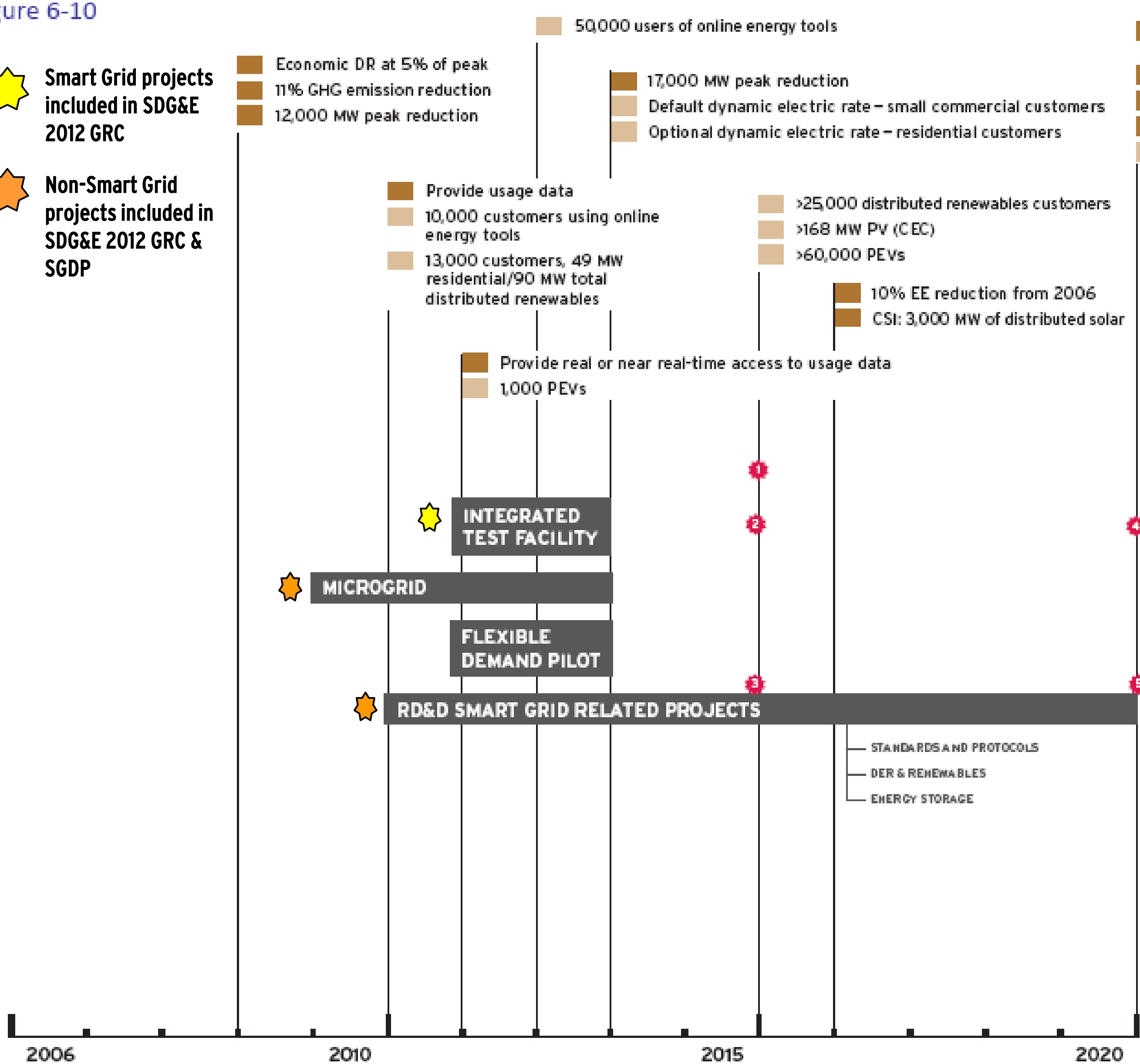
Key

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

Figure 6-10

Smart Grid projects included in SDG&E 2012 GRC

Non-Smart Grid projects included in SDG&E 2012 GRC & SGDP



SDG&E Smart Grid Vision: by 2015

1. SDG&E is helping advance the development of protocols that enable full integration of customer Distributed Energy Resources
2. SDG&E is demonstrating the benefits of energy storage and communications with conventional technologies in practical applications
3. SDG&E customers have the ability to control loads autonomously and many have adopted energy efficiency technologies to attain zero net energy objectives

SDG&E Smart Grid Vision: by 2020

4. SDG&E continues to work with the industry to develop interfaces with customer loads to allow dynamic control and regulation
5. Widely adopted NIST standards are creating a ubiquitous market of plug-and-play networked devices in homes and businesses

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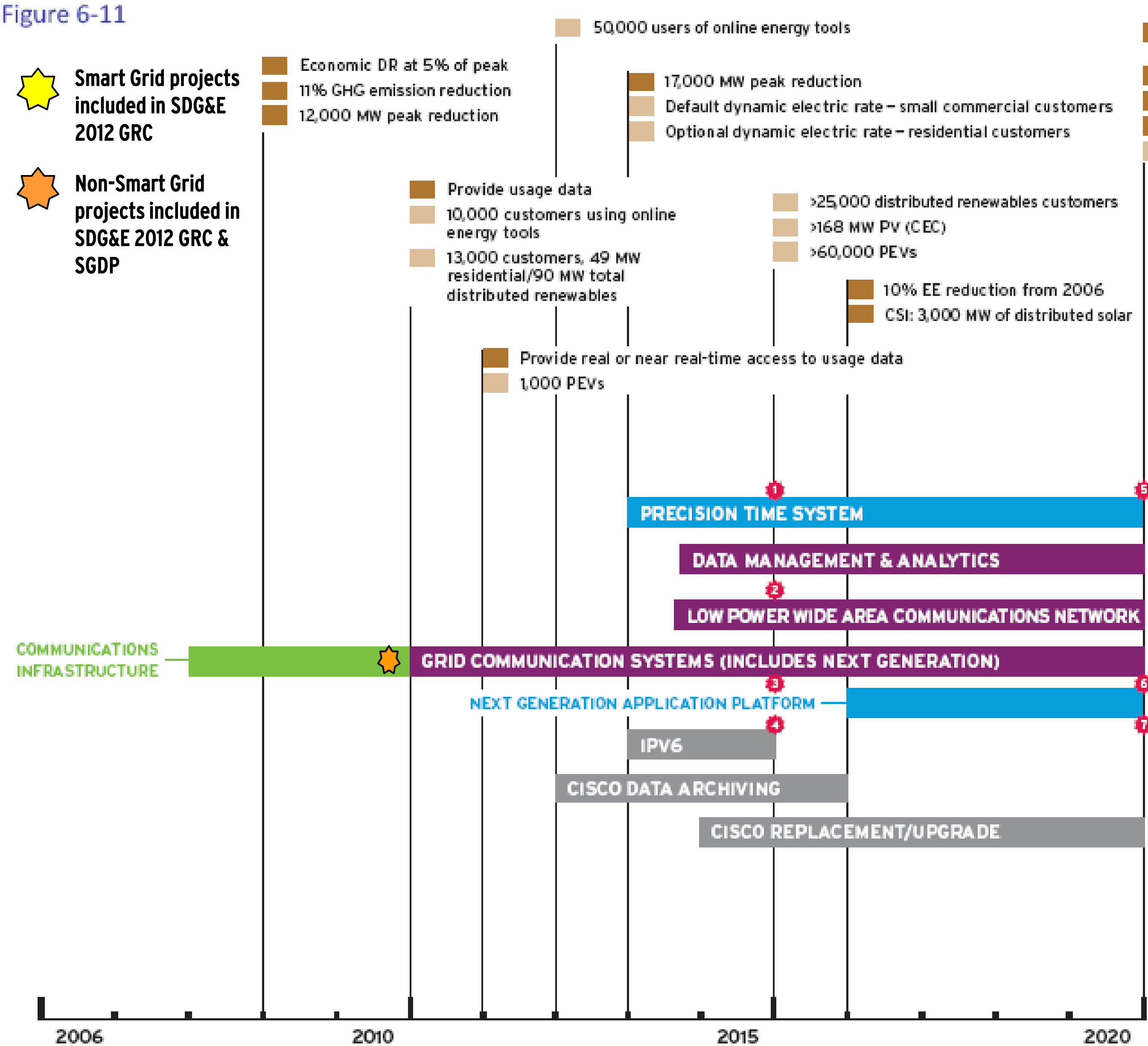
INTEGRATED AND CROSS-CUTTING SYSTEMS

Key

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

Figure 6-11



SDG&E Smart Grid Vision: by 2015

1. SDG&E continues to enhance near real-time analytic services for control room analysis (via time-series or alternative analytic tools) enabling predictive and geospatial analyses
2. Robust grid communications are enabling the near real time and real-time information access required operate the grid more efficiently
3. Smart Grid communications enabled along distribution lines connecting Distributed Energy Resource and energy storage providers, enabling timely and secure information exchange with the CAISO markets
4. SDG&E's system integration platform is providing improved interoperability among different systems

SDG&E Smart Grid Vision: by 2020

5. Fully integrated data systems enable a holistic approach to data management improving overall utility situational awareness regarding the state of the grid
6. SDG&E provides customers with opportunities to participate in the market using open standards and applications by leveraging time series data and event correlations, as well as meter data brought together using system integrations
7. SDG&E is enabling automatic server workload migration capabilities, based on availability, cost, and source (fossil fuel, solar, wind generated) of power

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Cost Overview

- As part of the SGDP, SDG&E has developed cost and benefit calculation procedures to identify, quantify and, where possible, monetize the costs and benefits of its current and planned Smart Grid investments. The cost and benefits developed are conceptual estimates for the years 2011-2015 and provisional ranges for 2016-2020.

SGDP Approach for calculating cost for Smart Grid projects proposed in GRC:

CAPEX & O&M
Direct cost in 2009 $ utilized in SDG&E 2012 GRC for Test Year + Post Test Years, except for Cyber Security Project

✖

Loaders
Added additional loaders for labor and non-labor not included as part of direct cost

✖

Escalation Factors
Added escalation factors based on inflation forecast used for SDG&E 2012 GRC

=

Conceptual Estimates for 2011-2015

CAPEX & O&M
Forecasted direct cost for 2016-2020 based on assumptions driven by SDG&E 2012 GRC

✖

Loaders
Added additional loaders for labor and non-labor not included as part of direct cost

✖

Escalation Factors
Added escalation factors based on inflation forecast used for SDG&E 2012 GRC

=

Provisional Ranges for 2016-2020

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Cost Overview

Amounts in Thousands of US Dollars Loaded & Escalated	Capital				O&M				Total Estimated Capital + O&M	
	Historical	Conceptual Estimates	Provisional Ranges 2016-2020		Historical	Conceptual Estimates	Provisional Ranges 2016-2020			
	2006-2010	**2011-2015**	**Low**	**High**	**2006-2010**	**2011-2015**	**Low**	**High**	**Low Range**	**High Range**
Renewable Growth Policy[1]	$0	($350,440)	($244,877)	($244,877)	$0	($31,878)	($33,101)	($33,101)	($660,297)	($660,297)
Electric Vehicle Growth Policy[2]	$0	($84,260)	($35,675)	($35,675)	$0	($19,293)	($32,419)	($32,419)	($171,646)	($171,646)
Reliability Value[3]	$0	($41,204)	($630)	($630)	$0	($7,591)	($11,296)	($11,296)	($60,721)	($60,721)
Smart Grid Development Pilot[4]	$0	($7,332)	$0	$0	$0	($4,801)	($5,580)	($5,580)	($17,714)	($17,714)
Customer Empowerment Policy & Value[5]	$0	($109,899)	($11,871)	($11,871)	$0	($25,956)	($38,295)	($38,295)	($186,021)	($186,021)
Security Policy[6]	($1,789)	($118,179)	($10,518)	($10,518)	$0	($15,005)	($35,853)	($35,853)	($181,344)	($181,344)

1 Includes the following projects: Energy Storage, Dynamic Line Ratings, Phasor Measurement Units, Capacitor SCADA & SCADA Expansion
2 Includes the following projects: Plug-In Electric Vehicles, Smart Transformers & Public Charging Facilities
3 Includes the following projects: Wireles Faulted Circuit Indicators and CBM Expansion
4 Includes the following projects: Integrated Test Facility
5 Includes the following projects: HAN Infrastructure, HAN Test Laboratory & DERMS
6 Includes the following projects: SEIM Refresh, Substation Phisical Security Hardening, Security Metrics, Reporting & Awarness, Security Compliance Management, Security Threat & Vulnerability Management, Security Incident Management & Security DNP

Benefits Overview

- SDG&E's approach for calculating benefits leveraged from the work conducted by EPRI that included the following categories:
  - Economic – includes avoided or reduced costs and investments due to improved system efficiency or asset utilization.
  - Reliability – includes avoidance or reduction in electrical service interruptions and improvements in power quality and the reliability benefits to customers that are determined through value of service studies.
  - Environmental – includes avoided or reduced emissions which impact climate change and adversely impact human health and various ecosystems.
  - Other – Includes improvements to cyber security, worker/customer safety, customer satisfaction as well as reduction in oil dependence.

Category	Benefit Type
Economic	Improved Asset Utilization
	Transmission & Distribution Capital Savings
	Transmission & Distribution Operating Expenses Savings
	Theft Reduction
	Energy Efficiency
	Electricity Cost Savings
Reliability	Power Interruptions
	Power Quality
Environmental	Air Emissions
Other	Security & Safety
	Customer Satisfaction
	Energy Independence

- Economic, reliability and other (except for oil dependence) benefits were calculated at the project level. Environmental benefits and potential fuel savings by customers were calculated at the program level
- The majority of the benefits included in the SGDP are "soft" benefits.

Benefits Overview

Amounts in Thousands of US Dollars Escalated	Benefits													Total Estimated Benefits		
	Historical	Conceptual Estimates 2011-2015						Provisional Ranges 2016-2020						2006-2020 Total		Beyond 2020
		Low			High			Low			High					Terminal Value
	2006-2010	"Soft"	"Hard"	Total	"Soft"	"Hard"	Total	"Soft"	"Hard"	Total	"Soft"	"Hard"	Total	Low Range	High Range	
Renewable Growth Policy[1]	$0	$58,903	$527	$59,431	$153,149	$1,371	$154,520	$63,513	$730	$64,243	$444,594	$5,108	$449,701	$123,674	$604,221	$321,374
Electric Vehicle Growth Policy[2]	$0	$14,009	$335	$14,343	$36,423	$870	$37,293	$23,449	$602	$24,051	$164,141	$4,214	$168,355	$38,394	$205,648	$107,978
Reliability Value[3]	$0	$44,627	$592	$45,219	$116,031	$1,539	$117,570	$40,546	$542	$41,088	$283,825	$3,791	$287,616	$86,307	$405,186	$157,142
Smart Grid Development Pilot[4]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Customer Empowerment Policy & Value[5]	$0	$3,068	$0	$3,068	$7,978	$0	$7,978	$10,270	$0	$10,270	$71,890	$2	$71,892	$13,339	$79,869	$0
Security Policy[6]	$0	$41,093	$83	$41,176	$106,842	$216	$107,057	$22,767	$57	$22,824	$159,368	$398	$159,766	$64,000	$266,823	$0

1 Includes the following projects: Energy Storage, Dynamic Line Ratings, Phasor Measurement Units, Capacitor SCADA & SCADA Expansion
2 Includes the following projects: Plug-In Electric Vehicles, Smart Transformers & Public Charging Facilities
3 Includes the following projects: Wireles Faulted Circuit Indicators and CBM Expansion
4 Includes the following projects: Integrated Test Facility
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Next Steps

- **Schedule**

SDG&E 2012 GRC

- DRA testimony – September 1, 2011
- Intervenor testimony – September 22, 2011
- Hearings – November 30-December 23, 2011
- Proposed Decision – February 2012

SDG&E SGDP

- Schedule to be established by the CPUC
- Workshops expected during the second half of 2011

- **Questions????**

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ATTACHMENT B

EDTA Presentation – EV's (09/27/11)

Deutsche Bank

Vehicle Electrification

Dan Galves
212-250-3738

September 27, 2011

Passion to Perform

The Future of Transportation

- **Late-decade regulatory mandates will require a significant penetration of alternative fuel vehicles (i.e. cannot be met with Internal Combustion Vehicles alone).**

- **Improvements in lithium-ion technology and the likely growth of renewable sources of electricity make Vehicle Electrification the mainstream choice for Alternative Fuel vehicles.**

- **Supported by Automaker plans for a proliferation of Hybrid (HEV) / Plug-in Hybrid (PHEV) / Electric Vehicle (EV) offerings over the next several years.**

- **Cost advantage of electric miles vs petrol miles make electrification a compelling value for consumers. This equation will improve over time, as oil prices increase and battery prices decline.**

CONCLUSION: Transportation likely to change more in the next 10 years than it has in the prior 50 years.

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The Future of Transportation

Global Markets Research | Company

Global
Automobiles Auto Manufacturing

Deutsche Bank

9 June 2008

Electric Cars: Plugged In

Batteries must be included

FITT Research

Fundamental, Industry, Thematic, Thought Leading
Deutsche Bank Company Research's Research Product Committee has deemed this work F.I.T.T. for investors seeking differentiated ideas. Rising oil prices, regulations, and advances in battery technology set the stage for increased electrification of the world's automobiles. We see implications not only for automakers and traditional auto parts suppliers – but also for battery companies, raw material producers, electric utilities, alternative power, oil demand, and the global economy.

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Global Markets Research | Company

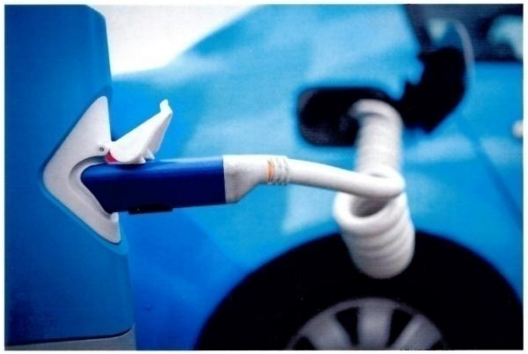
North America United States
Consumer Autos & Auto Parts

Deutsche Bank

3 November 2009

Electric Cars: Plugged In 2

A mega-theme gains momentum



Courtesy of: Better Place

FITT Research

Fundamental, Industry, Thematic, Thought Leading
Deutsche Bank's Company Research Product Committee has deemed this work F.I.T.T. for investors seeking differentiated ideas. In our June 2008 FITT report entitled "Electric Cars: Plugged in", we suggested that a number of factors, including rising oil prices, regulations, and battery technology advancements set the stage for increased electrification of the world's automobiles. We see implications not only for automakers and traditional auto parts suppliers, but also for raw material producers, electric utilities, oil demand, and the global economy.

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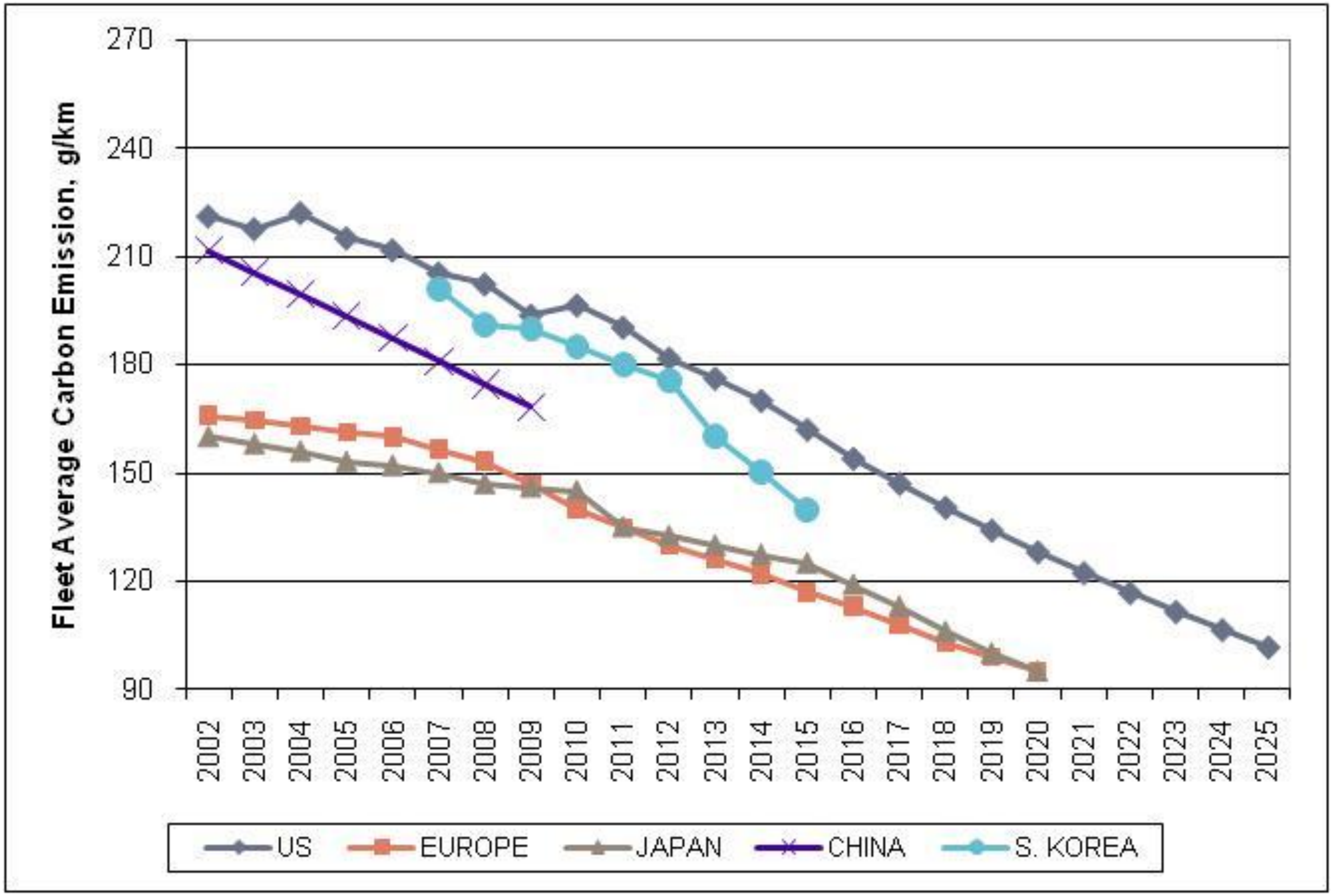
Regulatory standards are tightening across the globe

Fleet Average CO_2 Emissions (g/km)

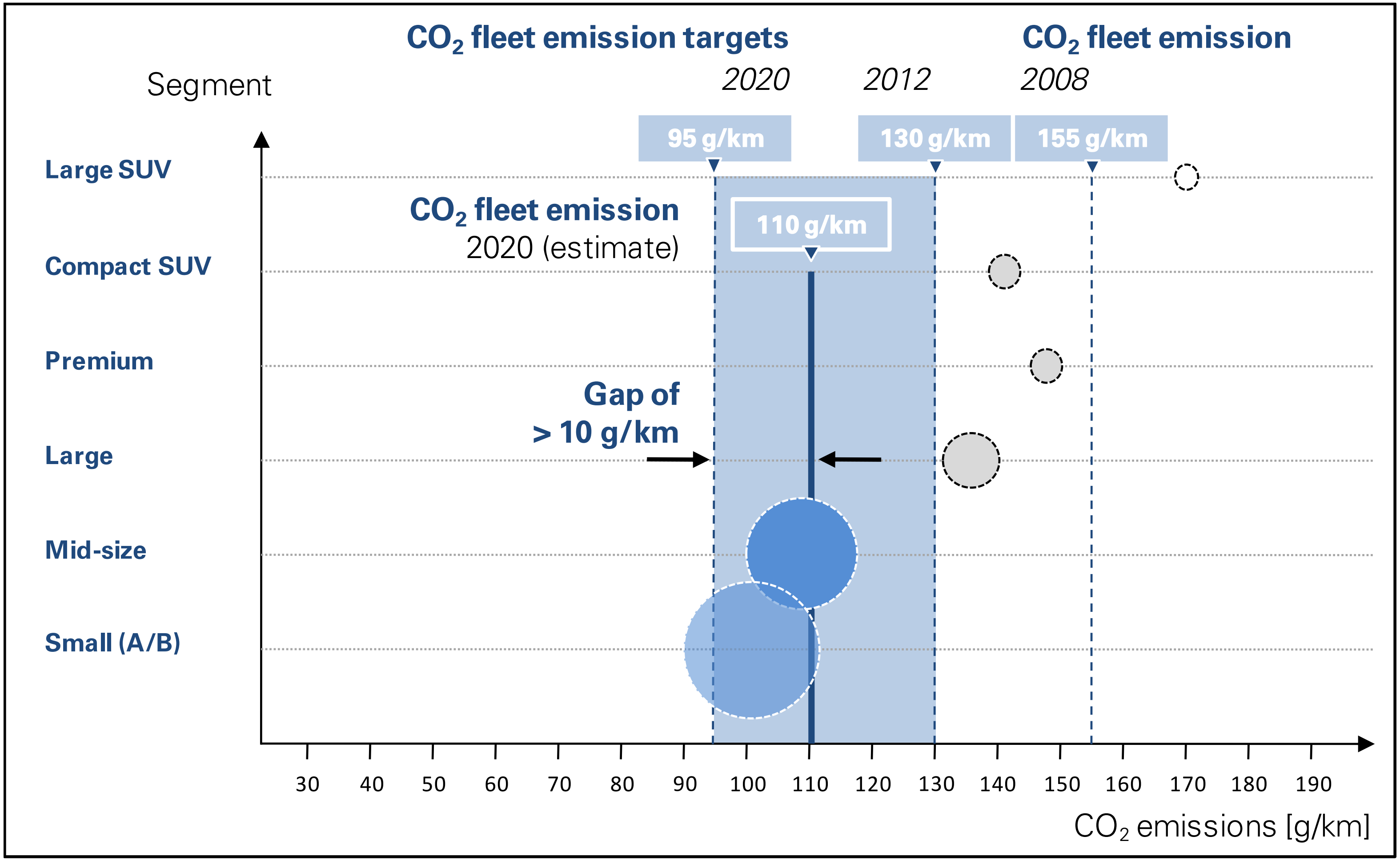


Source: Int'l Council on Clean Transportation, NHTSA, EPA, ACEA

- **105 g/km appears to be theoretical limit for the avg European ICE vehicle.**
- **130 g/km appears to be theoretical limit for the avg U.S. ICE vehicle.**

European reg's make increased electrification inevitable

….but Zero-Emission Vehicles are needed to reach 2020 EU 95 g/km limit



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Source: Deutsche Bank, Ward's Automotive

Why Electric vs other alternative fuel options?

- **Advantages of electrification:**
  - Electric propulsion is more efficient than oil-based propulsion (on a well-to-wheel basis, electric propulsion translates 29% of fuel into usable energy. Oil-based propulsion is 17%).
  - EV's will likely be re-charged at night when demand for electricity is the lowest.
  - Political support for electrification is bi-partisan, appealing for 1) environmental, 2) national-security, and 3) economic reasons (would reduce impact of oil shocks).
  - Low infrastructure-building requirements – the electric grid is ubiquitous.

- Advanced diesel can improve fuel economy significantly. But there is a theoretical limit to diesel penetration, as each barrel of oil can only produce a certain % of diesel fuel.
- Biofuels will have a significant place in transportation. Penetration likely will be limited by significant amount of feedstock required per litre of fuel.

- Natural gas vehicles – penetration likely limited by lack of infrastructure. One large fleet buyer told us that a 20-vehicle fueling depot costs $1.7MM, compared to tens of thousands for an electric charge depot.

- Fuel cells – still not ready. Penetration likely hindered by lack of infrastructure and significant energy required to produce the hydrogen.

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Advances in battery technology enable electrification

- **Inherent advantages of Li-Ion vs Nickel-Metal Hydride imply smaller batteries and lower cost:**
  - **1.4x – 1.7x power density**
  - **20%-80% higher energy density**
  - **Lower metal cost per kWh**
  - **Double the charge cycles (likely more). Most advanced lithium-ion producers are quoting 3,000+ cycles (implies 240k miles – 15-20 years – with 80% capacity remaining.**

- **Lithium-ion has highly probable cost reduction / energy improvement curve**
  - **Laptop batteries were 90 wh / kg in mid-'90's. Now 230 wh / kg. Auto batteries are 150 now.**
  - **Laptop batteries cost $2,000 kWh in mid-'90's. Now $250 / kWh. Auto batt's are ~$600-$800 now.**

- **Battery price expectations have been reduced significantly over the last year.**
  - **Acceleration of heavy-duty transportation and energy storage applications likely increasing battery-makers expectations for reaching high-scale production**
  - **Development of secondary-use market could lead to further price declines**

Estimated pricing for high-energy EV batteries over time (includes cells, packaging, battery mgmt system, warranty cost, and gross margin), Current vs our published estimates in November 2009.

	2012 Est (Now)	2012 Est (as of Nov '09)	2015 Est (Now)	2015 Est (as of Nov '09)	2020 Est (Now)	2020 Est (as of Nov '09)
Price / kWh	475	650	375	488	275	325
kWh per battery	25	25	25	25	25	25
Total EV Battery Pack	11,875	16,250	9,375	12,188	6,875	8,125

Source: Primary source interviews

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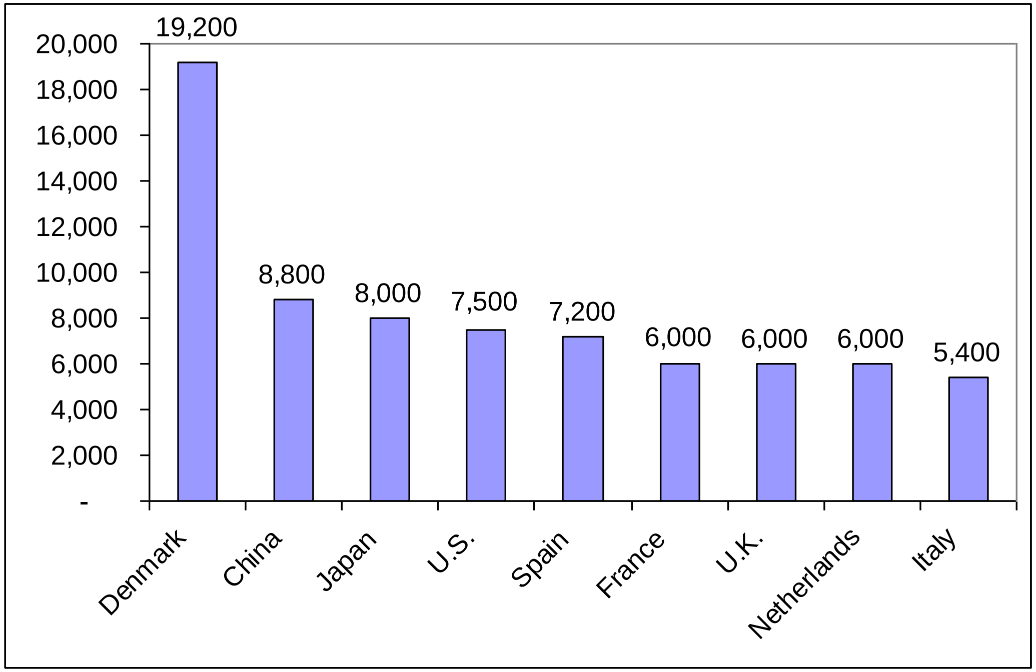
Tax / Subsidy policies enhance value of EV's

Areas representing 58% of global auto sales have EV subsidies of $5,000+ per unit

Incentive per unit ($) for EV's in key markets



Source: ACEA, US DOE, hybridcars.com

Additional local-level incentives available in many areas, including:

- London: EV's exempt from congestion charge (up to £ 2,000 per year)
- Quebec, Canada: C$8,000 (Ontario has signaled a C$10k incentive to be offered post-July '10)
- California: $5,000 per unit purchase rebate
- Colorado: personal tax credit up to 40% of vehicle purchase price (most veh's capped at $6k)
- NJ / CT / WA: EV's exempt from sales tax ($3,600 - $4,200 on $60k purchase)
- SC / MD / LA / IL / GA : $1,500 / $2,000 / $3,000 / $4,000 / $5,000 per unit tax credit
- HOV lane access / reduced or free parking available in many areas

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Source: Ward's Auto, Company Filings

Electric-miles are cheaper than petrol-miles even when including depreciation of the battery

U.S. - Petrol-fueled driving currently roughly equivalent per mile vs electric (including battery depreciation), but likely to be $0.05 more expensive in 2015

	U.S. - Current						
	$'s per Gallon / kWh	Miles per Gallon / kWh	Battery Cost ($)	Battery Lifetime (miles)	$'s per Mile	$'s per 450 Mile "Fill-Up"	Fuel per Year (12k miles)
Petrol Cost	**4.00**	**30**			**0.13**	60	1,600
Electricity Cost	0.11	3.5			0.03	14	377
Battery Depreciation			11,875	125,000	0.10		
Total Electric Cost					**0.13**		
Petrol vs Electric					**0.01**		1,223
Payback (Years), excl subsidies - Annual Fuel Savings / Battery Cost							9.7

	U.S. - 2015 Projection						
	$'s per Gallon / kWh	Miles per Gallon / kWh	Battery Cost ($)	Battery Lifetime (miles)	$'s per Mile	$'s per 450 Mile "Fill-Up"	Fuel per Year (12k miles)
Petrol Cost	**5.00**	**35**			**0.14**	64.29	1,714
Electricity Cost	0.12	4			0.03	13.61	363
Battery Depreciation			9,375	150,000	0.06		
Total Electric Cost					**0.09**		
Petrol vs Electric					**0.05**		1,351
Payback (Years), excl subsidies - Annual Fuel Savings / Battery Cost							6.9

Europe - Petrol-fueled driving currently 7 cents more per mile than electric. We expect this to increase to 9 cents by 2015.

	Europe - Current						
	$'s per Gallon / kWh	Miles per Gallon / kWh	Battery Cost ($)	Battery Lifetime (miles)	$'s per Mile	$'s per 450 Mile "Fill-Up"	Fuel per Year (12k miles)
Petrol Cost	**7.00**	**35**			**0.20**	90	2,400
Electricity Cost	0.15	3.5			0.04	19	514
Battery Depreciation			11,875	125,000	0.10		
Total Electric Cost					**0.14**		
Petrol vs Electric					**0.06**		1,886
Payback (Years), excl subsidies - Annual Fuel Savings / Battery Cost							6.3

	Europe - 2015 Projection						
	$'s per kWh	Miles per Gallon / kWh	Battery Cost ($)	Battery Lifetime (miles)	$'s per Mile	$'s per 450 Mile "Fill-Up"	Fuel per Year (12k miles)
Petrol Cost	**8.00**	**42**			**0.19**	85.71	2,286
Electricity Cost	0.17	4			0.04	18.56	495
Battery Depreciation			9,375	150,000	0.06		
Total Electric Cost					**0.10**		
Petrol vs Electric							1,791
Payback (Years), excl subsidies - Annual Fuel Savings / Battery Cost					**0.09**		5.2

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Source: Deutsche Bank estimates

And the automakers are voting with their product plans

28 HEV's on the market in 2009; at least 135 xEV models by 2012

2008 (13 Models)	2009 (28 Models)	2010 (43 Models)	2011 / 2012 (105 Models)		2012 / 2013 (135 Models)	
Ford Escape	Ford Escape	Ford Escape	Ford Escape	Renault Kangoo [EV]	Ford Escape	Renault Kangoo [EV]
GM Lg SUV's	GM Lg SUV's	GM Lg SUV's	GM Lg SUV's	Renault Twizy [EV]	GM Lg SUV's	Renault Twizy [EV]
GM Malibu	GM Malibu	**Honda Civic**	Honda Civic	SAIC Roewe 750	Honda Civic	SAIC Roewe 750
Honda Civic	Honda Civic	**Nissan Altima**	Nissan Altima	Subaru Legacy	Nissan Altima	Subaru Legacy
Nissan Altima	Nissan Altima	**Toyota Prius**	Toyota Prius	Th!nk Ox [EV]	Toyota Prius	Th!nk Ox [EV]
Toyota Prius	Toyota Prius	**Toyota Camry**	Toyota Camry	Toyota Avalon	Toyota Camry	Toyota Avalon
Toyota Camry	Toyota Camry	Toyota Highlander	Toyota Highlander	Toyota Tundra	Toyota Highlander	Toyota Tundra
Toyota Highlander	Toyota Highlander	**Toyota Lexus GS**	Toyota Lexus GS	Toyota Sequoia	Toyota Lexus GS	Toyota Sequoia
Toyota Estima	Toyota Estima	Toyota Lexus RX	Toyota Lexus RX	Toyota RAV4	Toyota Lexus RX	Toyota RAV4
Toyota Crown	Toyota Crown	**Toyota Lexus LS600h**	Toyota Lexus LS	Toyota Yaris	Toyota Lexus LS	Toyota Yaris
Toyota Lexus GS	Toyota Lexus GS	BYD F3DM [PHEV]	BYD F3DM [PHEV]	Toyota Lexus ES	BYD F3DM [PHEV]	Toyota Lexus ES
Toyota Lexus RX	Toyota Lexus RX	Changan Jiexun	Changan Jiexun	Toyota Lexus CT200h	Changan Jiexun	Toyota Lexus CT200h
Toyota Lexus LS	Toyota Lexus LS	**Daimler S400**	Daimler S-Class	Toyota Prius [PHEV]	Daimler S-Class	Toyota Prius [PHEV]
	BYD F3DM [PHEV]	**Ford Fusion**	Ford Fusion	VW Golf	Ford Fusion	VW Golf
	Changan Jiexun	**Honda Insight**	Honda Insight	VW Jetta	Honda Insight	VW Jetta
	Daimler S-Class	Hyundai Elantra	Hyundai Elantra	VW Polo	Hyundai Elantra	VW Polo
	Ford Fusion	Jianhuai Yuebin	Jianhuai Yuebin	VW Passat	Jianhuai Yuebin	VW Passat
	Honda Insight	Mitsubishi iMiEV [EV]	Mitsubishi iMiEV [EV]	VW Touareg	Mitsubishi iMiEV [EV]	VW Touareg
	Hyundai Elantra	Subaru Stella [PHEV]	Subaru Stella [PHEV]	VW Audi Q5	Subaru Stella [PHEV]	VW Audi Q5
	Jianhuai Yuebin	Tata Indica [EV]	Tata Indica [EV]	Volvo C30 [EV]	Tata Indica [EV]	Volvo C30 [EV]
	Mitsubishi iMiEV [EV]	Tesla Roadster [EV]	Tesla Roadster [EV]	Honda Fit	Tesla Roadster [EV]	Honda Fit
	Subaru Stella [PHEV]	Tianjin Messenger [EV]	Tianjin Messenger [EV]	Hyundai Sonata	Tianjin Messenger [EV]	Hyundai Sonata
	Tata Indica [EV]	Th!nk City [EV]	Th!nk City [EV]	Hyundai Accent	Th!nk City [EV]	Hyundai Accent
	Tesla Roadster [EV]	**Toyota Lexus HS 250h**	Toyota Lexus H	Nissan Leaf [EV]	Toyota Lexus H	Nissan Leaf [EV]
	Tianjin Messenger [EV]	Zotye Auto [EV]	Zotye Auto [EV]	Peugeot Ion [EV]	Zotye Auto [EV]	Peugeot Ion [EV]
	Th!nk City [EV]	Bestrun B50	Bestrun B50	Peugeot Berlingo [EV]	Bestrun B50	Peugeot Berlingo [EV]
	Toyota Lexus H	BMW X6	BMW X6	Tata Nano [EV]	BMW X6	Tata Nano [EV]
	Zoyte Auto [EV]	**BMW 7-Series**	BMW 7-Series	Toyota Corolla	BMW 7-Series	Toyota Corolla
		BMW Mini-E [EV]	BMW Mini-E [EV]	Toyota Auris	BMW Mini-E [EV]	Toyota Auris
		BYD E6 [EV]	BYD E6 [EV]	Fisker Karma	BYD E6 [EV]	Fisker Karma
		BYD F6DM [PHEV]	BYD F6DM [PHEV]	Ford Taurus	BYD F6DM [PHEV]	Ford Taurus
		Chery Qilin M1	Chery Qilin M1	Ford Edge	Chery Qilin M1	Ford Edge
		Daimler M-Class	Daimler M-Class	Chrysler Ram	Daimler M-Class	Chrysler Ram
		Ford Transit Connect [E\	Ford Transit Connect [E\	Chrysler Mid SUV	Ford Transit Connect [EV]	Chrysler Mid SUV
		Geely EK-1 [EV]	Geely EK-1 [EV]	Coda Sedan [EV]	Geely EK-1 [EV]	Coda Sedan [EV]
		Great Wall Oula [EV]	Great Wall Oula [EV]	Toyota Estima	Great Wall Oula [EV]	Toyota Estima
		Honda CR-z	Honda CR-z	Toyota Crown	Honda CR-z	Toyota Crown
		Kia Lotze	Kia Lotze		Kia Lotze	BMW 3 Series
		Lifan 320 [EV]	Lifan 320 [EV]		Lifan 320 [EV]	BMW 5 Series
		Luxgen EV+ [EV]	Luxgen EV+ [EV]		Luxgen EV+ [EV]	Changan EV [EV]
		Renault Fluence [EV]	Renault Fluence [EV]		Renault Fluence [EV]	Chery ZC7050A [EV]
		Tianjin Siabao [EV]	Tianjin Siabao [EV]		Tianjin Siabao [EV]	Chrysler / Fiat [EV]
		Toyota Sienna	Toyota Sienna		Toyota Sienna	Daimler E-Class
			VW Golf [PHEV]		VW Golf [PHEV]	Daimler Vito Van [EV]
			Chrysler Minivans		Chrysler Minivans	Daimler Smart Fortwo [EV]
			Fiat 500 [EV]		Fiat 500 [EV]	Ford Escape [PHEV]
			Dongfeng Aeolus		Dongfeng Aeolus	Ford Focus Hybrid
			Ford Flex		Ford Flex	GM Cadillac Converj [PHEV]
			Ford Focus [EV]		Ford Focus [EV]	GM / Reva JV [EV]
			GM Mid CUV's		GM Mid CUV's	GM Opel City Car [EV]
			GM Sm CUV's		GM Sm CUV's	GM Buick Sail [EV - China]
			GM Lg Sedan		GM Lg Sedan	GM Buick Regal (China)
			GM Volt [PHEV]		**GM Volt [PHEV]**	Honda Midsize veh [PHEV]
			GM Small CUV [PHEV]		GM Small CUV [PHEV]	Honda Commuter veh [EV]
			GM Opel Ampera [PHEV]		GM Opel Ampera [PHEV]	Hyundai [PHEV]
			Honda Acura RL		Honda Acura RL	Mazda Demio [EV]
			Honda Odyssey		Honda Odyssey	Mitsubishi Minicab MiEV [EV
			Hyundai Tucson		Hyundai Tucson	Peugeot [PHEV]
			Jianghuai (JAC) Tojoy [EV]		Jianghuai (JAC) Tojoy [EV]	Renault Zoe [EV]
			Kia Optima		Kia Optima	SAIC Roewe [PHEV]
			Mitsubishi Colt		Mitsubishi Colt	Tesla Model S [EV]
			Nissan Serena		Nissan Serena	Toyota RAV4 [EV]
			Nissan Infiniti M35h		Nissan Infiniti M35h	VW Porsche Cayenne
			Nissan Fuga		Nissan Fuga	VW Porsche Panamera
			Nissan Van [EV]		Nissan Van [EV]	VW Passat
			Peugeot (Citroen) C-Zero [EV]		Peugeot (Citroen) C-Zero [E	VW Audi A8
			Peugeot 3008		Peugeot 3008	Haima Automobile
			Peugeot 408			FAW Group

Source: JD Power, News Reports, Ward's Automotive, AABC, AT Kearney

U.S. Regulations make increased electrification inevitable

•CURRENT LAW (2012-2016): Fleet emissions must average 154 g/km by 2016, an 18% increase from current fleet average of 197 g/km.

•NEW LAW (2017-2025): U.S. EPA agency is evaluating annual improvements of 3%-6% vs 2016 standard (implies 117 – 88 g/km by 2025). Represents a 40%-55% improvement from current levels and 25%-45% vs 2016.

•California now has authority to set its own emission standards post-2016, which could be de facto standard for U.S. and will likely drive EPA to adopt more aggressive standards when announced in October 2011.

CY	2010	2015e	2020e
Total U.S. PC sales ('000)	11,556	15,900	17,555
Vehicle Penetration			
traditional ICE	95.7%	71.0%	30.0%
Micro hybrid	2.0%	18.0%	45.0%
Mild hybrid	0.1%	2.0%	4.0%
Full hybrid	1.9%	6.0%	9.0%
PHEV	0.1%	2.0%	8.0%
EV	0.1%	1.0%	4.0%
Average CO2 emission per unit	193	162	128
Target	197	162	128

Source: Deutsche Bank, Ward's Automotive

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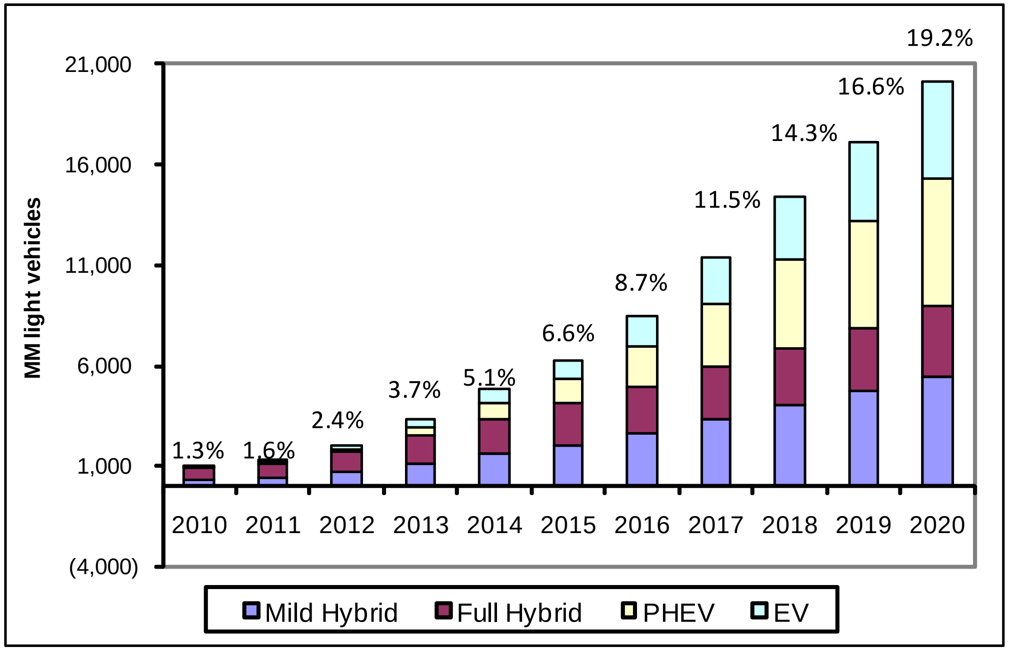
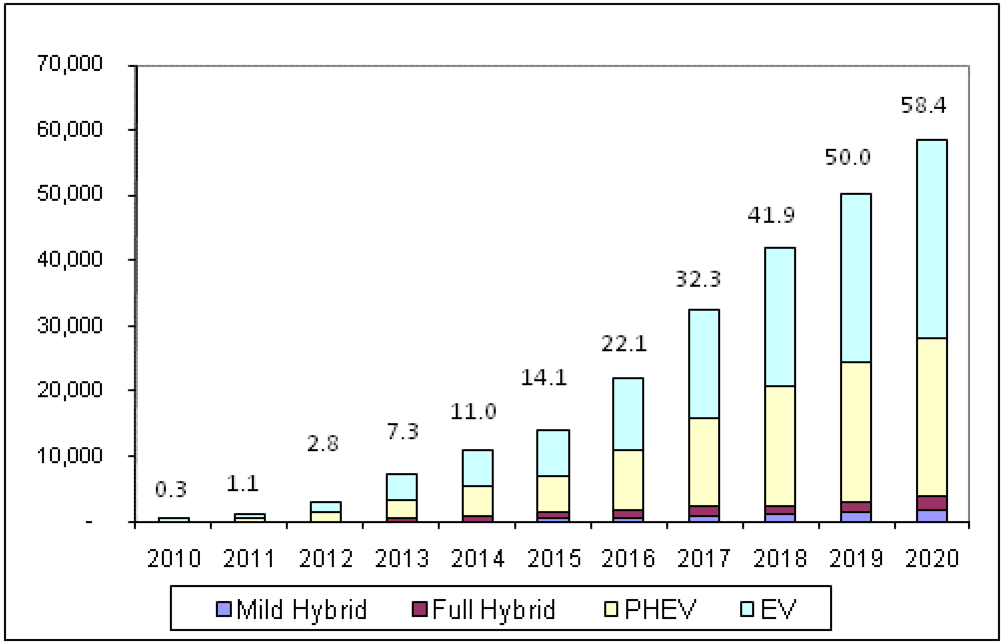
Global xEV Market Forecast (light-vehicles only)

Market fcst by type (xEV penetration %'s)



Lithium-Ion Battery Revenue Fcst (Lt Veh auto only) ($ bn)



Industry Forecasts (in 2010, total lithium-ion battery market (mostly consumer products app's) was $11bn):

- **Sanyo (as of Nov '10): By 2015, total industry: $43 bn, consisting of $13bn consumer / $13bn auto / $17bn grid.**
- **LG Chem (as of Apr '11): By 2015, Auto-only: $15bn (based on $3.7bn LG rev target and 25% mkt share target)**
- **Samsung (as of Apr '11): By 2015, total industry: $32 bn. xEV penetration: 2015: 7% 2020: 17%**
- **JCI (as of Jun '11): From $23bn today, automotive battery market (including lead-acid) will be $39bn (Li-Ion $13.5 - $15.5) in 2016; and $72bn in 2020 (Li-Ion $36bn - $43bn).**

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Source: Deutsche Bank, company filings

Global xEV market volume by region

	2015E (000's)	2015E Penetration	2020E (000's)	2020E Penetration
U.S. Volume				
HEV	1,272	8.0%	2,282	13.0%
PHEV	254	1.6%	1,404	8.0%
EV	159	1.0%	702	4.0%
Total	1,685	10.6%	4,389	25.0%
Europe Volume				
HEV	1,171	7.0%	3,156	17.0%
PHEV	418	2.5%	2,599	14.0%
EV	167	1.0%	1,114	6.0%
Total	1,757	10.5%	6,868	37.0%
Japan Volume				
HEV	625	12.5%	1,152	24.0%
PHEV	50	1.0%	288	6.0%
EV	45	0.9%	192	4.0%
Total	719	14.4%	1,632	34.0%
China Volume				
HEV	768	3.6%	1,543	6.0%
PHEV	320	1.5%	1,517	5.9%
EV	470	2.2%	2,392	9.3%
Total	1,558	7.3%	5,452	21.2%
ROW Volume				
HEV	345	1.0%	813	2.1%
PHEV	94	0.3%	581	1.5%
EV	76	0.2%	440	1.1%
Total	515	1.4%	1,834	4.8%
Global Volume				
HEV	4,181	4.4%	8,946	8.5%
PHEV	1,137	1.2%	6,389	6.1%
EV	917	1.0%	4,840	4.6%
Total	6,234	6.6%	20,175	19.2%

Source: Deutsche Bank estimates

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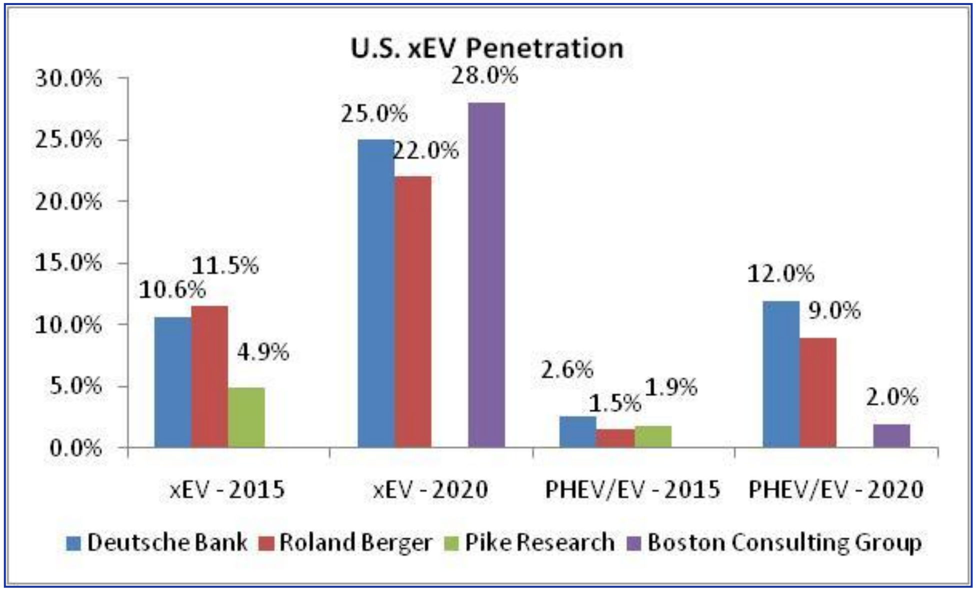
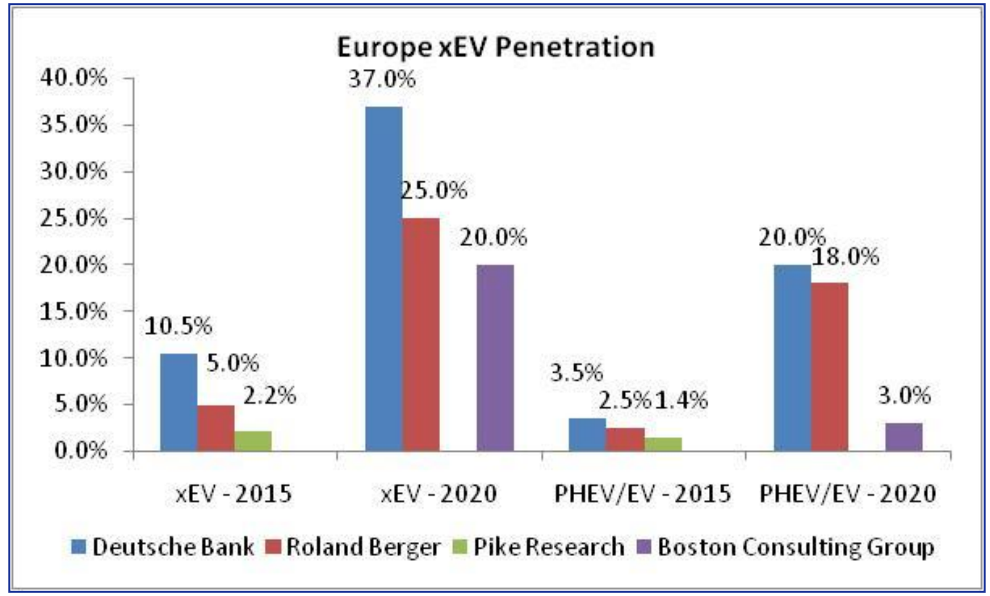
Global Lithium-Ion Battery forecast

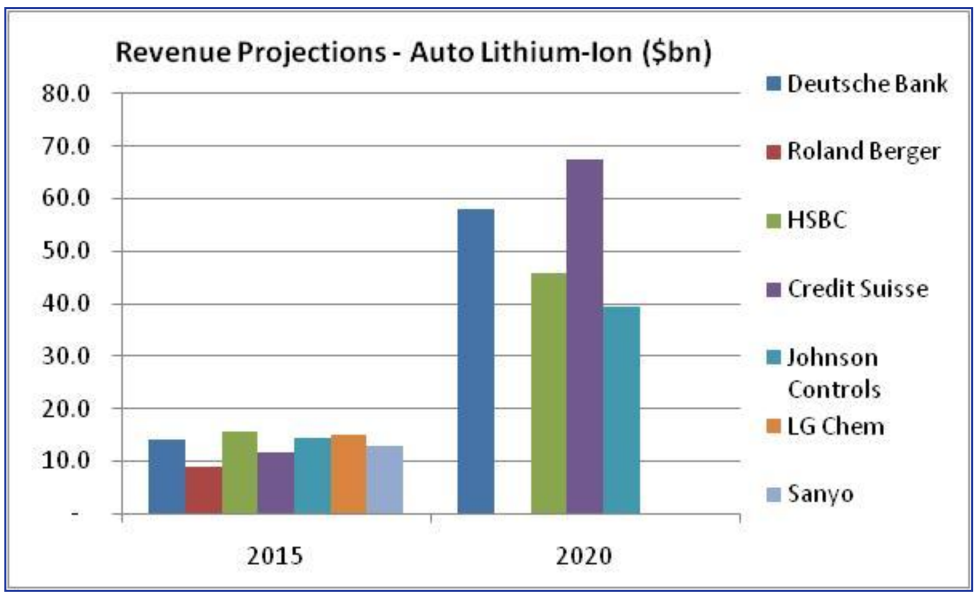
	2015E		2020E	
Global Volume (000 units)	Units	Penetration	Units	Penetration
HEV	4,181	4.4%	8,946	8.5%
PHEV	1,137	1.2%	6,389	6.1%
EV	917	1.0%	4,840	4.6%
Total				
Global Price per Unit	$ per unit		$ per unit	
HEV	963		600	
PHEV	4,812		3,803	
EV	7,883		6,262	
Global Revenue (incl NiMH)	Rev ($MM)	% of Total	Rev ($MM)	% of Total
HEV	4,025	24.1%	5,368	9.0%
PHEV	5,470	32.7%	24,296	40.5%
EV	7,225	43.2%	30,305	50.5%
Total	**16,719**		**59,969**	
Lithium-Ion Penetration	% LIB		% LIB	
HEV	35%		70%	
PHEV	100%		100%	
EV	100%		100%	
Global Revenue (Lithium-Ion only)	Rev ($MM)	% of Total	Rev ($MM)	% of Total
HEV	1,409	10.0%	3,758	6.4%
PHEV	5,470	38.8%	24,296	41.6%
EV	7,225	51.2%	30,305	51.9%
Total	**14,103**		**58,359**	

Source: Deutsche Bank estimates

xEV Forecasts Converging – Divergence on Type







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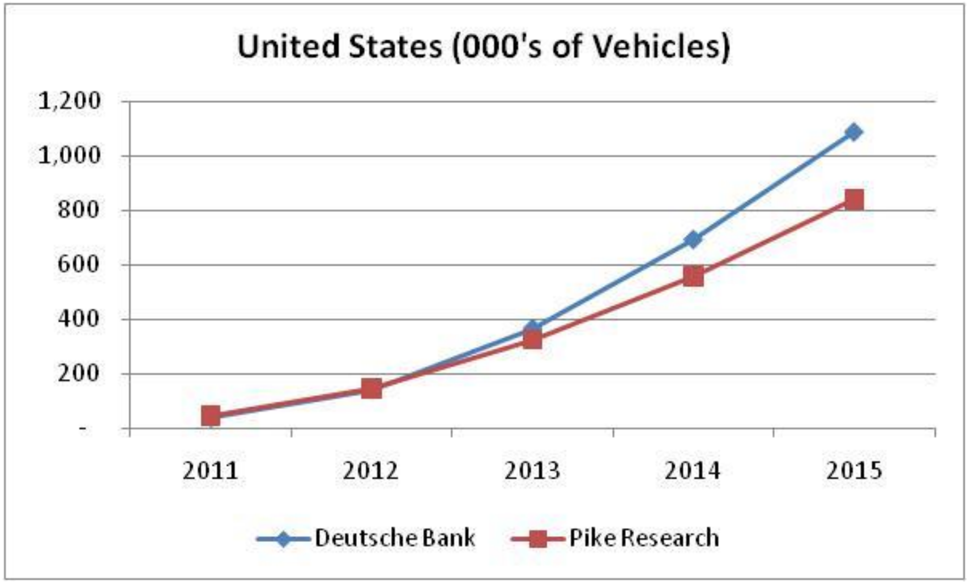
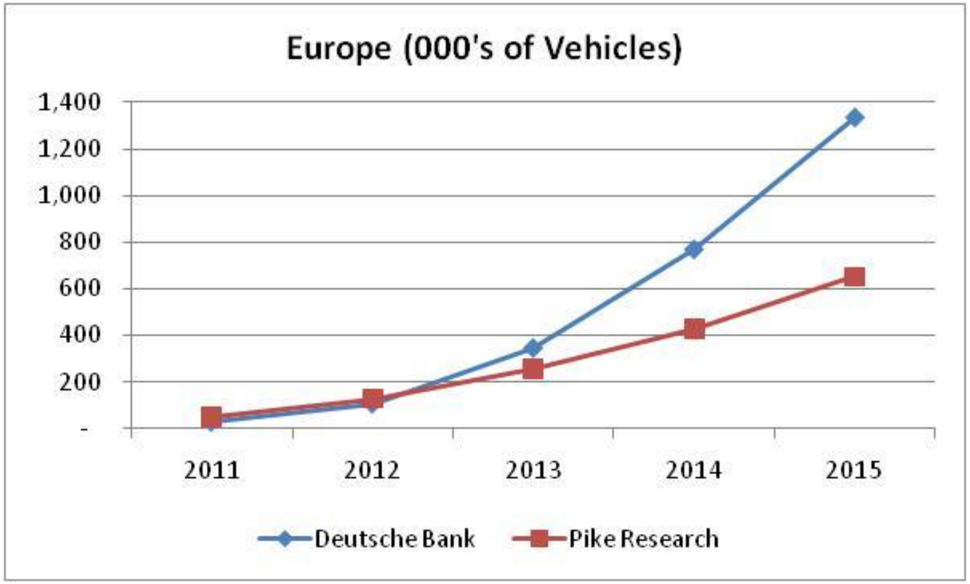
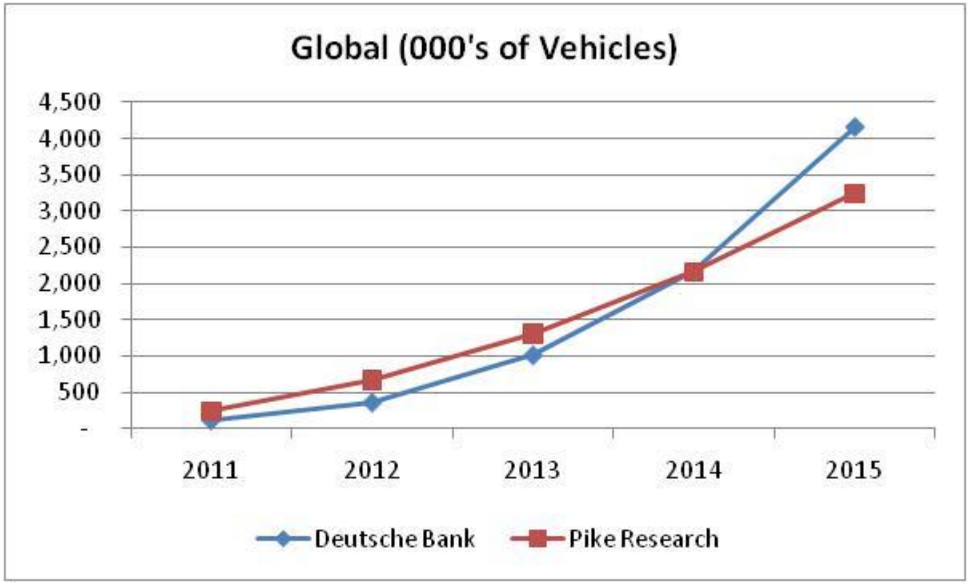
Cumulative PHEV / EV Volume by 2015







Vehicles to Watch

US Sales	11/2010	12/2010	1/2011	2/2011	3/2011	4/2011	5/2011	6/2011	7/2011	8/2011	Total
VOLT	0	326	321	281	608	493	481	561	125	302	**3,498**
LEAF	0	19	87	67	298	573	1,142	1,708	931	1362	**6,187**
Volt Production	776	443	580	624	782	692	591	0	637	2395	**7,520**

Ford Focus EV – mid 2012
Ford C-Max Energi (PHEV) – late 2012
Toyota Prius (PHEV) – 2012
Renault Kangoo – 2011
Renault Twizy – 2012
Renault Fluence – 2012
BMW I series – 2014
Tesla Model S – 2012
VW Golf PHEV - 2013

Capacity additions are best indication on the market

	Company	Key auto company	Battery Company	Factory	Investment ($MM)	Capacity (EV Units) 2010	Capacity (EV Units) 2015e
Li-ion Battery (EV based* units)	Ener1		EnerDel	Korea	20	10,000	10,000
				USA	300	10,000	30,000
	Lithium Energy Japan	Mitsubishi 15%	GS-Yuasa 51%, Mitsubishi 34%	Japan	187	6,800	55,000
				Japan (Ritto)	430	0	50,000
	Blue Energy	Honda 49%	GS-Yuasa 51%	Japan	263	20,000	30,000
	Panasonic EV Energy	Toyota 60%	Panasonic 40%	Japan (Li-ion)	111	9,400	9,400
	AESC	Nissan 51%	NEC Group 49%	Japan	145	50,000	250,000
				USA	1000	0	
				UK	330	0	
				Spain	356	0	
	A123	-	-	USA	800	0	120,000
				Korea/China	100	15,000	30,000
	Dow/Kokam	Dow	Kokam America	USA	350	0	60,000
	JCI			USA	600	0	140,000
	Sanyo	-	Sanyo 100%	Japan (Li-ion)	315	2,000	110,000
	Hitachi Vehicle Energy	-	Hitachi S / S 65%, Shinkobe 25%, Maxell 10%	Japan	456	10,000	70,000
	Toshiba	-	Toshiba 100%	Japan	278	0	60,000
	SB LiMotive **	Bosch 50%	Samsung 50%	S-Korea	500	0	336,000
	LG **	-	LG 100%	S-Korea	1700	10,000	282,000
				USA	300		
	SK Energy	-	SK 100%	S-Korea	500	0	50,000
	LiTec	Daimler 49% Daimler 90%	Evonik-Degussa 51% (cells) Evonik-Degussa 10% (pack)	Germany	100	0	40,000
	Total capacity in EV based* (Li-ion only) units				**9,141**	**143,000**	**1,732,000**

DB's xEV forecast is equivalent to 1.63MM EV-equivalent units in 2015

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Appendix 1

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Buy: Based on a current 12-month view of total shareholder return (TSR = percentage change in share price from current price to projected target price plus projected dividend yield), we recommend that investors buy the stock.

Sell: Based on a current 12-month view of total shareholder return, we recommend that investors sell the stock.

Hold: We take a neutral view on the stock 12 months out and, based on this time horizon, do not recommend either a Buy or Sell.

Notes:

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2. Ratings definitions prior to 27 January, 2007 were:

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Sell: Expected total return (including dividends) of -10% or worse over a 12-month period

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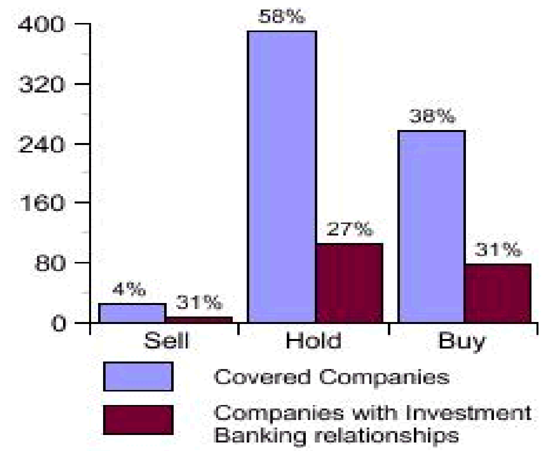

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