Application No. A.14-04-____
Exhibit No.: _____
Witness: Lee Krevat

Application of SAN DIEGO GAS & ELECTRIC COMPANY (U 902 E) For Approval of its Electric Vehicle-Grid Integration Pilot Program.	))))	Application No. 14-04-___ (Filed April 11, 2014)

PREPARED DIRECT TESTIMONY OF

LEE KREVAT

CHAPTER 1

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

April 11, 2014

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PREPARED DIRECT TESTIMONY OF

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CHAPTER 1

I. INTRODUCTION

San Diego Gas & Electric Company (SDG&E) proposes in this Application a Vehicle-Grid Integration (VGI) Pilot Program to establish grid-beneficial electric vehicle (EV) charging. SDG&E proposes introducing EV charging infrastructure that uses an innovative time-variant rate to promote efficient grid usage and charging. The proposed VGI Pilot Program will promote EV driver "range confidence," leading to increased adoption of EVs, increased demand for EV charging, increased zero emission miles driven per EV (resulting in less greenhouse gas (GHG)), and increased EV cost-saving opportunity through alternative fuel choice availability and a time-variant rate. SDG&E expects the VGI Pilot Program to positively impact the growth of the EV charging market as well as to increase the adoption of EVs. Increased adoption of environmentally beneficial EVs is strongly supported in state law, Commission policy, and the Governor's Zero Emission Vehicle (ZEV) Action Plan. The VGI Pilot Program is thus consistent with and supportive of Commission policy and state law, which encourages utilities to propose efforts that

increase the environmentally beneficial use of electricity as transportation fuel[1] and to optimize use of the electrical system consistent with California smart grid policy goals.[2]

The VGI Pilot Program is designed to examine untapped EV benefit potential. The VGI Pilot Program will test and measure the flexibility of EV charging loads and the degree to which the efficient integration of EV loads can yield cost savings by avoiding future utility infrastructure additions. The VGI Pilot Program proposed here will identify the benefits to all customers by demonstrating the avoidance of potential negative impacts on the grid and any unnecessary costs due to EV charging.

Ratepayer interests are served by increased environmental benefits, GHG reductions, and increased alternative fuel use;[3] thus the VGI Pilot Program's support of EV growth in a sustainable, grid-friendly manner serves ratepayer interests.[4] Data from the VGI Pilot Program and grid-friendly EV charging is intended to help inform VGI policy development, create and expand EV charging solutions and benefit the EV charging market and SDG&E customers. The VGI Pilot Program will help position the market for future vehicle-to-grid technology applications per the February 2014 California Independent System Operator (CAISO) VGI Roadmap[5] and the Energy Division's October 2013 VGI White Paper.[6] And, as explained more fully in Chapter 2, the VGI Pilot Program is designed to provide

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[1] California Public Utilities Code (P.U. Code) Section 740.3 directs the Commission to implement policies designed to promote the development of infrastructure needed to facilitate the use of electric power and natural gas to fuel low emission vehicles (LEVs). P.U. Code § 740.8 expanded the definition of ratepayer interest in Section 740.3 to include health and environmental benefits, GHG reductions, and increasing alternative fuel use when evaluating LEV utility proposals, such as the VGI program.

[2] P.U. Code § 8360 states several smart grid policy goals consistent with the VGI Pilot Program proposal, including "dynamic optimization of grid operations and resources…," among others.

[3] As defined by P.U. Code § 740.8.

[4] *See* P.U. Code §§ 740.3 and 740.8.

[5] Available at http://www.caiso.com/Documents/Vehicle-GridIntegrationRoadmap.pdf.

[6] Available at http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M080/K775/80775679.pdf.

increased opportunity and business growth for those industries that provide support services to EV customers.

Under the VGI Pilot Program, to the greatest extent possible, SDG&E will contract with third parties to build, install, operate and maintain EV charging facilities under a service level agreement, to SDG&E's VGI specifications, and under SDG&E's overall supervision. SDG&E will target the VGI offering to two critical customer segments where there is very low deployment of EV charging facilities and where cars are parked the longest, and which have the greatest potential to demonstrate the benefits of VGI including increasing EV adoption and increasing zero emission miles driven per EV: workplace and multi-unit dwelling customers.

My testimony (Chapter 1) discusses the policy foundation for the proposed VGI Pilot Program. The testimony of Randy Schimka, Chapter 2, provides a summary of the VGI Pilot Program, its implementation costs and management. Cynthia Fang's testimony in Chapter 3 summarizes the proposed VGI Pilot Program rate and related electric rate policy relevant to the objectives for the VGI Pilot Program proposal. Chapter 4, the testimony of Jonathan B. Atun, summarizes revenue requirements, and Chapter 5, the testimony of Norma G. Jasso, describes cost recovery. Chapter 6, the testimony of J.C. Martin, summarizes the proposed VGI Pilot Program benefits and cost-effectiveness.

II. VGI PILOT PROGRAM OBJECTIVES AND SUPPORTING POLICY

California policy strongly supports establishing vehicle-grid integration technologies for EV charging, although the pricing plans that have been made available through EV charging service providers have not yet shown pricing variability relevant to variant grid

conditions and/or energy prices. The policy climate in California is ripe for SDG&E's VGI Pilot Program proposal, as several recent developments demonstrate; for example:

- Governor Brown's ZEV Action Plan, proposing actions to expand the use of zero-emission vehicles to 10 percent of new public and private vehicle purchases in California and neighboring states by 2016 and invest in necessary infrastructure to enable low-carbon electric transportation;[7]
- SDG&E's incorporation of significant levels of renewable energy resources in its procurement portfolio, per the Renewable Portfolio Standard (RPS),[8] creates an opportunity to integrate these resources with EV charging;
- Commission issuance of the Energy Storage Order Instituting Rulemaking (OIR) decision (D.13-10-040),[9] the Alternative Fuel Vehicle (AFV) OIR,[10] and Energy Division Staff's VGI White Paper;[11]
- The California legislature's enactment of Senate Bill (SB) 17, which codifies state policy to encourage "smart" grid modernization and usage;[12]
- CPUC's Decision 12-12-033 Adopting Cap-and-Trade GHG Allowance Revenue Allocation Methodology and the California Air Resources Board's Cap-and-Trade Auction Proceeds Investment Plan.

These are just a few examples of California's recent and significant progress toward decreased carbon emissions and increased EV growth. The VGI Pilot Program will provide

[7] ZEV Action Plan available at http://opr.ca.gov/docs/Draft2012ZEVActionPlan (09-21-12).pdf.
[8] See Decision (D.) 11-12-020, implementing the new RPS procurement quantities established in P.U. Code § 399.15(b).
[9] D.13-10-040, http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M079/K171/79171502.PDF, R.10-12-007, http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M078/K912/78912194.PDF.
[10] Alternative Fuel Vehicle Order Instituting Rulemaking, R.13-11-007.
[11] Available at http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M080/K775/80775679.pdf.
[12] *See* P.U. Code § 8360. SB 17 (Stat. 2009, ch. 327) became effective on January 1, 2010.

innovative support toward achieving California's goals and continuing this growth, as discussed below.

A. Zero Emission Vehicle Action Plan and Pledge

As reported in the ZEV Action Plan,[13] Governor Brown has set ambitious ZEV adoption goals for the state of California, issuing an Executive Order for state government to help significantly expand the market for ZEVs in California. The Executive Order established several action items and milestones and set a goal of 1.5 million ZEVs in California by the year 2025, building upon significant work already undertaken by government agencies.

On October 28, 2013, Governor Brown announced that California signed a regional agreement with the Governors of Oregon and Washington and the British Columbia Premier to strategically align policies to reduce GHGs and promote clean energy. Among other key actions cited in the pact, the most notable is to take steps to expand the use of ZEVs, aiming for 10 percent of new public and private fleet vehicle purchases by 2016.[14]

Governor Brown's ZEV Action Plan underscores the important role of EV adoption in advancing California's climate change objectives, and the urgency for all stakeholders to work collaboratively to dramatically increase the adoption of ZEVs. The VGI Pilot Program is intended to help achieve these state policy objectives in a timely and innovative manner.

B. Renewable Energy Resources

Renewable technologies including solar and wind energy are expected to have significant impacts on California electricity markets in the near future, in part because of

[13] Available at http://opr.ca.gov/docs/Draft2012ZEVActionPlan(09-21-12).pdf.
[14] http://gov.ca.gov/home.php, Governor Brown Joins Oregon, Washington, British Columbia Leaders to Combat Climate Change.

California's push for a low carbon economy and a 33 percent RPS, with a preference for in-state renewables. As distributed and central station renewable generation (particularly solar) grows, daily energy price profiles will change and the net demand (i.e., the total demand minus renewable power) will shift to later in the day. Increased solar renewable generation will produce increasingly more energy during the afternoon hours. When renewable resources produce energy it will be accepted by the grid regardless of price, because of RPS requirements;[15] hence, renewable production is "must-take" at the time it is produced. SDG&E's VGI Pilot Program is designed to improve system efficiency by encouraging customers through price signals to charge vehicles when market prices are low, thereby avoiding charging during times of system demand peaks.

SDG&E is not alone in recognizing the significant changes on the horizon. Table LK-1 shows the large increase in renewable generation that California's Electricity Analysis Office has projected for the next 10 years, with over 70 percent being in-state renewable generation.[16]

[15] The benefits of using electricity as an alternative fuel will also increase as the percentage of renewable energy in the resource portfolio increases, especially if grid integrated charging is in place.

[16] Dave Vidaver, Electricity Analysis Office, Electricity Supply Assessment Division, "Evaluating Electricity System Needs in 2030," Integrated Energy Policy Report (IEPR) Lead Commissioner Workshop on Evaluation of Electricity System Needs in 2030, Sacramento, CA, August 19, 2013.

Table LK-1: Significant Increase in Renewables

Projected RPS Additions
2013 - 2022

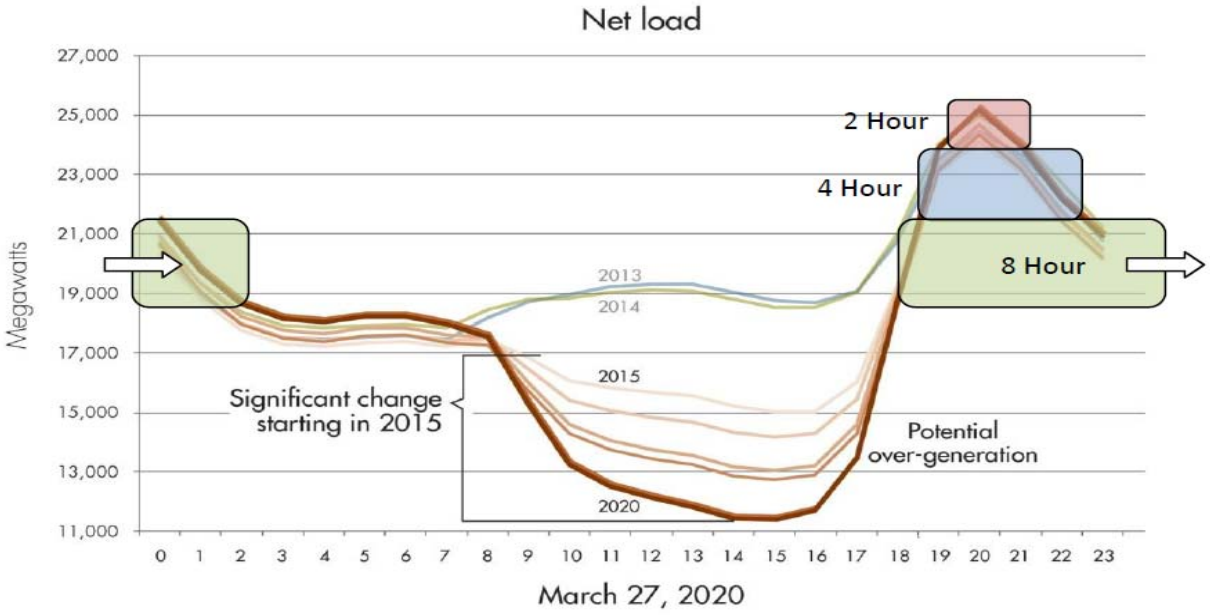
Technology	Projected Annual Energy (GWh)			Nameplate Capacity (MW)
	In-State	Out-of-State	Total	
Solar	18,843	1,633	20,476	9,115
Wind	4,481	1,496	5,977	2,149
Geothermal	3,766	1,200	4,965	688
Biofuels	1,377	0	1,377	193
Small Hydro	0	0	0	0
Total	28,468	4,328	32,796	12,144

Source: California ISO

Chart LK-1 shows how CAISO has projected the impact of solar on the net load shape to be substantial over the next few years, requiring significant ramping resources in the afternoon to meet peak net demands in the evening during days with low peak loads.[17]

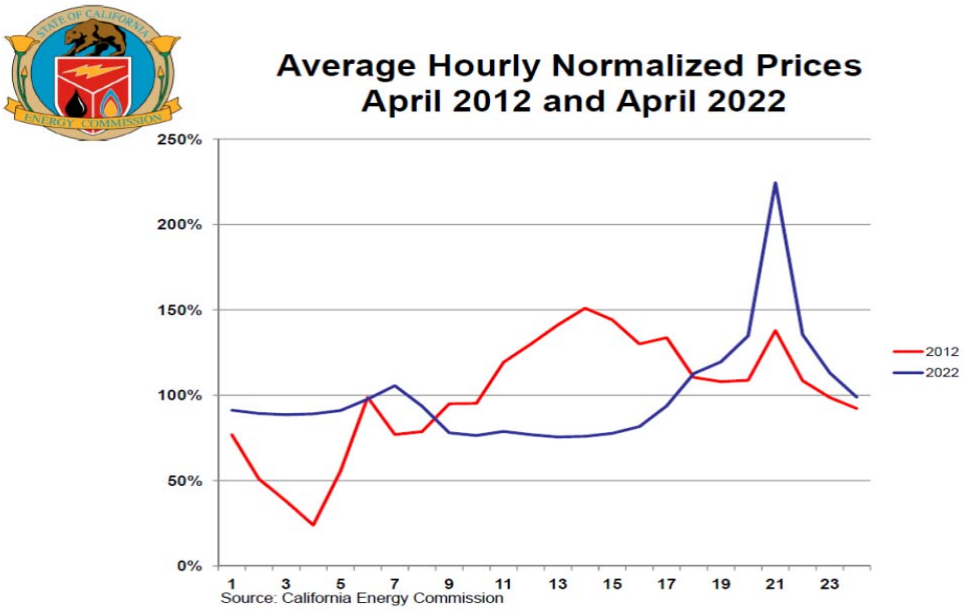
[17] CAISO, "Consideration of Alternatives to Transmission or Conventional Generation to Address Local Needs in the Transmission Planning Process," September 4, 2013, page 13. The blocks refer to the need for demand response or customer load reductions in response the net peak occurring in the evening.

Chart LK-1. Spring Loads Net of Wind and Solar



The addition of must-take renewable energy is also expected to impact electricity prices, as shown in Chart LK-2. Marginal energy costs will become lower midday and higher in the early evening hours.

Chart LK-2. Change in Electricity Price Shape[18]



The purpose of presenting these charts is to show that California is expecting a change in circumstances in the not too distant future as a high penetration of variable renewable generation occurs. SDG&E's VGI Pilot Program could improve system efficiency by allowing and encouraging customers to charge vehicles when solar energy is plentiful and prices are low, thereby avoiding charging at system peaks.

C. Energy Storage Rulemaking

The VGI Pilot Program can test and develop data concerning technology that efficiently integrates EV charging with the grid and explores EV energy storage capabilities. On October 17, 2013, the CPUC unanimously voted to establish a target of 1,325 megawatts (MW) of energy storage capacity for procurement by the investor-owned utilities (IOUs) by 2020, with installations under the program required no later than 2024.[19] Based on the

[18] Dave Vidaver, Electricity Analysis Office, Electricity Supply Assessment Division, "Evaluating Electricity System Needs in 2030," IEPR Lead Commissioner Workshop on Evaluation of Electricity System Needs in 2030, Sacramento, CA, August 19, 2013.
[19] D.13-10-040.

results of the VGI Pilot Program, VGI-related EV storage may be evaluated in the future, to determine whether to treat it as a form of energy storage under the CPUC's energy storage capacity mandate.

In the meantime, platforms such as SDG&E's VGI Pilot Program can help to better determine the potential value of the inherent EV energy storage properties. For example, the energy stored in an EV battery during one time of day, perhaps at one location, is efficiently "dispatched" directly to the vehicle for mobility in meeting travel needs at another time of day. D.13-10-040's Concurrence of Commissioners Ferron and Peevey on Item 29 encouraged the utilities to evaluate various options and solutions (e.g., customer-sited storage), with the objective to use this decision to help transform the energy storage market. Furthermore, the Energy Storage Procurement Framework and Design Programs decision adopted in D.13-10-040 states the following related to procurement eligibility: "All energy storage resources as defined by Pub. Util. Code § 2835(a), except for pumped storage resources over 50 MW, are eligible to bid into the energy storage solicitations. Energy storage that could be obtained from plug-in electric vehicles and programs/systems that utilize electric vehicles for grid services (Vehicle to Grid), could count for procurement targets."[20] In light of these interests, it would be valuable to innovate, test and develop data concerning technology that efficiently integrates EV charging with the grid and better explores the energy storage capabilities within EVs, to the benefit of all customers.

D. Improving Grid Utilization

The VGI Pilot Program will test customer response to grid-integrated EV charging by implementing an hourly time-variant pricing plan that reflects the expected changes in

[20] D.13-10-040, p. 5.

energy prices and grid conditions throughout the day with enabling technology for workplace and multi-unit dwelling customers. The hourly time-variant pricing will be communicated to the customer in a simple, convenient and easy to understand way, on a day-ahead basis. This time-variant pricing is designed to encourage EV drivers to meet their charging needs while simultaneously enhancing grid efficiency by adding load at times of least cost. The proposed VGI charging management functions will be designed to encourage the EV driver to avoid charging during peak grid capacity conditions and to charge during periods of plentiful supply. This is described further in Mr. Schimka's and Ms. Fang's testimony (Chapters 2 and 3).

The VGI Pilot Program proposal is responsive to California policy to take affirmative action toward improved utilization of utility grid assets and energy resources and improving the market penetration of multi-unit dwelling and workplace charging,[21] thereby increasing the benefits to all ratepayers through vehicle-grid integrated EV charging. Through the VGI Pilot Program, SDG&E will examine the following critical issues to efficient, grid-beneficial EV charging:

1. Informative Study of Customer Preferences

Given the unique and flexible demand characteristics of EV charging (e.g., by location, rate of charge, duration of charge) it will be informative to see whether hourly-variant pricing influences charging decisions, with the aid of enabling technology. This proposal builds off the results of SDG&E's current PEV Pricing and Technology Study, the results of which indicate that pricing and enabling technology play a strong role in

[21] *See*, for example, P.U. Code § 8360 and the Commission's objectives for the AFV OIR, R.13-11-007.

influencing charging time decisions.[22] Technology innovation and pricing options need to be explored in terms of the corresponding customer or behavioral response. SDG&E's VGI proposal offers customers a choice in the way of easy-to-use pricing options designed to provide value to the EV customer that takes advantage of the load flexibility of EV charging. Data from the VGI Pilot will help inform Commission policy regarding:

- the relationship between pricing and charging behavior in the workplace and at home (e.g., at what price will customers charge at work when compared to applicable rates at home?);
- whether the pricing and availability of charging facilities increase zero emission miles driven (i.e., EV miles traveled) per EV customer, resulting in less GHG; and
- whether utility management of EV charging away from times of system or distribution peak can minimize or eliminate upward pressure on grid capacity and dispatch EV load to take best advantage of available energy supply.

2. Improved Grid Performance, Renewable Energy Consumption and EV Energy Storage Utilization

This proposal enables SDG&E and other stakeholders to determine how effectively grid-integrated charging enables plug-in electric vehicle batteries to provide the benefits of energy storage in grid support. As explained in the AFV OIR, November 14, 2013,[23] potential benefits to the grid include:

[22] SDG&E is in its final year of PEV Pricing and Technology study to test how EV charging time decisions respond to varying price ratios between time-of-use periods, approved by the CPUC June 2010, Advice Letter 2157-E. The results of the study can be found at https://www.sdge.com/sites/default/files/documents/1681437983/SDGE%20EV%20%20Pricing%20&%20Tech%20Study.pdf?nid=10666

[23] AFV OIR, R.13-11-007, pp. 15-16.

- reducing system ramping needs by building loads during the lowest demand periods;
- providing load to absorb low cost energy supply; and
- avoiding local distribution impacts by minimizing load when local distribution system is near capacity.

To this end, the VGI Pilot Program proposal introduces a cost-effectiveness methodology applicable to VGI solutions, particularly those incorporating pricing with managed charging, where the benefits stated above are quantified and evaluated against the costs to achieve these benefits. This is discussed in greater detail in J.C. Martin's testimony (Chapter 6).

3. Targeting Customer Segments with High VGI Potential

The VGI Pilot Program targets critical customer segments with high VGI potential and where there is a very low deployment of EV charging facilities: workplace and multi-unit dwelling customers. Strategically, both of these customer segments offer around-the-clock opportunity for grid-integrated charging. The workplace setting offers the opportunity to charge during times when renewable energy is at a high level of output versus the load thus lowering market clearing prices. The multi-unit dwelling customers are expected to respond similarly to and enjoy the same benefits as single family customers, who take advantage of super-off peak energy rates from midnight to 5 AM, when both capacity and low-cost energy are plentiful.

4. Implementation Approach Works with EV Service Providers

Under the VGI Pilot Program, to the greatest extent possible, SDG&E will contract with third parties to build, install, operate and maintain EV charging facilities under a service level agreement, to SDG&E's VGI specifications, and under SDG&E's overall

supervision. It is expected that this form of competitive bidding will encourage innovation at least cost and improve customer experience. It is also expected that such an approach enables SDG&E to expand Diversified Business Enterprise (DBE) support into the third-party EV service provider domain.

E. Commission Decision 12-12-033 Adopting Cap-and-Trade GHG Allowance Revenue Allocation Methodology

In addition to approval of this proposed project, SDG&E also requests a determination that this project is eligible to receive funding from the revenues generated by the sale of cap-and-trade allowances consistent with the P.U. Code § 748.5(c). In order to receive such a designation, D.12-12-033 states the Commission must determine that the proposed project will (1) have a goal of reducing GHGs (Conclusion of Law 46)[24] and (2) be administered by the electrical corporation and is not otherwise funded by another funding source (Conclusion of Law 7).[25] In addition to the VGI Pilot Program GHG reduction potential, charging infrastructure is one of the project types in the California Air Resources Board's Investment Plan for GHG reductions.[26] As stated in the application, the project would be administered by SDG&E and is currently not funded.

III. CONCLUSION

This concludes my prepared direct testimony.

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[24] D.12-12-033, p. 198, Conclusion of Law 46 "Should the Commission decide at a later date to direct GHG revenues toward energy efficiency or clean energy programs or projects, such projects should have as a stated and measurable goal a reduction in GHG emissions."

[25] D.12-12-033, p. 191 Conclusion of Law 7 "Section 748.5(c) states that the Commission may allow investor-owned utilities to use up to 15% of the revenues, including any accrued interest, received by an electrical corporation as a result of the direct allocation of GHG allowances to electrical distribution utilities pursuant to subdivision (b) of Section 95890 of Title 17 of the California Code of Regulations, for clean energy and energy efficiency projects established pursuant to statute that are administered by the electrical corporation and that are not otherwise funded by another funding source."

[26] California Air Resources Board, Cap-and-Trade Auction Proceeds Investment Plan: Fiscal Years 2013-14 through 2015-16, May 14, 2013, page B-7.

IV. STATEMENT OF QUALIFICATIONS

My name is Lee S. Krevat. My business address is 9305 Lightwave Avenue, San Diego, California 92123. I am employed by SDG&E as Director for SDG&E's Smart Grid and Clean Transportation. My present responsibilities are to ensure a coordinated strategy, direction and policy across all Smart Grid domains, specifically, Transmission, Distribution, Customer Services and Information Technology. I am also responsible for SDG&E's strategy, direction, policy, and implementation for our clean transportation efforts.

I have been employed by Sempra Energy and/or SDG&E since 1998 and have held various director-level positions including Infrastructure Engineering and Operations, Architecture, Business Partnership, Strategy, Project Delivery and Smart Grid. I received a Bachelor of Science Degree in Applied Mathematics/Computer Science with university honors from Carnegie Mellon University in 1984. I have previously testified before this Commission.

I have been an all-electric vehicle owner since March 2011. I celebrated the purchase of my family's third all-electric vehicle three years later, in March 2014.

APPENDIX

GLOSSARY OF ACRONYMS AND DEFINED TERMS

ACRONYM	TERM
AFV	Alternative fueled vehicle
CAISO	California Independent System Operator
CARB	California Air Resources Board
EV	Electric vehicle
IEPR	Integrated Energy Policy Report
GHG	Greenhouse gases
LEVs	Low emission vehicles
OIR	Order Instituting Rulemaking
PEVs	Plug-in electric vehicles
RPS	Renewable portfolio standard
TOU	Time of use
VGI	Vehicle-Grid Integration
ZEV	Zero emission vehicle