BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Application of San Diego Gas & Electric Company (U 902 E) for Authority to Update Electric Rate Design Effective on January 1, 2015	Application 14-01-027 (Filed January 31, 2014)

Application 14-01-027
Exhibit No.: (SDG&E-___)

PREPARED DIRECT TESTIMONY OF

LESLIE WILLOUGHBY

CHAPTER 5

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION

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June 16, 2014

SDGE

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I. INTRODUCTION

Pursuant to the May 15, 2014 Scoping Memo and Ruling of Assigned Commissioner Florio ("Scoping Memo") in the above captioned matter, the purpose of this supplemental testimony is to clarify how San Diego Gas & Electric Company ("SDG&E") complied with Ordering Paragraph 3 of Commission Decision ("D.")11-07-029. As explained below, SDG&E believes that it has satisfied the requirements of D.11-07-029, to the extent reasonably feasible and based on current information, and provides additional supporting analysis, including graphics and tables that were filed with the Commission prior to the submittal of this Rate Design Window ("RDW") Application, which was filed on January 31, 2014. In addition, I have provided more recent information. However, there are no changes in the analysis as a result of the updated information.

II. BACKGROUND

In 2009, the Commission initiated an Alternative Fueled Vehicle ("AFV") Rulemaking (R.09-08-009 or the "AFV OIR") in accordance with Senate Bill ("SB") 626, which added Public Utilities Code Section 740.2, to evaluate policies to develop infrastructure sufficient to overcome barriers for the widespread deployment and use of Plug-in Electric Vehicles ("PEVs") and EVs in California. Ultimately, in July 2011, D.11-07-029 was issued in the AFV OIR and required SDG&E to include EV rate proposals in its 2013 RDW Application. Specifically, Ordering Paragraph ("OP") 3 of D.11-07-029 required that the rate design proposals include:

1. An analysis of EV and plug-in hybrid charging load profiles;
2. Costs and benefits of plug-in hybrid and EV integration and charging;

3. Consumer responses to plug-in hybrid and EV time-of-use ("TOU") price differentials; and

4. An evaluation of the feasibility and benefits of plug-in hybrid and EV demand charges in the residential and commercial context.

D.11-07-029 also required the IOUs to perform load research on PEVs and to report on charging load profiles. These studies provided much of the information requested in OP 3. SDG&E has submitted two annual load research studies that report on various aspects of PEV charging behavior.[1] Additionally, SDG&E conducted a two year EV pricing study. The study tested how over 400 Nissan Leaf owners responded to varying price ratios between TOU periods and calculated price elasticities. The interim report was filed in December of 2012, and the final report that was filed in February of 2014.[2]

It should also be noted that since the issuance of D.11-07-029 the Commission continues to actively address rules for electric vehicles ("EVs"). For example, in November of 2013, the CPUC issued a new Order Instituting rulemaking ("OIR") (R.13-11-007) that will consider AFV programs, tariffs and policies ("New AFV OIR"). The New AFV OIR will have two tracks: the first will evaluate the potential and value of vehicle-grid-integration and the second will focus on the development of new AFV tariffs in each of the investor owned utilities' ("IOUs'") service areas.[3] The second track of this new OIR may also include new rate designs for plug-in electric and natural

[1] Joint IOU Electric Vehicle Load Research Final Report, December 28, 2012 - Electric Vehicle Load Research & Cost Studies R.09-08-009 (AFV OIR) Ordered in D.11-07-029 and the January 31, 2014 Load Research Report Compliance Filing of Southern California Edison Company (U 338-E), on behalf of itself, Pacific Gas and Electric Company (U39E), and San Diego Gas and Electric Company (U 902-M), Pursuant to Ordering Paragraph 4 of D.13-06-014. Both studies are posted at: http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=42158457 & http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=88489523

[2] SDG&E's interim pricing study was completed on December 21, 2012, and the Final EV Pricing study was completed and filed with the CPUC in February 2014. The final study can be found at: http://www.sdge.com/sites/default/files/documents/1681437983/SDGE%20EV%20%20Pricing%20%26%20Tech%20Study.pdf?nid=10666

[3] R.13-11-007 at pgs. 2-3.

gas vehicles, including light-duty and medium/heavy duty vehicles, and policies for residential, multi-family, workplace and fleet PEVs.[4] In addition, this new proceeding will consider primary mechanisms the IOUs have for recovering costs from customers, including volumetric rates, demand charges and upgrade assessment fees.[5]

In its RDW Application, filed on January 31, 2014, SDG&E addressed its compliance with the AFV OIR.[6] However, the Scoping Memo expressed the need to further clarify whether SDG&E had provided each of the required rate design proposals and performed each of the required analyses and evaluations that are specified in OP 3 of D.11-07-029. The Scoping Memo also instructs SDG&E to prepare a new exhibit explaining how it has complied with the decision, or how it proposes to comply. This testimony serves that purpose.

III. SDG&E'S SHOWING OF COMPLIANCE WITH OP 3 OF D.11-07-029

A. Analysis of EV and plug-in hybrid charging load profiles

SDG&E has been conducting load research studies on AFVs since 2012, as required by Ordering Paragraph 7 of D.11-07-029 and Ordering Paragraph 4 OF D.13-06-014. These studies also satisfy the load profile analysis required under OP 3 of D.11-07-029. The most recent AFV Load Research study was filed on January 31, 2014. This study provided analysis of plug-in hybrid EV charging load profiles and demand information for EV charging behaviors. SDG&E's EV analysis is summarized in the following tables. The figures are updated with more current data as available.

[4] November 14, 2013 Order Instituting Rulemaking, R.13-11-007, at p. 3.
[5] *Id*. at p. 1.9.
[6] January 31, 2014 Testimony of Christopher Yunker, Chapter 1, Section VII.

SDG&E Current Residential EV Tariffs (May 1st 2014):[7]

Table 1: ¢/kWh by Tariff

Rate and TOU Periods	*TOU Hours*	*Winter*	*Summer*
EVTOU2			
Super Off-Peak	Midnight - 5am	17.2	16.1
On-Peak	Noon - 6pm*	19.8	44.1
Off-Peak	All Other	19.5	20.6
EVTOU			
Super Off-Peak	Midnight - 5am	17.2	16.1
On-Peak	Noon -8pm	20.2	44.0
Off-Peak	All Other	19.2	20.3
EPEV-X			
Super Off-Peak	Midnight - 5am	17.7	17.6
On-Peak	Noon - 8pm	21.9	35.3
Off-Peak	All Other	21.1	21.5
EPEV-Y			
Super Off-Peak	Midnight - 5am	14.4	14.0
On-Peak	Noon - 8pm	43.7	53.6
Off-Peak	All Other	29.2	33.7
EPEV-Z			
Super Off-Peak	Midnight - 5am	13.2	12.9
On-Peak	Noon - 8pm	63.9	73.8
Off-Peak	All Other	25.6	29.5

*Excluding Holidays

1. Definitions for residential Single Meter and Separate Meter rates

SDG&E has two different residential EV rate structures, one is for Single-Meter Electric Vehicle Charging (Schedule EVTOU2) and the other is for Separate-Meter EV Charging (EVTOU and EPEV [X, Y, and Z]). The Single-Meter rate structure includes all end-use consumption in the

[7] Prior to May 1, 2014, the EPEV rates had On-Peak to Super Off-Peak ratios of 2:1 for EPEV-X, 4-1 for EPEV-Y, and 6-1 for EPEV-Z. The pricing study utilized the EPEV rate prior to May 1, 2014.

home (whole-house load) while the Separate-Meter rate structure measures the consumption of EV charging only. Many of the residential customers on the separate meter rate structure were Nissan Leaf owners and part of SDG&E's pricing study. These customers were also provided with charging stations equipped with timers, which allowed them to efficiently set charging start times at the beginning of the Super Off-Peak period.

2. Load Profiles for Single and Separately Metered Customers

All EV customers show that their Super Off-Peak consumption is lower on Sundays and Mondays; however, the Off-Peak and On-Peak loads follow the typical Weekday/Weekend patterns. A customer returning home from work on Friday will plug in their vehicle to recharge from the daily commute. This charge will not occur until midnight – 2am on Saturday. If a customer uses their EV solely for commuting to work, their car may be lightly used or unused on Saturday and Sunday. If the car was not heavily used over the weekend, it will not need a large charge to prepare for Monday's commute. Upon returning home from work on Monday, the customer plugs in their vehicle to charge at midnight – 2am the following day. This charging behavior is presented in Figures 1 and 2 below:

Figure 1: 2013 Average Load by Day of the Week for Single-Metered (EVTOU2)

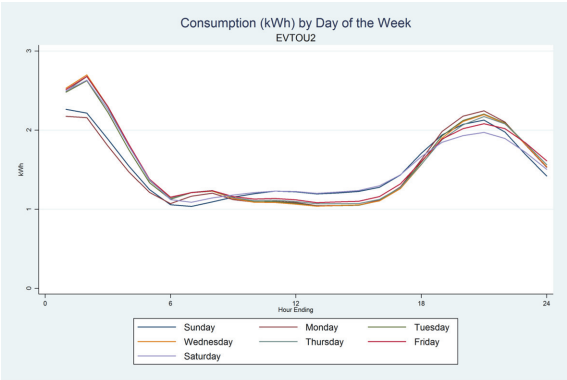
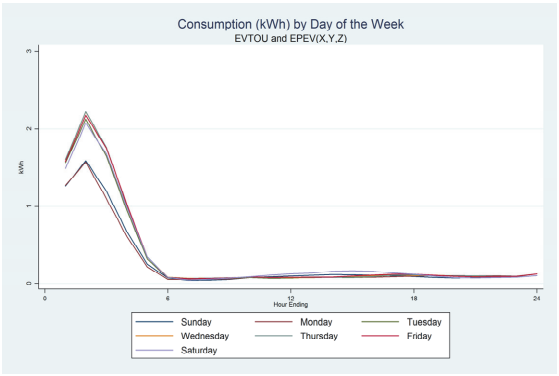


Figure 2: 2013 Average Load by Day of the Week for Separate-Metered (EVTOU and EPEV(X,Y,Z))

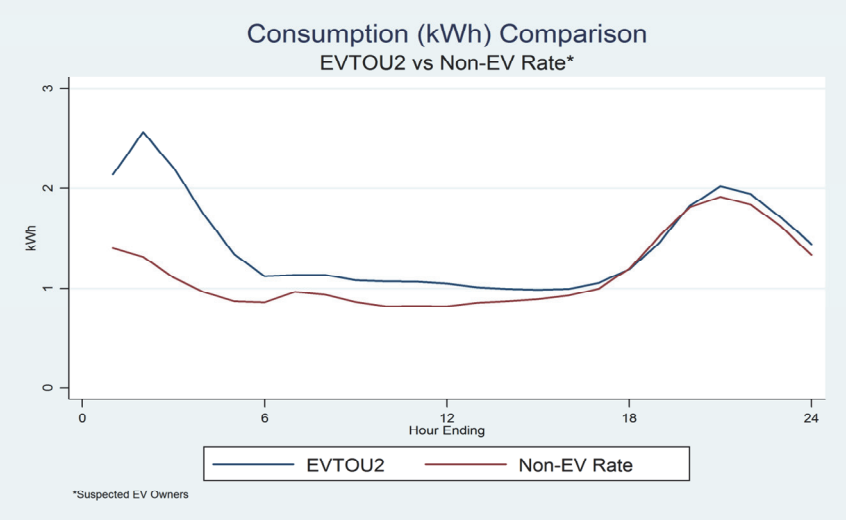


3. Comparison of Load Profiles for SDG&E EV owners on TOU vs. non-TOU Rates

SDG&E believes that there are almost 7,800 EVs owned by residential customers in its service territory and of those almost 50% are on an EV rate. There are approximately 735 customers who SDG&E believes own an EV but are not on a TOU rate.[8] These non-TOU customers do consume more during the Super Off-Peak hours than a typical residential customer that does not own an EV, but not as much as the EVTOU2 customers consume. Note that while SDG&E believes these customers own an EV, they may not, and therefore this discrepancy could be attributed to the assumption that a customer has an EV when they in fact do not. This result would bias the Super Off-Peak load downward while maintaining the basic residential load shape as seen in Figure 3. Figure 4 shows that there are differences in load shapes for EV owners on a non-TOU rate compared to non-EV owners on a non-TOU rate. This graphic indicates that even though the EV customers are on a non-TOU rate, that they typically use more energy during the Off-Peak and Super Off-Peak hours than typical residential customers without an EV.

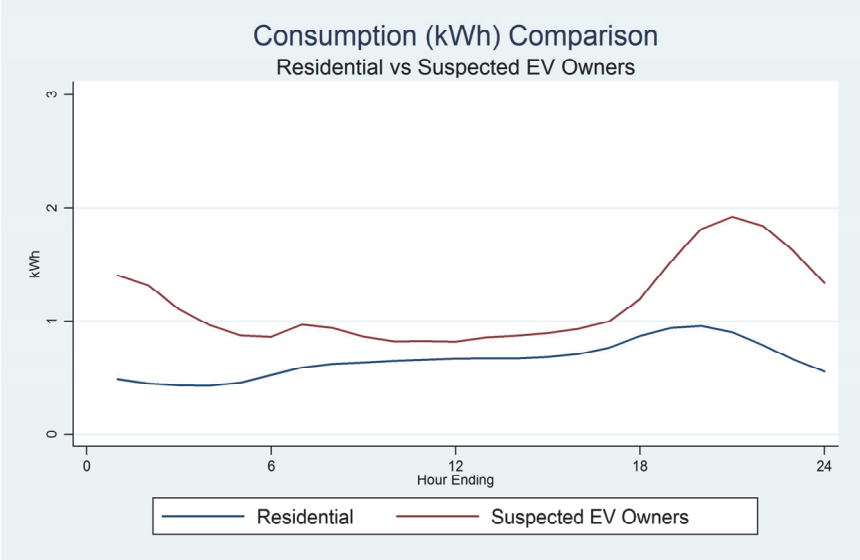
[8] Of the 3,900 or so customers that are not on a residential TOU rate, SDG&E knows that approximately 735 of these customers were known at one time to have owned or leased an EV at their premise. SDG&E does not have information about secondary EV sales and since these customers are not on an EV rate, it is possible that they may not possess an EV currently.

Figure 3: April 2014** Average Load Comparison - EVTOU2 vs Non-EV Rate



**Information on when a customer purchased an electric vehicle is not available; therefore, only data for the most recent month was used.

Figure 4: 2013 Average Load Comparison - Residential vs Suspected EV Owners



4. Comparison of EV owners to non-EV Residential Customers

In addition to the obvious difference in Super Off-Peak charging, the magnitude of the EVTOU2 customers' load profile is substantially greater than that of the "average" residential customers. Average daily consumption for EVTOU2 customers is more than double the average

consumption for a residential customer. Reasons for an EV customer's higher usage may be attributed to demographic factors such as appliance holdings that contribute to more consumption of electricity.

Figure 5: 2013 Average Load Comparison - EVTOU2 vs Residential

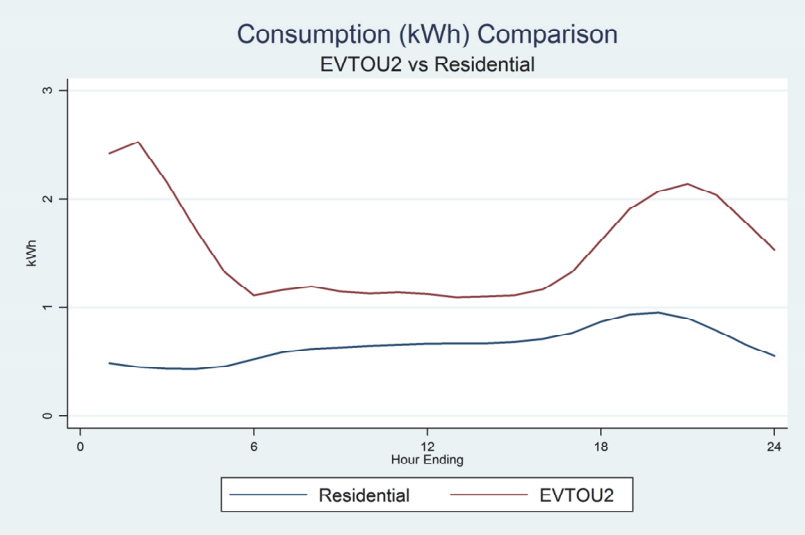


Table 2: Average Load Comparison - Residential vs EVTOU2 (2013)

	Residential	*EVTOU2*	*% Var*
Daily kWh	15.79	37.06	135%
Max kW	0.96	2.53	164%
n	9,000*	2,558**	

**Residential DLP sample*
***Includes any customers who received service under EVTOU2*

Table 3: Average Share of TOU Usage by Rate Type (2013)

Rate Type	Season	On-Peak	Off-Peak	Super Off-Peak
EVTOU2 (Single-Meter)	*Winter*	18.7%	54.5%	26.8%
	Summer	20.0%	52.2%	27.8%
EVTOU and EPEV(X, Y, and Z) (Separate-Meter)	*Winter*	9.9%	11.2%	78.9%
	Summer	10.4%	11.1%	78.5%

5. Consumption as a response to TOU Price Differentials

As shown in Table 3 above, customers with a single-meter EV rate have greater load share in the On-Peak and Off-Peak periods. Separate-Meter customers have the majority of their load recorded in the Super Off-Peak period indicating a strong response to the TOU price signals of the EPEV rates[9], encouraged with the charging station timers that came with the EV.

However, this finding does not mean that those on single meters did not also respond to the price differentials. Figure 5 below shows the differences in load profiles before and after customers purchased an EV where the customer switched from a non-TOU rate to the EVTOU2 rate. Many EVs come equipped with timers that can be programed to reflect charging preferences. As expected, once the customer changes to the TOU rate there is a significant jump in Super Off-Peak consumption that can be associated with EV charging. SDG&E also observes load shifting during the daytime hours from the On-Peak period to the Off-Peak period. Thus, it appears that EVTOU2 customers are responding to the TOU pricing structure by reducing peak consumption and pushing it until later in the day.

[9] These load shapes reflect the EPEV rates that were in effect prior to May 1, 2014.

Figure 6: 2013 Average Load Comparison for Single-Metered - Before and After EV Acquisition

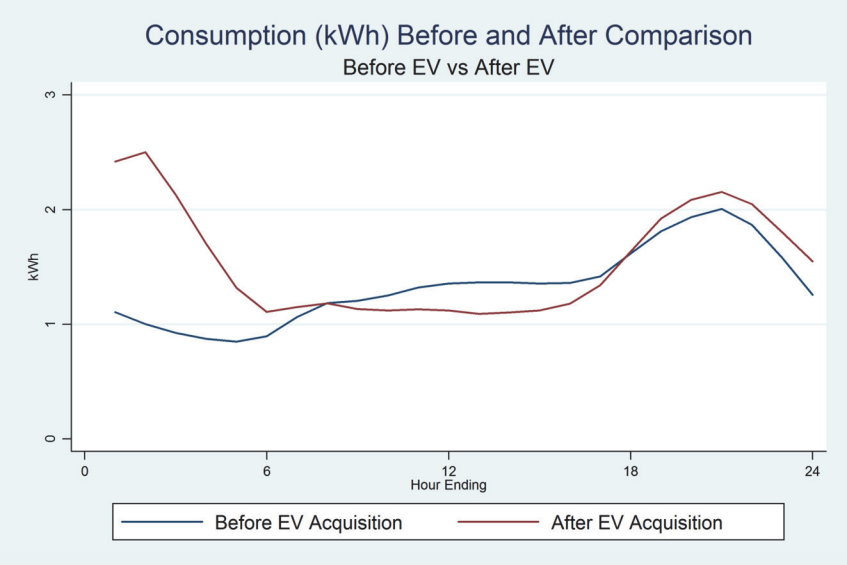


Table 4: Average Load Comparison - Before and After EV Acquisition (2013)

	Before EV	*After EV*	*% Var*
Daily kWh	31.98	37.06	16%
Max kW	2.01	2.50	25%
n	2,295*	2,295*	

**Includes any customer who was on a non-EV domestic rate and switch to EVTOU2 during 2013 and stayed on EVTOU2 through 12/31/2013 or discontinued service*

B. Costs and Benefits of EV Load

Due to the nature of the charging levels for EVs, it is not within the utility's ability to disaggregate the load in order to attribute appropriate costs to EV customers. EV load is similar to standard household appliances. Larger EV loads are in line with medium to large household appliances; comparable to central air-conditioners, electric ovens or an electric dryer.

As stated in D.11-07-029, Ordering Paragraph 5, for the dates between July 25, 2011 and June 30, 2013, all residential upgrade costs that are in excess of the residential allowance are being treated as common facility costs. In D.13-06-014, this exemption was extended until June 30, 2016. This means that SDG&E's residential EV customers do not incur costs over and above the normal residential allowance, and in fact to date SDG&E's residential EV customers have not exceeded the allowance. Residential customers may have incurred costs on their side of the meter as required by Rule 15 and 16.[10] Through October 31, 2013, SDG&E completed 11 EV-related residential service facility upgrades. Total costs incurred during that time were $32,041, with an average cost of $4,089 for the distribution system upgrade and $939 for the service line upgrade. The average cost for infrastructure upgrades per EV customer was about $7.30 based on 4,400 EV customers as of October 31, 2013.

There are benefits to EV adoption that affect both the consumer and SDG&E. EV adoption that is coupled with TOU rates for charging can increase grid utilization without increasing demand. Customers who charge during the Super Off-Peak period receive a lower cost while contributing to the recovery of transmission, distribution and public purpose program costs.

C. Consumer responses to plug-in hybrid and EV TOU price differentials

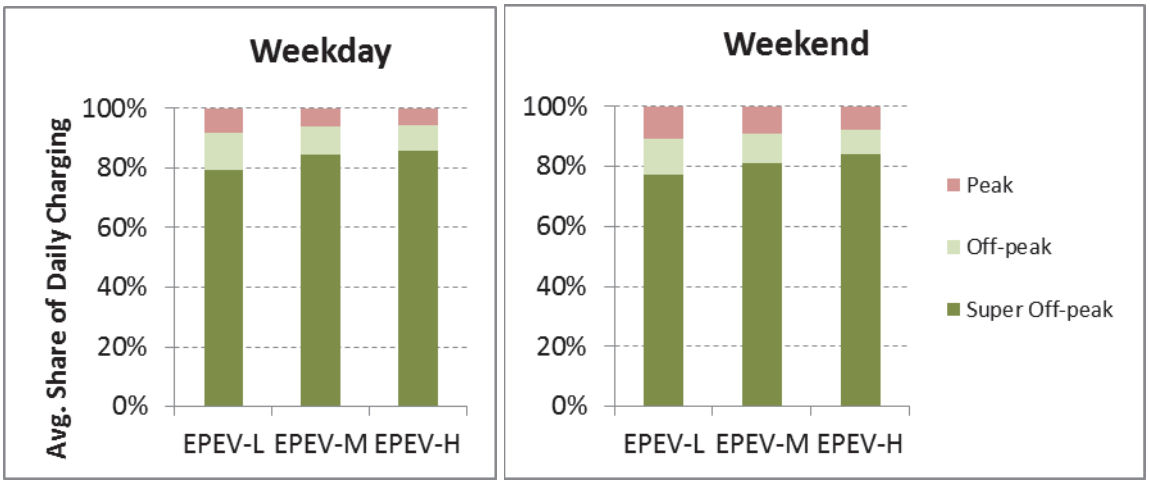
Both SDG&E's Interim and Final Evaluation for SDG&E's PEV TOU Pricing and Technology Studies[11] found that customers strongly respond to price signals. SDG&E's EV TOU pricing study created three different experimental rates, each with TOU periods. The study was able to show that given On-Peak, Off-Peak and Super Off-Peak periods, the majority of charging

[10] January 31, 2014 Load Research Report Compliance Filing of Southern California Edison Company (U 338-E), on behalf of itself, Pacific Gas and Electric Company (U39E), and San Diego Gas and Electric Company (U 902-M), Pursuant to Ordering Paragraph 4 of D.13-06-014 at pgs. 6-7.
[11] SDG&E's Interim EV Pricing and Technology Study was published at the end of 2012. SDG&E's Final EV Pricing and Technology study was published in February of 2014.

events occurred during Super Off-Peak time periods, which correlated with lower costs for the customer.

As noted above, most charging events took place during Super Off-Peak periods. With most charging events beginning around 12AM and lasting through about 5AM. This time period corresponded to about 85% and 83% of the total charging load for customers on EPEV-H and EPEV-M rates, respectively. The third rate, EPEV-L, saw about 78% of their total charging load during this time. The ability to charge at what seem to be inconvenient time periods (12AM-5AM) can be attributed to the use of timers to set charging times.

Figure 6. Average Proportion of Daily EV Energy Consumption by Rate Period on Charging Days



Although most charging occurred during Super Off-Peak time periods, there were a large number of days where no charging occurred, with most charging being done on weekdays. On those days that charging did occur, customers generally charged once, continuously, as opposed to many times in smaller increments.

Results from SDG&E's final EV TOU pricing study continues to add validity to the theory that customers respond to TOU price signals and will therefore adjust their usage to avoid incurring

greater costs. It also shows that customers with enabling technology, in this case a timer, have a greater ability to manage their energy usage and avoid higher On-Peak costs.

D. Analysis of Demand charges for EV rates include an evaluation of the feasibility and benefits of plug-in hybrid and EV demand charges in the residential and commercial context.

SDG&E has focused on the review of residential load profiles, charging habits, consumer responses and costs associated with EV charging. Residential rates are farthest from cost based and therefore were the area that warranted the greatest attention in terms of studying charging behavior and rate structures such as demand charges. At this time, SDG&E does not propose introducing demand charges for any of its residential EV rates. SDG&E will continue to review the need for demand-based charges especially in the context of EVs combined with Distributed Energy Resources ("DERs"). As shown above, charging patterns for customers on EV TOU rates in the residential context have demonstrated customer's tendencies to charge more during the Off and Super-Off Peak periods. The combination of technologies and current residential non-EV rates have the potential for customers to charge at system and circuit peak times Typically, the residential class peaks in the evening hours as customers return home from work. If EV customers were to charge as soon as they arrive home they would contribute to increasing the residential class peak.

The adoption of EVs in the commercial market is just at the beginning stages. EV loads are typically included as a component within the total commercial load and it is not known how much EV charging is done at the work place. SDG&E has not metered those commercial EV loads separately. Therefore an analysis of commercial EV charging and accompanying demand charges has not been conducted by SDG&E. Additionally, SDG&E does not have specific EV rates for its commercial customers as they generally have more accurate price signals than residential tiered rate structures. Rate schedules in the Medium and Large C&I class include TOU energy rates and

demand charges. SDG&E's small commercial customers are currently scheduled to be on mandatory TOU rates beginning November 2015 and have optional TOU rates available to them today.

SDG&E proposed to change its TOU periods for all customers in this RDW Application.[12] Specifically, SDG&E is asking to change the summer On-Peak period from 11am to 6pm to 2pm to 9pm in an effort to more closely align costs with peak energy usage times. The TOU proposal also proposes a change to the current Off-Peak period to a Super Off-Peak period of midnight to 6:00 a.m. to all customers. By extending the Super Off-Peak to all TOU rates SDG&E's will be able to study the impact of the Super Off-Peak across all customers on TOU rates. The later On-Peak period could provide an opportunity to look at EV charging behavior in a commercial setting and whether there could be an increase in EV charging earlier in the day.

It should also be noted that SDG&E has a separate Electric Vehicle Grid Integration ("VGI") pilot proposal in front of the CPUC (A.14-04-014) which will allow SDG&E to study EV charging in a commercial and multi-family setting. In SDG&E's pending VGI pilot Application, SDG&E has proposed an hourly day-ahead rate which includes dynamic price signals for system and circuit peak times. The rate also includes a dynamic component that reflects a reduced price for periods with high levels of renewables and low loads. This experimental rate will allow SDG&E to study EV charging behavior in a commercial context and the influence of dynamic price signals. The resulting data will help inform future grid-integrated vehicle charging policies and dynamic rate proposals. SDG&E requested a decision in its VGI Application for no later than the end of 2014 so that the experimental dynamic rates and associated infrastructure can be available to EV owners shortly thereafter.

[12] January 31, 2014 Testimony of Cynthia Fang, Chapter 2, Section IV.

IV. CONCLUSION

As described above, SDG&E has completed AFV load research filings during the past two years and an EV pricing study, which provided an in-depth study of charging behaviors of Nissan Leaf customers that received three different TOU rates. These studies, along with SDG&E's current residential EV rates and its commercial TOU rate structures, show how SDG&E has complied with D. 11-07-029. Regarding the requirement related specifically to the analysis of demand charges for both residential and commercial EV charging, while residential demands have been analyzed, SDG&E has been unable to study commercial demands specific to EV. As previously stated, SDG&E does not believe that residential demand charges are warranted at this time. The EV market is still in its very early stages and current analysis shows that current EV charging is similar to other large appliance loads. Information about commercial EV charging has been impossible to evaluate as EV charging load is typically a smaller component of a commercial customers load and is included in the overall commercial load at the premise.

It should also be noted that the recent rulemaking R.13-11-007 has a track that will focus on the development of new AFV tariffs that will include new rate designs for residential, multi-family, workplace and fleet plug-in vehicles[13].

> In this new phase, the Commission will explore new AFV tariffs as part of this proceeding, employing the results of existing research and the opportunities presented by new technologies. This proceeding will consider the primary mechanisms the utilities have for recovering costs from customers, including: volumetric rates, demand charges, and upgrade cost assessments. The use of these tools will be explored in three rate contexts: residential rates, workplace rates, and medium- and heavy-duty vehicles.[14]

Accordingly, EV demand charge analysis is still a work in progress and is likely to develop further as a result of the Commission's decisions in R.13-11-007.

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[13] R.13-11-007 pp2-3.
[14] R.13-11-007 at p. 19.

V. QUALIFICATIONS

My name is Leslie Willoughby. My business address is 8306 Century Park Court, San Diego, California 92123. I am employed by San Diego Gas & Electric Company ("SDG&E") as Electric Load Analysis Manager in the Strategic Analysis and Pricing Department. In my current position, I am responsible for managing and conducting load and energy research analysis.

I attended San Diego State University in San Diego, CA, where I graduated with a Bachelor of Science in Business Administration in 1983. I continued to attend San Diego State University where I graduated with an MA in Economics in 1989. In 1990, I was employed by SDG&E to work in the Load Research Section of the Marketing Department as an Associate Economic Analyst. Over the past 20 years I have held positions of increasing responsibility within the company that have included Load and Energy Research.

I have previously testified before the Commission.