BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

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Order Instituting Rulemaking to consider Alternative-Fueled Vehicle Programs, Tariffs, and Policies	Rulemaking 13-11-007 (Filed November 22, 2013)

LOAD RESEARCH REPORT COMPLIANCE FILING OF SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E), ON BEHALF OF ITSELF, PACIFIC GAS AND ELECTRIC COMPANY (U 39E), AND SAN DIEGO GAS & ELECTRIC COMPANY (U 902-M), PURSUANT TO ORDERING PARAGRAPH 2 OF D.16-06-011

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Dated: **December 30, 2016**

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Southern California Edison Company (SCE), on behalf of itself, Pacific Gas and Electric Company, and San Diego Gas & Electric Company,[1] hereby files the Load Research Report, attached hereto as Appendix A, as required by Ordering Paragraph 2 of Decision (D.) 16-06-011. The Load Research Report was prepared based on the load research methodology developed by the California Public Utilities Commission's Energy Division with input from stakeholders pursuant to Ordering Paragraph 3 of D.13-06-014. The data provided for SCE in this Load Research Report supersedes the data SCE provided in prior reports, as explained in the Load Research Report.

[1] This Load Research Report is being filed on behalf of Southern California Edison Company, Pacific Gas and Electric Company, and San Diego Gas & Electric Company pursuant to California Public Utilities Commission Rules of Practice and Procedure, Rule 1.8(d).

Respectfully submitted,

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December 30, 2016

Appendix A

JOINT IOU ELECTRIC VEHICLE LOAD RESEARCH REPORT

Joint IOU Electric Vehicle Load Research Report

5th Report

Filed on December 30, 2016

Electric Vehicle Load Research and Cost Studies

R.09-08-009/R.13-11-007 (AFV OIR)

Ordered in D.11-07-029, D.13-06-014, and D.16-06-011

Contents

Executive Summary

On July 25, 2011, the California Public Utilities Commission (CPUC or Commission) issued D.11-07-029 (the Phase 2 Decision) in the Alternative-Fueled Vehicle Rulemaking, R.09-08-009 (AFV OIR), to evaluate policies and develop infrastructure sufficient to overcome barriers for the deployment and use of Plug-in Electric Vehicles (PEV) in California. The Phase 2 Decision ordered California's investor-owned utilities (IOUs), made up of Pacific Gas and Electric (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Edison (SCE), to conduct research to examine PEV customer charging behavior, as well as track service and distribution system upgrade costs related to PEV load. The IOUs filed the first Joint IOU Electric Vehicle Load Research Report (1st Load Research Report) in December 2012. Decision 13-06-014, issued July 3, 2013 (the First Extension Decision), extended the research for an additional three years[1] with reports to begin in December 2013.[2] The First Extension Decision also directed the Energy Division to work with stakeholders to revise the load research methodology.[3] Finally, Decision 16-06-011, issued on June 13, 2016 (the Second Extension Decision), extended the interim policy of treating the electric vehicle charging costs that exceed the allowances in the Electric Rules 15 and 16 of the three IOUs as common facility costs for another three years, to June 30, 2019[4]. In addition, the annual filing requirement of the Load Research Reports was extended by another three years.

This December 2016 report (5th Load Research Report) includes data through October 2016 for service line and distribution system upgrades, and for the period September 2015 through August 2016 for load research data, along with the conclusions reached through analyzing this data. Data from prior Load Research Reports has been considered when drawing conclusions. It is important to note that the PEV market is still evolving. New vehicle models, vehicle battery sizes, charging levels, charging equipment, and charging services are continually entering the PEV market. PEV manufacturers and charging providers are also leaving the market. This evolution is expected to continue in the near term as the PEV market grows and matures.

As of October 31, 2016, the IOUs estimate there are over 202,569 PEVs within the three service territories. Of the 202,569 vehicles estimated to be currently on the road, only 387, or 0.19%, have required a service line or distribution system upgrade solely to support the PEV load at their residential charging location. In all but 66 instances, the standard allowance for residential service upgrades was sufficient to cover the portion of the service upgrade cost that is assigned to the utility.5 The IOUs have

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1 D.13-06-014, p. 15.

2 D.13-06-014, Ordering Paragraph 4.

3 D.13-06-014, Ordering Paragraph 3.

4 D.16-06-011, Ordering Paragraph 2.

5 For a service line upgrade, the utility is responsible for the cost of the service conductor, connecters, support poles, and metering. These costs are covered by the residential allowance and any amount in excess of the allowance (absent the CPUC's current policy for the excess to be paid by all customers for upgrades related to PEVs) is billed to the customer. The customer is responsible for any trenching, conduit, substructures, or protective structures required for the upgrade. These costs are not covered by the residential allowance, or the CPUC policy currently in place that directs costs in excess of the allowance to be paid by all customers.

evaluated the service and distribution system upgrades needed due to the addition of PEV load and have determined that the number of upgrades and associated costs to date is immaterial.

Generally, the usage and demand levels for customers on single-metered PEV rates are higher than that of the typical residential customer. PEV customers (separately-metered and single-metered) on Time-of-Use (TOU) rates take advantage of the lower off-peak costs and tend to charge their vehicles during the super off-peak period. Single-metered PEV customers tend to peak during the super-off-peak period. Many of these customers use timers either equipped in the vehicle or on the charging station.

The IOUs tracked load research data on a monthly basis and have included 12 months of data in this report. The usage and demand of customers were tracked in each rate group. The goal of this structure was to determine how monthly usage varies, how rates impact peak demand, and how usage varies by time-of-use rate among different groups of customers.

Part 1: Introduction

California is the 15th largest emitter of greenhouse gases in the world, representing about 2% of worldwide emissions.[6] California's transportation sector is the largest contributor, consisting of more than 37% of the State's total greenhouse gas emissions. Passenger vehicles alone are responsible for almost 26% of California's greenhouse gas emissions. To address these vehicle emissions, the California Air Resources Board (CARB) proposed a comprehensive three pronged strategy, which includes the following: reduce greenhouse gas emissions from vehicles, reduce the carbon content of the fuel vehicles use, and reduce the miles vehicles travel. Electrification of vehicles is a critical component of this strategy.[7]

The CPUC opened the Alternative-Fueled Vehicle Rulemaking, R.09-08-009 (AFV OIR), to consider alternative-fueled vehicle tariffs, infrastructure, and policies to support California's Greenhouse Gas Emissions Reductions Goals.

At the time of this report, December 2016, Go Electric Drive lists on its EV showroom 30 PEV models.[8] These vehicles have on-board chargers capable of charging at levels ranging from 3.3 kW to 19.2 kW.

The IOUs estimate more than 202,569 PEVs are in their service territories, as of October 31, 2016. The number of PEVs forecasted to be operating in the IOUs service territories from 2017 through 2023 are:

Year	PG&E[9]	SCE	SDG&E[10]
2017	138,000	133,352	22,124
2018	167,000	232,714	27,589
2019	195,000	351,478	33,008
2020	226,000	486,399	40,610
2021	268,000	637,154	50,240
2022	316,000	802,934	64,918
2023	374,000	977,108	81,492

This report includes data through October 2016 for service line and distribution system upgrades and for the period September 2015 through August 2016 for load research data along with the conclusions reached analyzing the data. Data from prior Load Research Reports are also considered in drawing

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6 *Climate Change Scoping Plan, A Framework for Change, Pursuant to AB 32, the California Global Warming Solutions Act of 2006* (herein ARB's 2008 Scoping Plan) at 11, adopted by the California Air Resources Board on December 11, 2008. The ARB 2008 Scoping Plan is available at: http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm.

7 D.11-07-029, p 3-4.

8 www.goelectricdrive.org/you-buy/ev-showroom

9 PG&E's EV forecast assumes sufficient customer demand in California to meet the CARB's Zero Emission Vehicle compliance requirements and sufficient installation and maintenance of EV infrastructure, including by electric utilities in the State, to support EV customer needs for EV charging infrastructure. If either of these assumptions is not accurate, then forecast EV market penetration likely will be significantly less than PG&E's forecast.

10 SDG&E Electric Vehicle-Grid Integration Pilot Program Application (A.14-04-014), Direct Testimony of J.C. Martin, Revised July 29, 2014, page JCM-17.

conclusions. It is important to note that the behavior of the early adopters of PEVs during this time period may not be representative of the average customer. While the data collected is illustrative of the behaviors of early adopters of PEVs, these behavior patterns are not likely to hold as PEV technology matures, charging technology and charging behaviors evolve, and PEVs achieve greater market adoption beyond the early adopter phase.

Part 2: Scope of Load Research

In the Phase 2 Decision, the CPUC required the IOUs to perform load research to inform future Commission policy.[11] The CPUC determined that additional research is needed to inform policies for the next stages of PEV market development.[12] Specifically, the CPUC ordered the IOUs to:

1. Track and quantify all new load and associated upgrade costs in a manner that allows PEV load and related costs to be broken out and specifically identified. This information shall be collected and stored in an accessible format useful to the Commission.

2. Evaluate how metering arrangements and rate design impact PEV charging behavior.

3. To the extent relevant, determine whether participation in demand response programs impacts PEV charging behavior.

4. Determine how charging arrangements, including metering options and alternative rate schedules impact charging behavior at Multi-Dwelling Units (MDU).

5. Evaluate whether distribution costs are increased by different charging levels, i.e., Level 1, Level 2, and quick charging, in public locations.

6. Separately track costs associated with PEV-related residential service facility upgrade costs and treated as "common facility costs" between the effective date of this decision and June 30, 2013, and propose a policy and procedural mechanism to address these residential upgrade costs going forward.[13]

In collaboration with the Energy Division and other stakeholders, the IOUs developed a load research plan to meet these specific requirements and filed the plan with the CPUC on October 1, 2012.[14] The plan identified certain areas where data is not available or sufficient to produce data or conclusions. The CPUC further ordered the IOUs to complete the load research by January 1, 2013 and file a load research report by January 1, 2013.[15] The IOUs filed the 1st Load Research Report in December 2012. The First Extension Decision extended the research an additional three years[16] to begin in December 2013[17] and directed the Energy Division to work with stakeholders to revise the load research methodology.[18] The deadline for the December 2013 report was extended to January 31, 2014 by CPUC Executive Director Paul Clanon, to allow the IOUs more time to prepare the report under the revised methodology. Following the Second Extension Decision, this December 2016 report is the fifth report to be filed.

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11 D.11-07-029, p. 3.
12 D.11-07-029, p. 60.
13 D.11-07-029, Ordering Paragraph 6.
14 *See* Advice Letters 2403-E for SDG&E, 2786-E for SCE, and 4115-E for PG&E.
15 D.11-07-029, Ordering Paragraph 7.
16 D.13-06-014, p. 15.
17 D.13-06-014, Ordering Paragraph 4.
18 D.13-06-014, Ordering Paragraph 3.

Part 3: Cost Tracking Data, Findings, and Policy Recommendations

Introduction

In the Phase 2 Decision the CPUC ordered that "Between July 25, 2011 and June 30, 2013, all residential service facility upgrade costs in excess of the residential allowance shall be treated as common facility costs rather than being paid for by the individual plug-in hybrid and electric vehicle customer."[19]
The CPUC further ordered "the IOUs to separately track costs associated with PEV-related residential service facility upgrade costs and treated as 'common facility costs' and propose a policy and procedural mechanism to address these residential upgrade costs going forward." [20] Lastly, the CPUC ordered that "The IOUs should evaluate whether distribution costs are increased by different charging levels, i.e., Level 1, Level 2, and quick charging, in public locations."[21]

The Second Extension Decision extended the "common facility treatment" for costs in excess of the allowance to June 30, 2019,[22] and extended the cost tracking and research an additional three years[23] with reporting to begin in December 2016.

Approach

Based on notification of a PEV's location, such as from the customer or auto Original Equipment Manufacturers (OEM), the utilities' service planning departments may conduct assessments of the customer's service line and the distribution system supporting the customer's electric service (such as the secondary line, transformer, etc.) to determine whether the new PEV load can be served by the existing infrastructure. The assessment considers factors such as voltage drop and flicker on the service and diversity of load on the local distribution system feeder. If the assessment indicates that existing infrastructure can accommodate the new PEV load, no upgrade is needed and the assessment is complete. If the existing infrastructure cannot accommodate the new PEV load, then the customer service line and the distribution system supporting the customer service are evaluated to determine if one or both need to be upgraded. As part of the evaluation, the service planning departments consider if the upgrade was needed before the addition of the PEV, and the PEV simply brought attention to the need for the upgrade. If an upgrade was needed before the addition of the PEV, then the upgrade is not attributed to the PEV because the PEV did not cause the need for the upgrade.[24] Similarly, if the customer is adding a PEV plus other new load such as a room addition, air conditioner, or pool pump, and an upgrade is needed, the upgrade is not attributed to the PEV since it was not the sole source of the new load.[25] Once the evaluation is complete, a new project is opened for the upgrade and

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19 D.11-07-029, Ordering Paragraph 5.
20 D.11-07-029, Ordering Paragraph 6.
21 D.11-07-029, Ordering Paragraph 6.
22 D.16-06-11, Ordering Paragraph 1.
23 D. 16-06-11, Ordering Paragraph 2
24 That is, if a customer notified the utility she intended to buy a PEV and the utility did an infrastructure check that determined an upgrade was needed even before the addition of the PEV load, even if the customer ultimately decided not to purchase the car the upgrade would still be completed because it was needed absent the PEV.
25 The upgrade would be completed absent the PEV because other new load is being added.

attributed to the PEV if it was the sole source of the new load and an upgrade was not needed before the PEV was added. The utilities create PEV-specific work orders to capture the upgrade costs and track them for reporting purposes when the upgrade work is complete. This is the most practical way for the IOUs to capture and report upgrade costs attributable solely to PEVs.

Upgrade costs related to PEVs fall into three general categories:

- Equipment on the customer side of meter
- The individual customer service line, and
- The utility distribution system that serves multiple customers.

The costs for each category are treated differently.

Costs for equipment on the customer side of the meter are borne by the customer and the utility does not have information on these costs. Therefore, they are not included in this report.

The table on the following page illustrates how costs for upgrades to the individual customer service line are split between the customer and the utility. The individual customer's assigned costs are the costs incurred in fulfilling the Applicant Responsibility of Rule 16. The utility's contribution toward the utility-assigned costs is limited to the amount of the residential allowance and any costs in excess of the allowance are assigned to the individual customer. The individual customer is responsible for the costs of the service line upgrade that are assigned to them. Any costs that are not covered by the utility-assigned residential allowance or by the CPUC policy currently in place that directs costs in excess of the allowance to be paid by all customers, are the responsibility of the individual customer requesting service to the PEV. The utility does not have information on the costs borne by the individual customer for the service upgrade and those costs are not included in this report.

Costs for upgrades to the utility distribution system, including secondary lines and transformers, are paid by the utility and recovered through distribution rates. The following table summarizes the types of costs in each category and the party responsible for the costs.

Table IOU-1: Summary of Upgrade Costs and Responsibilities

	Customer Assigned Costs	Allowance?	Utility Assigned Costs
Equipment on Customer Side of Meter	Customer pays all costs for charging equipment, including costs to plan, design, install, own, maintain, and operate facilities and equipment beyond the Service Delivery Point		
Service Line Upgrade	• Excavation: trenching, backfilling, and other digging as required including permit fees • Furnishing, installing, owning, and maintaining all Conduits (including pulling tape) and Substructures, furnishing riser materials • Protective Structures: Furnishing, installing, owning, and maintaining all necessary Protective Structures as specified by utility for utility's facilities	Yes, to cover work responsibility assigned to utility. Customer pays amount exceeding allowance. This is in addition to Customer assigned costs. **NOTE: CPUC policy exemption in place through June 2019 for residential upgrades when PEV load is added. Under exemption, amount exceeding allowance is not paid by customer and instead paid by utility and recovered through distribution rates.**	• Underground Service: Service conductors and connectors • Overhead Service: conductors and support poles • Metering: meters and associated utility owned metering equipment
Secondary Lines/ Transformer Upgrade (serving 2 or more Service Lines)			Utility pays all costs for upgrading and maintaining the distribution system. Recovered through distribution rates.

Summary Data

Table IOU-2 summarizes the PEV-related service line and distribution system upgrade costs for July 2011 through October 2015.

Table IOU-2: Summary of Service Line and Distribution System Upgrades

	PG&E	SCE	SDG&E	Total
Residential Customers				
Estimated PEV customers through September 30, 2016	102,329	78,200	22,040	202,569
Residential Upgrades				
Number of PEV-related Infrastructure Checks Completed	7,335	Not tracked[26]	Not[27] tracked	N/A
Number PEV-related Service Line and/or Distribution System Upgrades[28]	192	176	19	387
Total Costs Incurred by Utility for Upgrades	$3,883,167	$296,985	$36,243	$4,216,395
Range of Costs for Upgrades	$142-$275,817	$1 to $30,067	$80 to $10,958	N/A
Average Cost for Distribution System Upgrade[29]	$18,342	$4,847	$4,089	N/A
Average Cost for Service Line Upgrade	$1,462	$1,537	$732	N/A
Number of Service Line Upgrades Exceeding Residential Allowance	36	30	0	66
Current Residential Allowance	$2,431 [30]	$3,402	$2,841[31]	N/A
Amount of Foregone Billings to Customers for Service Line Upgrades Pursuant to "Common Facility Treatment" Policy Exemption for PEVs	$157,392	$29,324	$0	$186,716

[26] SCE does not have a reliable process to track specific PEV infrastructure checks from overall general infrastructure checks. The PEV infrastructure check is accounted for if an upgrade work order is opened.

[27] SDG&E does not separately track distribution infrastructure checks related to PEVs, the service call is tagged as PEV only if a construction project is opened to perform an upgrade.

[28] If a both a service line upgrade and distribution line upgrade was performed at the same residence, it is counted as one upgrade.

[29] For upgrades that included both a distribution system and service line upgrade PG&E and SDG&E broke them out between the distribution upgrade and service line upgrade line items. SCE reported total amount in distribution system upgrade line item.

[30] PG&E Electric Rule 15, Section C.3: http://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_15.pdf.

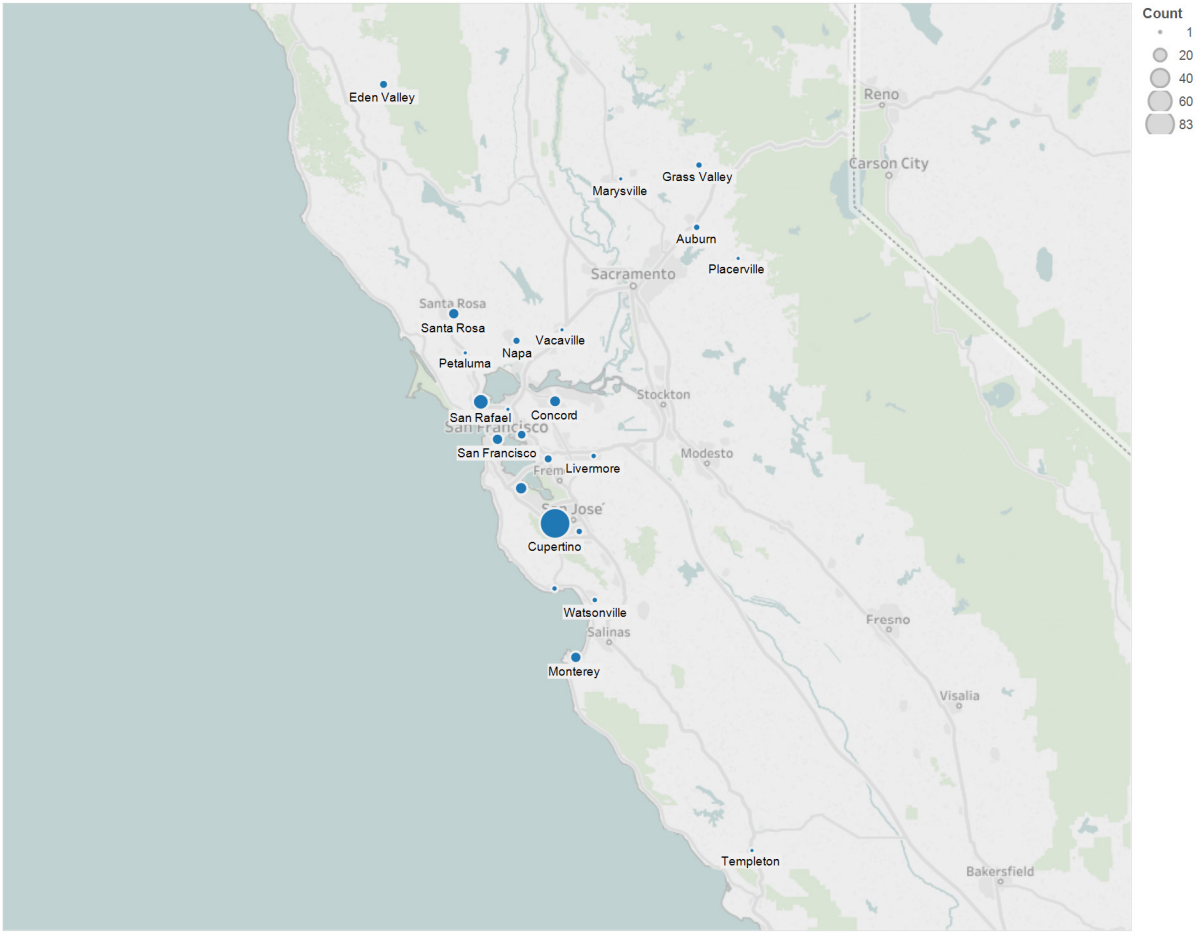
[31] SDG&E Electric Rule 15, Section C.3: http://regarchive.sdge.com/tm2/pdf/ELEC_ELEC-RULES_ERULE15.pdf.

PG&E Specific Details

As of October 2016, PG&E's best estimate of the number of PEVs in the PG&E service territory is 102,329. This value reflects all PEVs registered in PG&E service territory according to data obtained via EPRI from R. L. Polk (a third party Department of Motor Vehicles (DMV) data aggregator).

While PG&E's total estimate of PEVs in the service territory is 102,329, PG&E is only able to perform service assessments for customers that notify the utility of their PEV status. As of October 31, 2016, PG&E had completed 7,335 such service assessments. Of the 7,335 service assessments completed to date, 192, or 2.6%, have required upgrades due solely to the addition of PEV load. In 36 instances the allowance was not sufficient to cover the portion of the service upgrade assigned to the utility, and the customer would have incurred additional costs had the exemption not been in place. The total cost of the excess over the allowance for the 36 customers combined was $157,392. The map below identifies the locations of all 192 upgrades.

Figure PG&E-1: Location of Customers in the PG&E's Service Territory Requiring a Residential Upgrade Due to a PEV (as of October 2016)



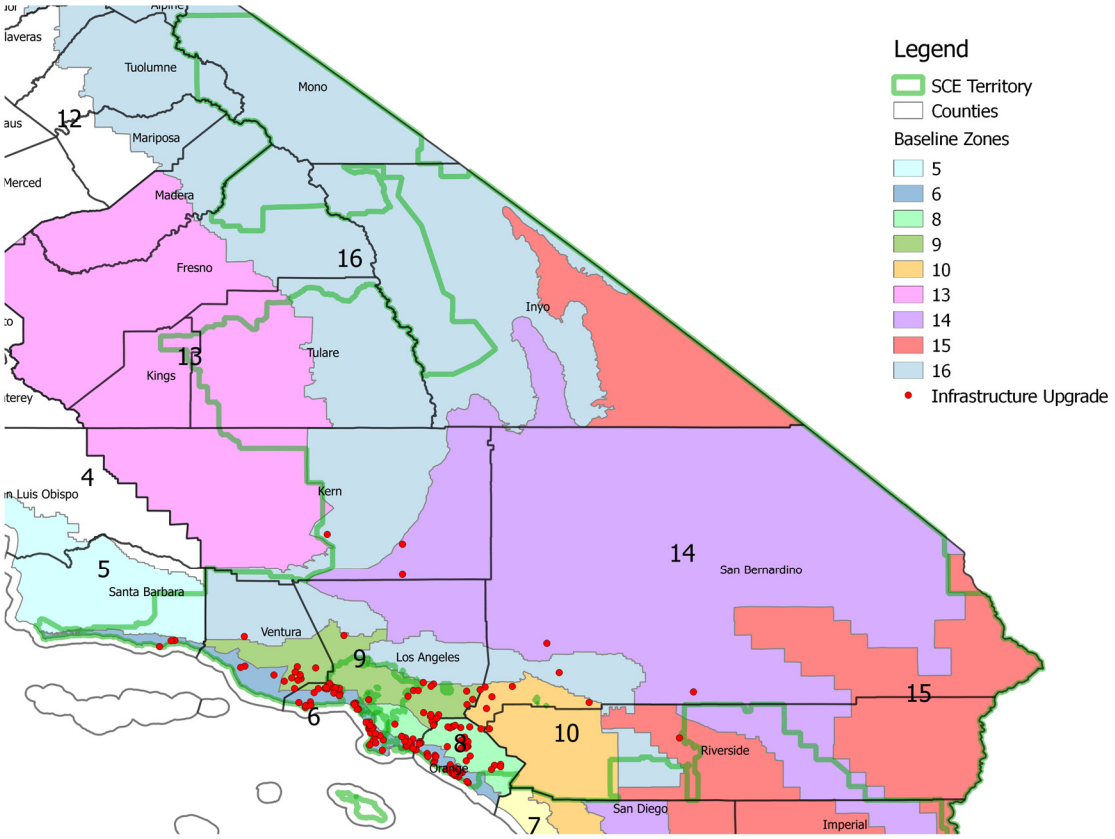
SCE Specific Details

As of October 2016, SCE's best estimate of the number of PEVs registered to residential customers in SCE's service territory is about 78,200. The data source for this estimate are based on registration data received through a third-party DMV vendor. There is some amount of uncertainty in this number.

SCE is only able to perform a residential service assessment when it has been notified of the street address of a charging location. Also, SCE does not have a reliable process to track specific PEV infrastructure checks from overall general infrastructure checks. The PEV infrastructure check is accounted for if an upgrade work order is opened. SCE conducts on-site infrastructure assessments for those residential customers with a PEV capable of charging at 6.6 kW and higher. Of the approximately 78,200 residential PEVs in SCE's service territory, only 176 or 0.23% have required upgrades where the PEV load was the sole reason for the upgrade. The locations of the upgrades are depicted on the map below.

In 30 instances, the allowance was not sufficient to cover the portion of the service upgrade assigned to the utility, and the customer would have incurred additional costs had the exemption not been in place. The total cost of the excess over the allowance for the 30 customers combined was $29,324.

Figure SCE-1: PEVs in the SCE Service Territory Requiring a Residential Upgrade as of October 2015



SCE also had 59 upgrades relating to the commercial installation of PEV charging stations totaling approximately $1,022,413.67.

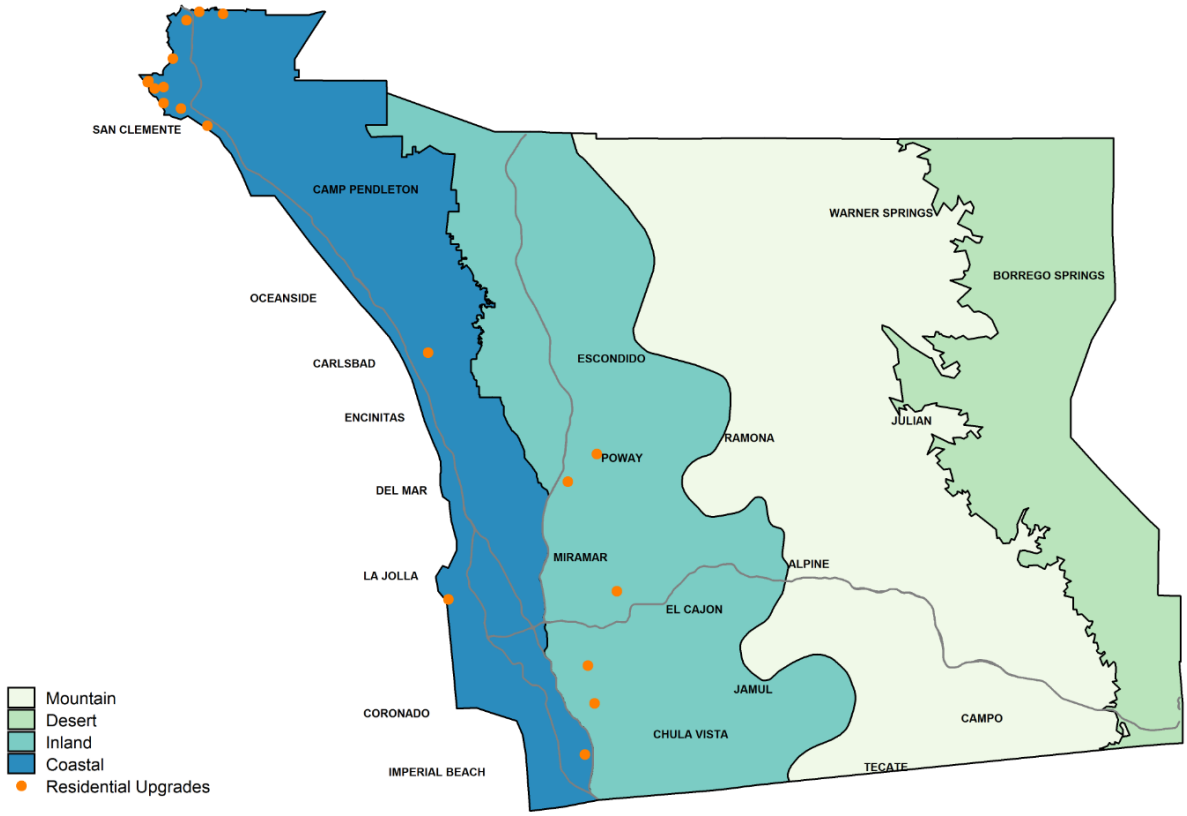
SCE is also reporting that it implemented a new process to collect the data for this report. Previously, SCE gathered data through a mostly manual process. After querying its systems of record in preparation for this report, SCE identified a number of discrepancies in previously reported data. As a result, SCE is restating the PEV cost data contained in this report for the entire reporting period (i.e., from July 25, 2011, to October 30, 2016).

SDG&E Specific Details

As of October 2016 SDG&E's best estimate of the number of PEVs registered to residential customers in the SDG&E service territory is 22,040. The data sources for this estimate are: customer self-identification, OEM opt-in notification, car dealership reporting, and PEV counts received through a third party DMV vendor. There is some uncertainty in this number and it is appropriately considered to be a lower bound of the number of PEVs in the SDG&E service territory.

Of the approximately 22,040 residential PEVs in SDG&E's service territory, 19, or 0.1%, have required upgrades where the PEV was the sole source of the new load. The locations of the PEV-related upgrades are depicted on the map that follows.

Figure SDG&E-1: Location of PEVs Requiring a Residential Upgrade in the SDG&E Service Territory as of October 2016



Conclusions/Recommendations

As of October 31, 2016, the IOUs estimate there are approximately 202,569 PEVs within the three service territories. Of the 202,569 vehicles estimated to be currently on the road, only 387, or 0.19%, have required a service line and/or distribution system upgrade. In all but 66 instances, the allowance for residential service upgrades was sufficient to cover the portion of the service upgrade cost that is assigned to the utility. The IOUs have evaluated the service and distribution system upgrades needed due to the addition of PEV load and have determined that the number of upgrades and associated costs to date is immaterial.

Part 4: Load Research and Customer Behavior on Rates in Various Settings

Introduction

The Second Extension Decision directed the IOUs to continue load research reporting related to PEVs for an additional three years, beginning in 2016. The First Extension Decision along with the Phase 2 Decision provided direction on scope and instructed the IOUs to work with the Energy Division on revising and continuing PEV load research reporting. In the Phase 2 Decision the IOUs were ordered to:

- Evaluate how metering arrangements and rate design impact PEV charging behavior.
- To the extent relevant, determine whether participation in demand response programs impacts PEV charging behavior.
- Determine how charging arrangements, including metering options and alternative rate schedules, impact charging behavior at MDU.[32]

To satisfy these requirements, metering data was collected to provide insight into residential charging behavior under:

- A whole house TOU rate available to customers with PEVs[33]
- A TOU rate available to customers with PEVs requiring to meter the PEV charging load separately from the main household load
- Tiered residential rates

This metering data provides the basis for analyzing how charging behavior is impacted by tariff rates or charging levels. Additionally, the recorded data allowed for the evaluation of metering scenarios on PEV charging behavior for customers in the following residential categories:[34]

- Single Family Home (SF)
- Multi Family Dwelling Unit (MDU)
- Net Energy Metering (NEM)
- Demand Response (DR)

The data for this 5th Load Research Report covers the 12-month period of September 2015 to August 2016. Distinctions between single metering and separate metering are shown, as well as NEM and DR program participation. The usage and demand of customers were tracked in each rate group. The goal of this structure was to determine how monthly usage varies, how rates impact peak demand and how usage varies by time-of-use rate among different groups of customers. A baseline for residential customers has been analyzed for context in the form of an average for a month during the season being examined.

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[32] D.11-07-029, Ordering Paragraph 6.

[33] SCE's whole-house TOU-D rate is open to all residential customers (SCE does not offer a whole-house TOU plan for PEV customers, only).

[34] The MDU and SF categories are mutually exclusive. However, the others categories can overlap. For example, a NEM customer that is also on DR would appear in three categories.

To the extent possible, the IOUs provided similar information for easy comparisons. However, there are some cases where this is simply not possible due to differences in the underlying IOU data. Metrics with less than 15 customers are clearly noted and not reported due to confidentiality concerns described in the 15/15 Rule adopted by the Commission in Decision 97-10-031 and Decision 14-05-016. All statistics in this report are provided as an average on a per-customer basis in each rate group and are based on interval data collected by each IOU. All time periods are reported in 24-hour time, except for SCE's load profiles, which are reported in Pacific Standard Time. Time-of-use periods vary across the IOUs and will be explicitly defined within each separate section below.

Pacific Gas and Electric Company

Single-Metered (EV-A) and Separately-Metered (EV-B) PEV Rates

As of the date of this report, PG&E has two residential PEV rates, EV-A and EV-B, as described in Schedule EV[35] for single and separately-metered PEVs respectively. The EV-A rate is designed for residential customers who have their typical load and electric vehicle charging on the same meter. The EV-B rate is designed for customers who wish to bill their vehicle charging separately and who have installed a separate meter to do so. Both rate plans use an un-tiered TOU rate structure. They offer on-peak, partial peak, and off-peak energy prices according to the time periods in Table PG&E-1a.

Regardless of season, or day of the week, both rates seek to encourage usage in off-peak hours from 11:00 p.m. to 7:00 a.m. The rates further encourage weekend usage by removing the "partial-peak" time periods on Saturdays and Sundays.

[35] Pacific Gas and Electric Company. Electric Schedule EV. Residential Time-of-Use Service for Plug-in Electric Vehicle Customers. Retrieved from http://www.pge.com/tariffs/tm2/pdf/ELEC_SCHEDS_EV.pdf.

Table PG&E-1a: Tariff Type and Rate ($/kWh)

Rate: EVA

Hour	Winter Weekday	Winter Weekend / Holidays	Summer Weekday	Summer Weekend / Holidays
12mn - 1am	0.11904	0.11904	0.11628	0.11628
1am - 2am	0.11904	0.11904	0.11628	0.11628
2am - 3am	0.11904	0.11904	0.11628	0.11628
3am - 4am	0.11904	0.11904	0.11628	0.11628
4am - 5am	0.11904	0.11904	0.11628	0.11628
5am - 6am	0.11904	0.11904	0.11628	0.11628
6am - 7am	0.11904	0.11904	0.11628	0.11628
7am - 8am	0.19197	0.11904	0.24311	0.11628
8am - 9am	0.19197	0.11904	0.24311	0.11628
9am - 10am	0.19197	0.11904	0.24311	0.11628
10am - 11am	0.19197	0.11904	0.24311	0.11628
11am - 12nn	0.19197	0.11904	0.24311	0.11628
12nn - 1pm	0.19197	0.11904	0.24311	0.11628
1pm - 2pm	0.19197	0.11904	0.24311	0.11628
2pm - 3pm	0.31374	0.11904	0.44549	0.11628
3pm - 4pm	0.31374	0.31374	0.44549	0.44549
4pm - 5pm	0.31374	0.31374	0.44549	0.44549
5pm - 6pm	0.31374	0.31374	0.44549	0.44549
6pm - 7pm	0.31374	0.31374	0.44549	0.44549
7pm - 8pm	0.31374	0.11904	0.44549	0.11628
8pm - 9pm	0.31374	0.11904	0.44549	0.11628
9pm - 10pm	0.19197	0.11904	0.24311	0.11628
10pm - 11pm	0.19197	0.11904	0.24311	0.11628
11pm - 12mn	0.11904	0.11904	0.11628	0.11628

Rate: EVB

Hour	Winter Weekday	Winter Weekend / Holidays	Summer Weekday	Summer Weekend / Holidays
12mn - 1am	0.11854	0.11854	0.11581	0.11581
1am - 2am	0.11854	0.11854	0.11581	0.11581
2am - 3am	0.11854	0.11854	0.11581	0.11581
3am - 4am	0.11854	0.11854	0.11581	0.11581
4am - 5am	0.11854	0.11854	0.11581	0.11581
5am - 6am	0.11854	0.11854	0.11581	0.11581
6am - 7am	0.11854	0.11854	0.11581	0.11581
7am - 8am	0.18853	0.11854	0.23988	0.11581
8am - 9am	0.18853	0.11854	0.23988	0.11581
9am - 10am	0.18853	0.11854	0.23988	0.11581
10am - 11am	0.18853	0.11854	0.23988	0.11581
11am - 12nn	0.18853	0.11854	0.23988	0.11581
12nn - 1pm	0.18853	0.11854	0.23988	0.11581
1pm - 2pm	0.18853	0.11854	0.23988	0.11581
2pm - 3pm	0.30685	0.11854	0.43901	0.11581
3pm - 4pm	0.30685	0.30685	0.43901	0.43901
4pm - 5pm	0.30685	0.30685	0.43901	0.43901
5pm - 6pm	0.30685	0.30685	0.43901	0.43901
6pm - 7pm	0.30685	0.30685	0.43901	0.43901
7pm - 8pm	0.30685	0.11854	0.43901	0.11581
8pm - 9pm	0.30685	0.11854	0.43901	0.11581
9pm - 10pm	0.18853	0.11854	0.23988	0.11581
10pm - 11pm	0.18853	0.11854	0.23988	0.11581
11pm - 12mn	0.11854	0.11854	0.11581	0.11581

Legend:

	Winter	Summer
On		
Part		
Off		

* While the table depicts 24-hour time, there is a daylight saving time adjustment as described in the tariff.

** Rates effective October 1, 2016. For details see Electric Schedule EV, Residential Time-of-Use Service for Plug-in Electric Vehicle Customers, retrieved from http://www.pge.com/tariffs/tm2/pdf/ELEC_SCHEDS_EV.pdf.

These rates change seasonally, rising in summer and dropping in winter. Table PG&E-1b depicts price ratios for the TOU periods by season to illustrate this seasonal difference.

Table PG&E-1b: Price Ratios

	EV-A Tariff		EV-B Tariff	
Season	Between Off-Peak and Partial Peak	Between Off-Peak and Peak Period	Between Off-Peak and Partial Peak	Between Off-Peak and Peak Period
Winter	0.62	0.38	0.63	0.39
Summer	0.48	0.26	0.48	0.26

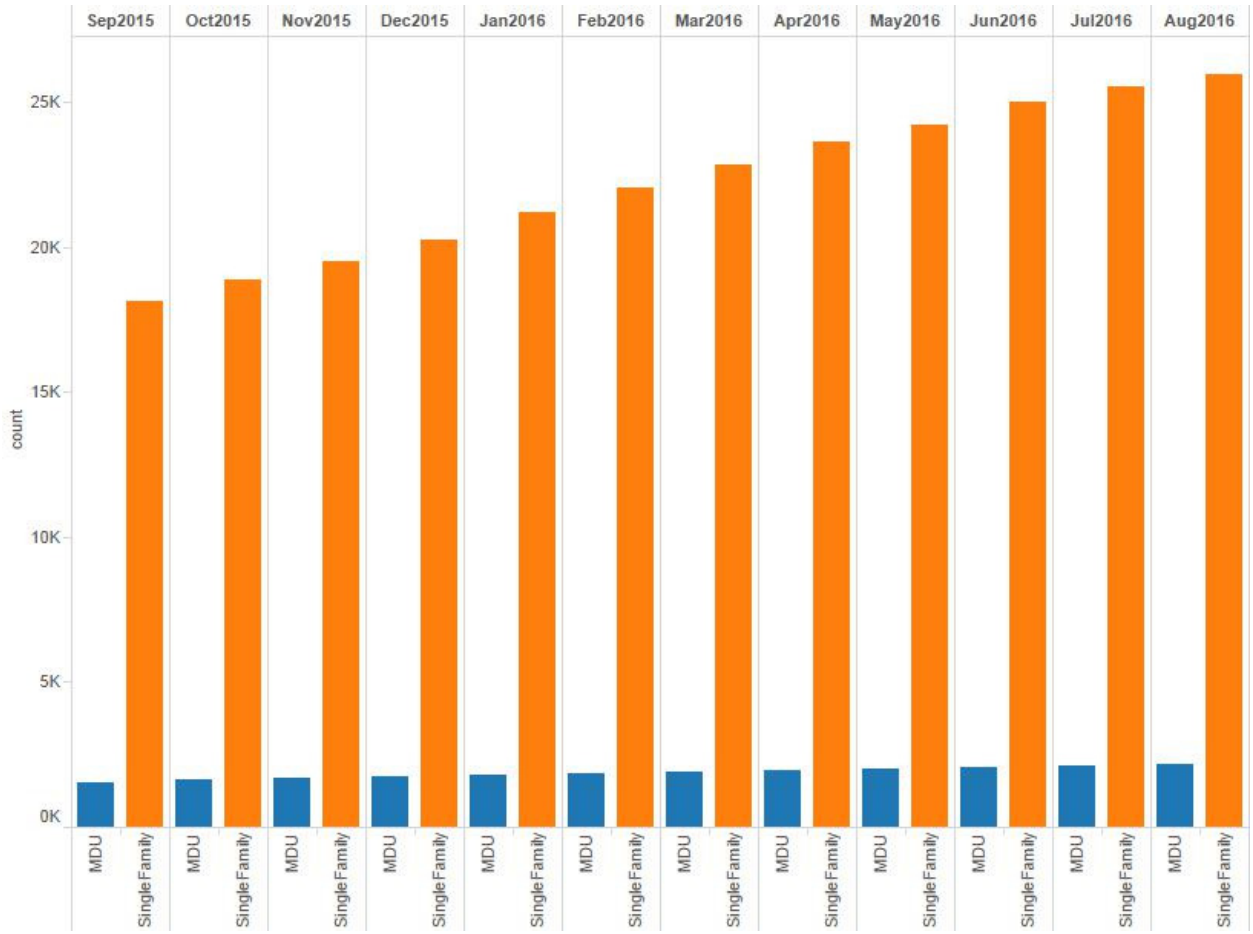
Single Metering (EV-A) Rate Growth

Participation in both EV-A and EV-B has increased during the study period. However, not all PEV customers have adopted PEV rates.[36] The vast majority of PEV rate participants are on the EV-A single metering rate.

All EV-A Customers: Chart PG&E-1 below displays the total customers on the EV-A rate. During the study period, there was a steady increase in EV-A overall, as well as the Single Family and MDU subcategories. Between September 2015 and August 2016, the number of accounts in the EV-A group as a whole increased by 40% at the last reported month compared to the base month.

[36] Data obtained by PG&E from auto manufacturers and other sources cannot be verified by the due date of this report to produce a load analysis for Chart 9 or Tables 10, 11, or 12 from Energy Division's reporting requirements. PG&E will seek to include these data in future reports, if feasible. Therefore, the load research figures in this report only represent the number of PG&E PEV customers on PEV rates, not all PEV customers.

Chart PG&E-1: Single Metering Accounts by Customer Type



NEM EV-A Customers: NEM customers on the PEV rates are an important group to consider. Of all the PG&E customers who were on a PEV rate up to 20% were also on NEM at any given time during the study period. Virtually all of these dual PEV Rate/NEM customers were on the single-metered EV-A rate (see Tables PG&E-2 and PG&E-4).

The fact that NEM customers with PEVs predominately use the EV-A rate presents a load research challenge. The presence of onsite distributed generation (DG) alongside a PEV behind these customers' meters indicates that their utility energy usage data does not reflect their gross consumption. This is because the DG will have offset some portion of consumption. However, without additional metering of the DG, it is not feasible to isolate the effect PEV ownership has on usage patterns for this group using utility metering data alone.[37]

[37] While there are numerous other demographic and behavioral attributes of this early PEV adopter group that affect usage, there was insufficient data or resources to isolate and identify their contribution to load shapes.

Table PG&E-2: Single Metering NEM Program Enrollment by Customer Type

Year	Month	Total Single Metering NEM (n)	NEM % of Single Metering	NEM % of SF Single Metering	NEM % of MDU Single Metering
2015	Sept	3,636	18%	19%	6%
2015	Oct	3,745	18%	19%	5%
2015	Nov	3,944	18%	19%	6%
2015	Dec	4,233	18%	19%	6%
2016	Jan	4,481	19%	20%	6%
2016	Feb	4,614	19%	20%	6%
2016	Mar	4,745	19%	20%	7%
2016	Apr	4,892	19%	20%	7%
2016	May	5,111	19%	20%	7%
2016	Jun	5,363	19%	20%	7%
2016	Jul	5,545	20%	21%	7%
2016	Aug	5,750	20%	21%	7%

DR EV-A Customers: DR program participating customers on the PEV rates are another important group to consider. Of all the PG&E customers who were on a PEV rate up to 6% were also participating in a DR program at any given time during the study period. Virtually all of these dual PEV Rate/DR customers were on the single-metered EV-A rate (see Tables PG&E-3 and PG&E-5). This dual participation is important to consider because DR customers are familiar with altering their usage patterns in response to TOU price signals. Consequently, these customers should respond to the PEV rate price signals and charge their vehicles during partial or off-peak periods.

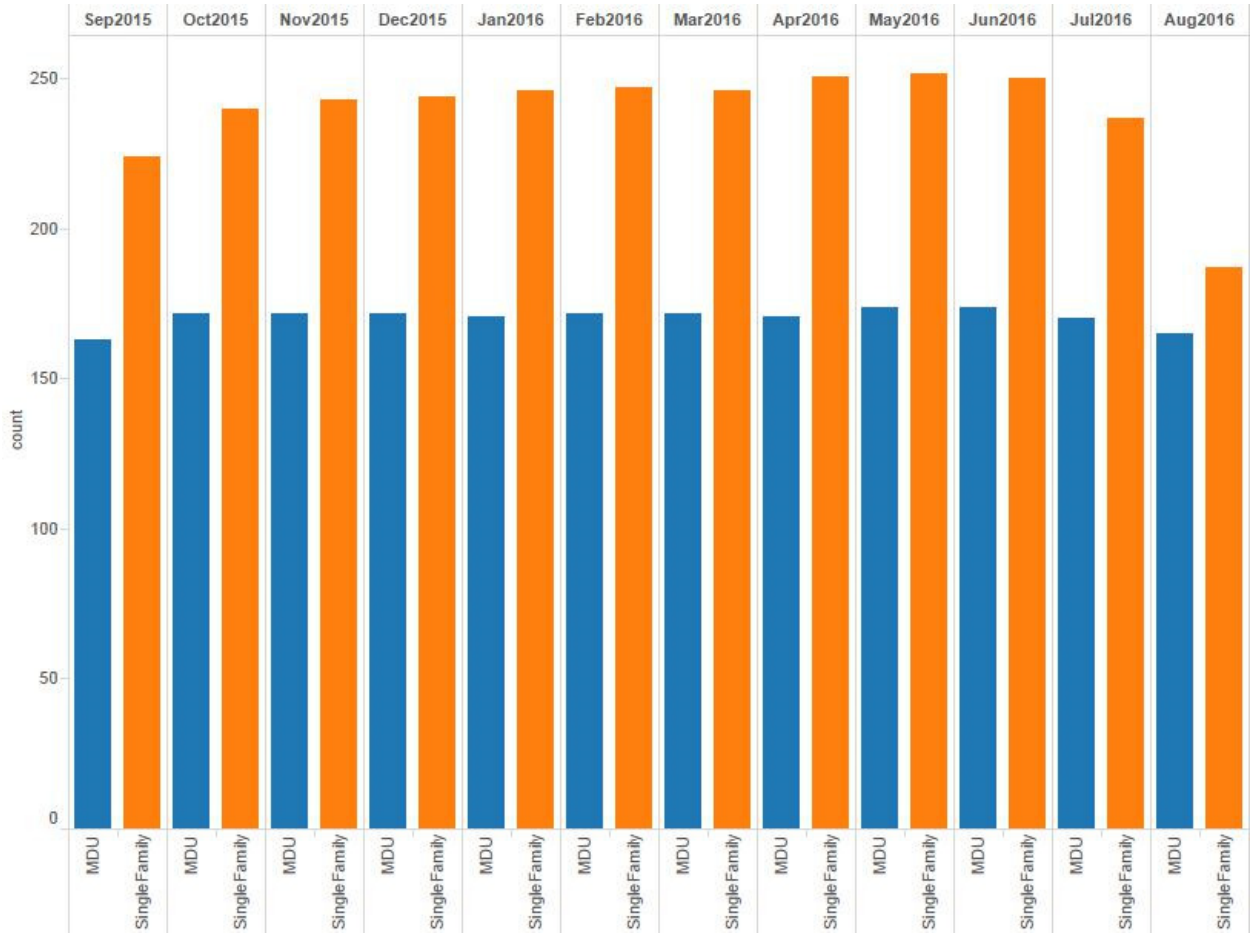
Table PG&E-3: Single Metering DR Program Enrollment by Customer Type

Year	Month	Total Single Metering DR (n)	DR % of Single Metering	DR % of SF Single Metering	DR % of MDU Single Metering
2015	Sept	1,299	6%	6%	7%
2015	Oct	1,286	6%	6%	7%
2015	Nov	1,296	6%	6%	7%
2015	Dec	1,338	6%	6%	7%
2016	Jan	1,356	6%	6%	7%
2016	Feb	1,374	6%	5%	6%
2016	Mar	1,419	6%	5%	6%
2016	Apr	1,444	6%	5%	6%
2016	May	1,457	5%	5%	6%
2016	Jun	1,504	5%	5%	6%
2016	Jul	1,519	5%	5%	6%
2016	Aug	1,545	5%	5%	5%

Separate Metering (EV-B) Rate Growth

All EV-B Customers: The number of customers on the EV-B rate remained relatively flat over the study period, with a decrease near the end of the period (see Chart PG&E-2). This trend shows that separate metering remains a much less popular option for PEV rate customers than single metering.

Chart PG&E-2: Separate Metering Accounts by Customer Type



NEM EV-B Customers: The number of PEV rate customers on EV-B and NEM remained relatively flat during the study period with some small fluctuations. The EV-A rate continues to be the more popular option for PEV customers wishing to offset their charging with DG.

Table PG&E-4: Separate Metering NEM Program Enrollment by Customer Type

Year	Month	Total Separate Metering NEM (n)	NEM % of Separate Metering	NEM % of SF Separate Metering	NEM % of MDU Separate Metering
2015	Sept	13	3%	3%	3%
2015	Oct	13	3%	3%	3%
2015	Nov	13	3%	3%	3%
2015	Dec	15	4%	3%	4%
2016	Jan	15	4%	3%	4%
2016	Feb	15	4%	3%	4%
2016	Mar	15	4%	3%	4%
2016	Apr	15	4%	3%	4%
2016	May	15	3%	3%	4%
2016	Jun	14	3%	3%	4%
2016	Jul	14	3%	3%	4%
2016	Aug	14	3%	3%	4%

DR EV-B Customers: Similar to dual participation in NEM and PEV rates, there was minimal dual participation during the study period in EV-B and a DR program.

Table PG&E-5: Separate Metering DR Program Enrollment by Customer Type

Year	Month	Total Separate Metering DR (n)	DR % of Separate Metering	DR % of SF Separate Metering	DR % of MDU Separate Metering
2015	Sept	1	0%	0%	0%
2015	Oct	1	0%	0%	0%
2015	Nov	1	0%	0%	0%
2015	Dec	1	0%	0%	0%
2016	Jan	1	0%	0%	0%
2016	Feb	1	0%	0%	0%
2016	Mar	1	0%	0%	0%
2016	Apr	1	0%	0%	0%
2016	May	1	0%	0%	0%
2016	Jun	1	0%	0%	0%
2016	Jul	1	0%	0%	0%
2016	Aug	1	0%	0%	0%

Notes of Caution Regarding Reliance upon Load Research Data

The reader should take careful note of the following issues that make the load research data ill-suited for drawing conclusions for policymaking at this time.

1. The PEV owners on the EV-A rates cannot be compared to a similar group of PEV owners not on EV rates. The most accurate and reliable way to measure load impacts is to identify a comparison case, or control group, that represents how customers would have behaved had they not been on the rate or program being measured. In 2015, PG&E conducted a study attempting to identify a control group of EV owners on a non-EV rate (E-1) by testing algorithms to analyze load profiles. To gauge the effectiveness of the algorithm, PG&E sent surveys to a randomly selected subset of 1,500 customers with a high likelihood of owning EVs in order to confirm EV ownership. The results collected through August 2015 indicate that the algorithm has weak predictive power, 31% of survey respondents have thus far confirmed they own an EV, and 69% have indicated they do not. PG&E believes there is room for learning and improvement, but most significantly, more adoption is necessary to reduce the false positive results of the algorithm. Furthermore, the results should be considered in the context of a low incidence rate environment, effectiveness of the test will improve as EV adoption increases. However, these early results demonstrate how difficult it may be to accurately collect data and report metrics related to EVs.
2. The current group of PEV owners is comprised of early adopters who are likely to be materially different than later PEV owners. These differences could include, but are not limited to, income, pre-PEV ownership usage habits, NEM penetration, altruistic tendencies, and willingness to adopt usage patterns beneficial to grid stability.
3. The types of PEVs available in the market fluctuate through the year, suggesting that the types of PEVs owned by PEV rate customers would have changed during that same time frame. New vehicles and charging requirements may lead to changes in charging profiles in the future (i.e., differing charging demands and durations).
4. The study period was relatively short and the customer counts were fairly small in all cases. This is particularly true for EV-B data derived from PG&E's load research sample.
5. The mix of customers being evaluated changed over time due to customers joining or leaving the EV-A or EV-B.
6. While PEV charging for EV-A (single meter) may be fairly obvious if peak customer demand occurs during off-peak rate periods, the lack of on-site survey or enduse- data to help disaggregate other loads from PEV charging prevents the identification of PEV charging in other periods (particularly partial-peak) where multiple significant loads are likely present.

Therefore, while the data collected are illustrative of the behaviors of early adopters based on the types of vehicles that are currently available in the market, one cannot conclude that these behavior patterns will hold as PEV technology matures, as charging technology and charging behaviors evolve, and as PEVs achieve greater market adoption beyond the early adopter phase. Data that is sufficiently reliable for

policymaking can only be obtained via an appropriately funded and carefully designed study that controls for the above issues.

Average Monthly Usage for PEV Rate Customers

Keeping in mind the above cautions about the data collected, Chart PG&E-3 displays the average monthly usage for each EV-A category including NEM customers, which means that the average monthly usage of these categories is net of behind the meter generation. Chart PG&E-4 displays the average monthly usage for each EV-A category but does not include NEM customers. NEM customers are not segregated in the EV-B rate class for Chart PG&E-5 due to much lower penetration.

Chart PG&E-3: Single Metering Average Monthly Usage (kWh) by Customer Type With NEM

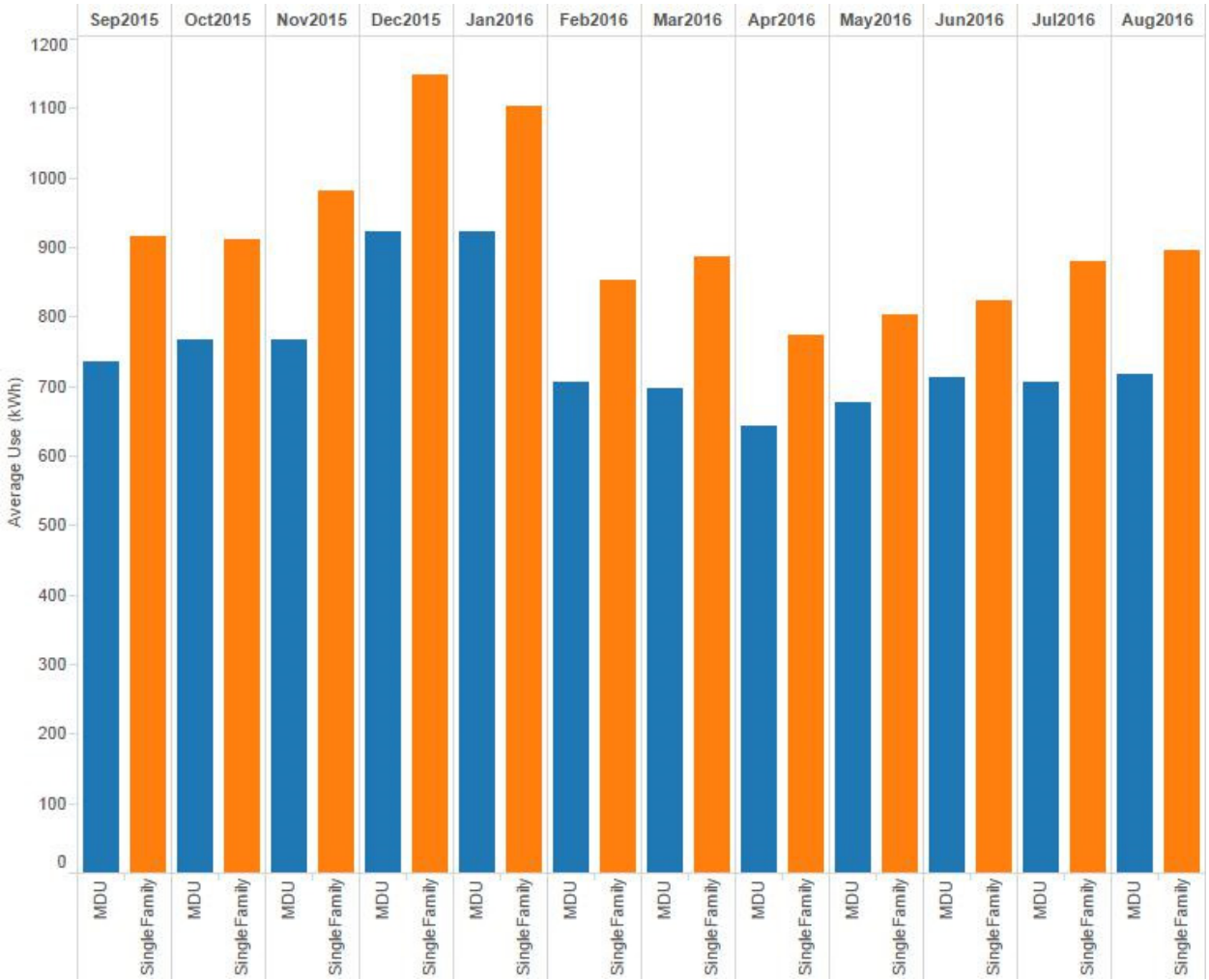
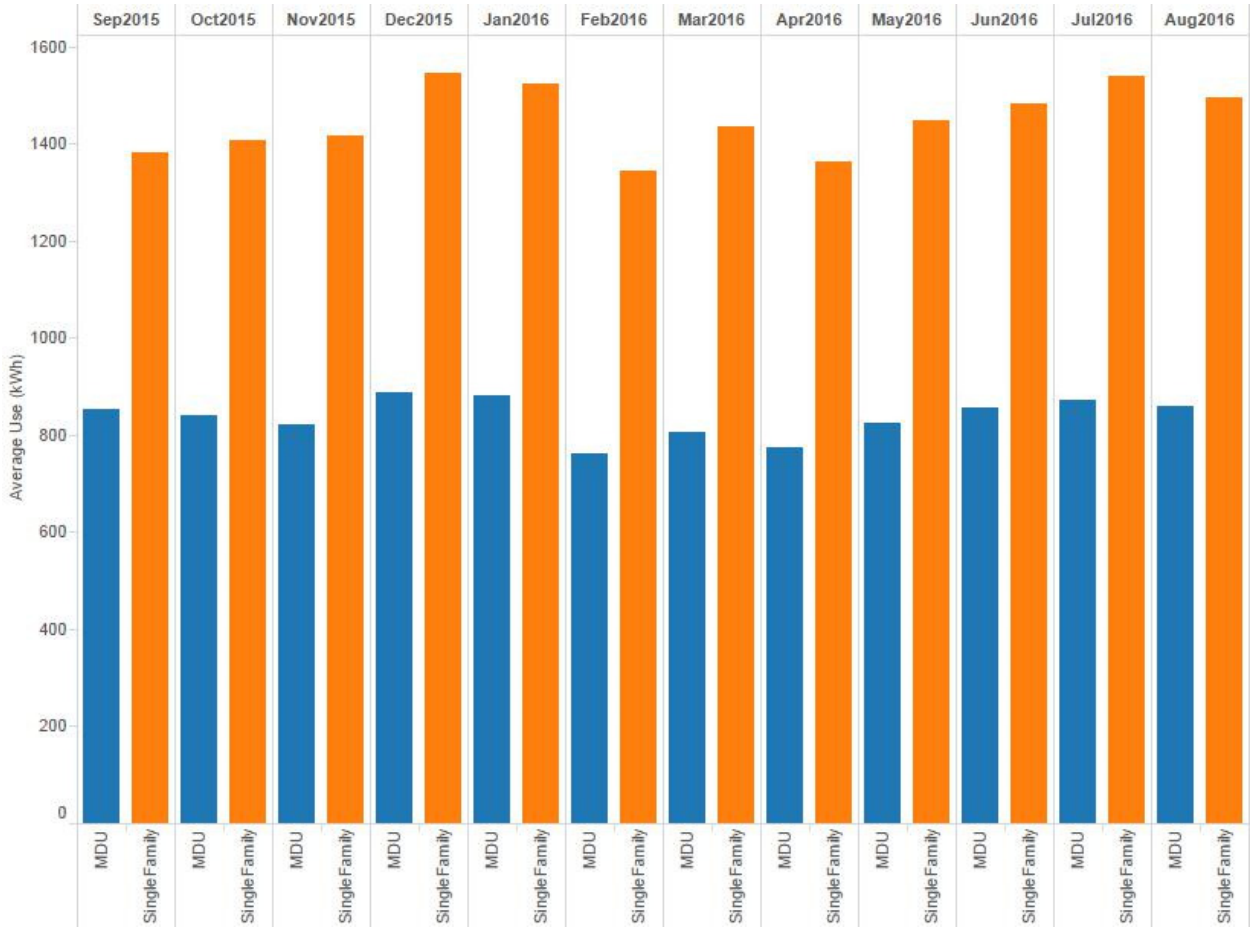
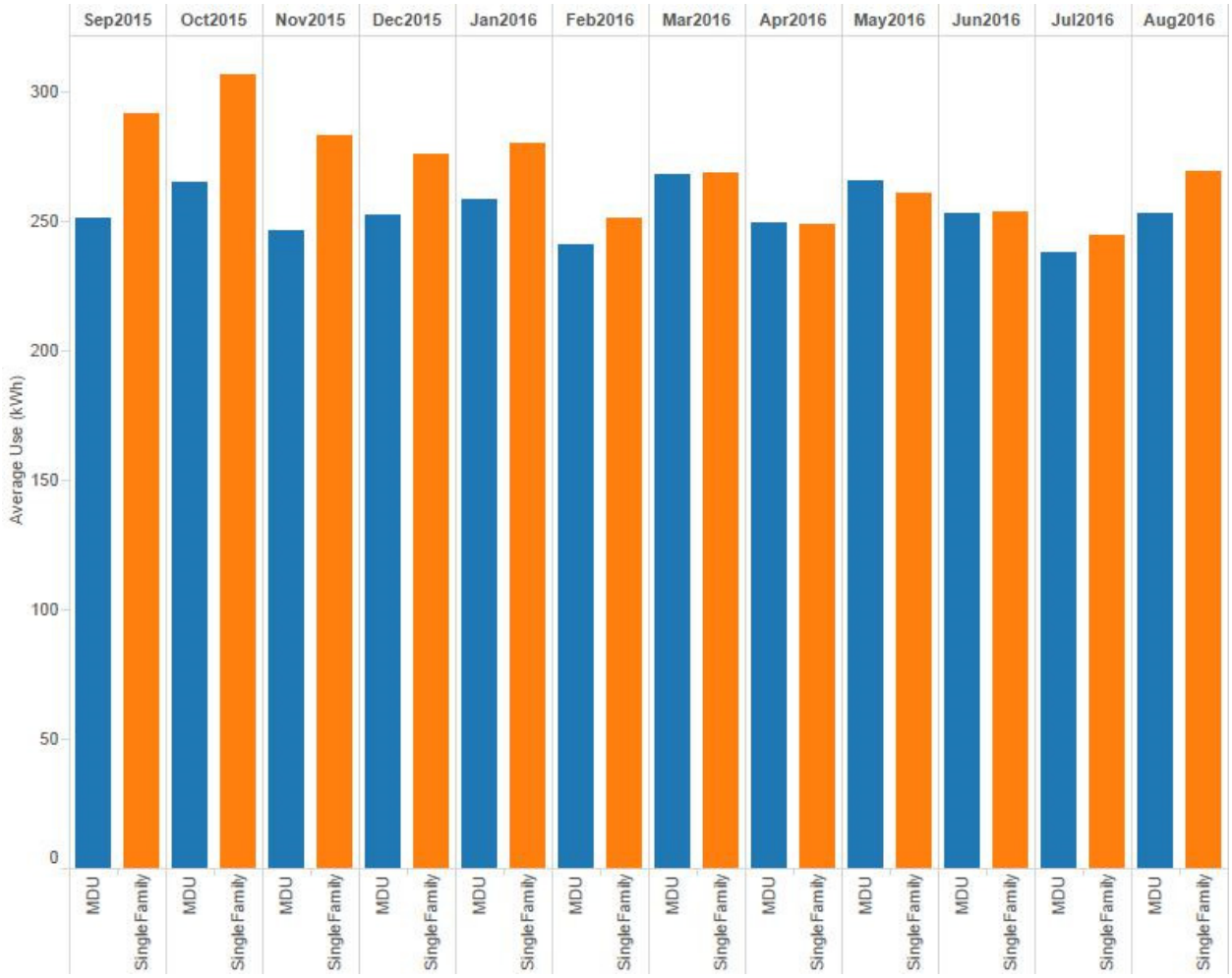


Chart PG&E-4: Single Metering Average Monthly Usage (kWh) by Customer Type Without NEM



A comparison of Charts PG&E 3 and 4 reveals an unsurprising result for both sectors: absent the NEM accounts, usage is flatter for both PEV rate customers throughout the study period. This result demonstrates that offsetting consumption with behind-the-meter generation obfuscates researchers' ability to parse PEV load from other site loads for NEM customers using their consumption data alone.

Chart PG&E-5: Separate Metering Average Monthly Usage (kWh) by Customer Type



The results depicted in Chart PG&E-5 demonstrate that absent other loads on the meter, researchers can better observe that PEV rate customers' total charging amount remains relatively consistent over time.

Average Usage during Time of Use Periods

TOU PEV rates are designed to discourage charging during on-peak hours and instead encourage charging during off-peak hours when the grid is less stressed and generation costs are lower. For both EV-A and EV-B customers, the time of use periods are defined in Table PG&E-1a.

One useful way to determine whether the TOU PEV rates are achieving their goal of avoiding peak PEV charging is to measure the distribution of charging in the various time periods. Given that NEM customers have a very unique usage profile, they are segregated from all other EV-A customers groups in Tables PG&E-6, 7 and 8.

- Table PG&E-6 shows the EV-A and EV-B customers share of peak usage by sector, with and without NEM, compared to the peak usage of PG&E's entire residential population. Non-NEM customers on EV-A used an average of 10% less energy during the peak period than the average PG&E residential customer and NEM customers on EV-A used 13% less energy than the residential population. Likewise non-NEM customers on EV-B used an average of 24% less energy during the peak period, and NEM customers on EV-B used 4% less than the residential population. As previously noted the small customer population of NEM customers on EV-B detracts from the meaningfulness of results produced by its data. Because the goal of PEV rates is to encourage customers to charge their vehicles during off-peak hours, the fact that PEV rate customers' peak period usage is reasonably below that of all residential customers indicates that the rates are not having an adverse effect on PEV customers' usage. Consequently, the EV TOU rates are achieving their goal among this group of early PEV adopters by avoiding PEV charging during the peak period.
- Table PG&E-7 shows the EV-A and EV-B customers share of off-peak usage by sector, with and without NEM, compared to the off-peak usage of PG&E's entire residential population. Consistent with performance expectations for customers on EV rates, during the study period, non-NEM customers on EV-A used an average of 13% more energy than the average PG&E residential customer and NEM customers on EV-A used 30% more energy than the residential population. Likewise, non-NEM customers on EV-B used an average of 43% more energy off-peak and NEM customers on EV-B used 25% more than the residential population. Consequently, all groups met the off-peak performance expectations for their EV TOU rate by consuming more energy during this period than non-PEV customers.
- Table PG&E-8 shows the EV-A and EV-B customers share of partial peak usage by sector, with and without NEM, compared to the partial peak usage of PG&E's entire residential population. During the study period non-NEM customers on EV-A used an average of 4% less energy than the average PG&E residential customer during partial peak periods, and NEM customers on EV-A used 17% less energy than the residential population. Non-NEM customers on EV-B used an average of 19% less energy during partial peak periods, and NEM customers on EV-B used 21% less than the residential population. These groups met the performance expectations for their EV TOU rate by consuming less energy during the partial peak period than non-PEV customers.

Collectively, the data Tables PG&E-6, 7 and 8 show that for both EV-A and EV-B customers a smaller percentage of their usage is in on-peak and a larger percentage is in off-peak as compared to customers not on a PEV rate. Furthermore, non-NEM separately-metered EV-B customers are completing 86% of their charging in the off-peak period on average and only 7% on average during the on-peak period. This suggests that customers on the PEV rates are responding to the price signal embedded in their rates and charging during the off-peak periods.

Table PG&E-6: Share of On-Peak Usage by Tariff and Customer Type

Year	Month	Total Residential Population*	All Single Metering, excluding NEM	SF Single Metering, excluding NEM	MDU Single Metering, excluding NEM	Single Metering NEM	All Separate Metering, excluding NEM	SF Separate Metering, excluding NEM	MDU Separate Metering, excluding NEM	Separate Metering NEM
2015	Sep	34%	22%	22%	23%	18%	7%	6%	9%	27%
2015	Oct	31%	21%	21%	22%	20%	7%	6%	9%	26%
2015	Nov	28%	21%	21%	22%	25%	7%	7%	7%	32%
2015	Dec	29%	22%	22%	22%	26%	7%	6%	8%	31%
2016	Jan	28%	21%	21%	22%	24%	8%	6%	9%	28%
2016	Feb	28%	20%	20%	21%	21%	7%	5%	9%	26%
2016	Mar	28%	21%	21%	22%	18%	7%	5%	9%	22%
2016	Apr	29%	20%	20%	20%	9%	7%	5%	10%	14%
2016	May	28%	20%	20%	21%	10%	6%	5%	9%	23%
2016	Jun	35%	22%	22%	22%	12%	6%	5%	8%	29%
2016	Jul	36%	23%	23%	23%	15%	7%	6%	7%	37%
2016	Aug	35%	22%	22%	23%	15%	6%	5%	7%	30%
Max		36%	23%	23%	23%	26%	8%	7%	10%	37%
Average		31%	21%	21%	22%	18%	7%	6%	9%	27%

* Load data used for the analysis are from January 2015 to December 2015.

Table PG&E-7: Share of Off-Peak Usage by Tariff and Customer Type

Year	Month	Total Residential Population*	All Single Metering, excluding NEM	SF Single Metering, excluding NEM	MDU Single Metering, excluding NEM	Single Metering NEM	All Separate Metering excluding NEM	SF Separate Metering, excluding NEM	MDU Separate Metering, excluding NEM	Separate Metering NEM
2015	Sep	41%	56%	56%	56%	73%	85%	86%	84%	72%
2015	Oct	42%	56%	56%	56%	72%	84%	85%	83%	67%
2015	Nov	48%	57%	57%	58%	66%	84%	84%	85%	61%
2015	Dec	44%	57%	57%	57%	62%	86%	87%	84%	58%
2016	Jan	46%	56%	56%	56%	63%	85%	87%	83%	54%
2016	Feb	45%	58%	58%	58%	70%	87%	89%	83%	69%
2016	Mar	44%	56%	56%	56%	74%	83%	85%	81%	73%
2016	Apr	42%	57%	57%	57%	82%	85%	88%	81%	85%
2016	May	47%	57%	57%	57%	82%	87%	90%	83%	75%
2016	Jun	38%	56%	56%	56%	80%	88%	90%	85%	68%
2016	Jul	37%	55%	55%	55%	77%	87%	88%	85%	62%
2016	Aug	42%	55%	55%	55%	76%	87%	89%	85%	69%
Max		48%	58%	58%	58%	82%	88%	90%	85%	85%
Average		43%	56%	56%	57%	73%	86%	87%	83%	68%

* Load data used for the analysis are from January 2015 to December 2015.

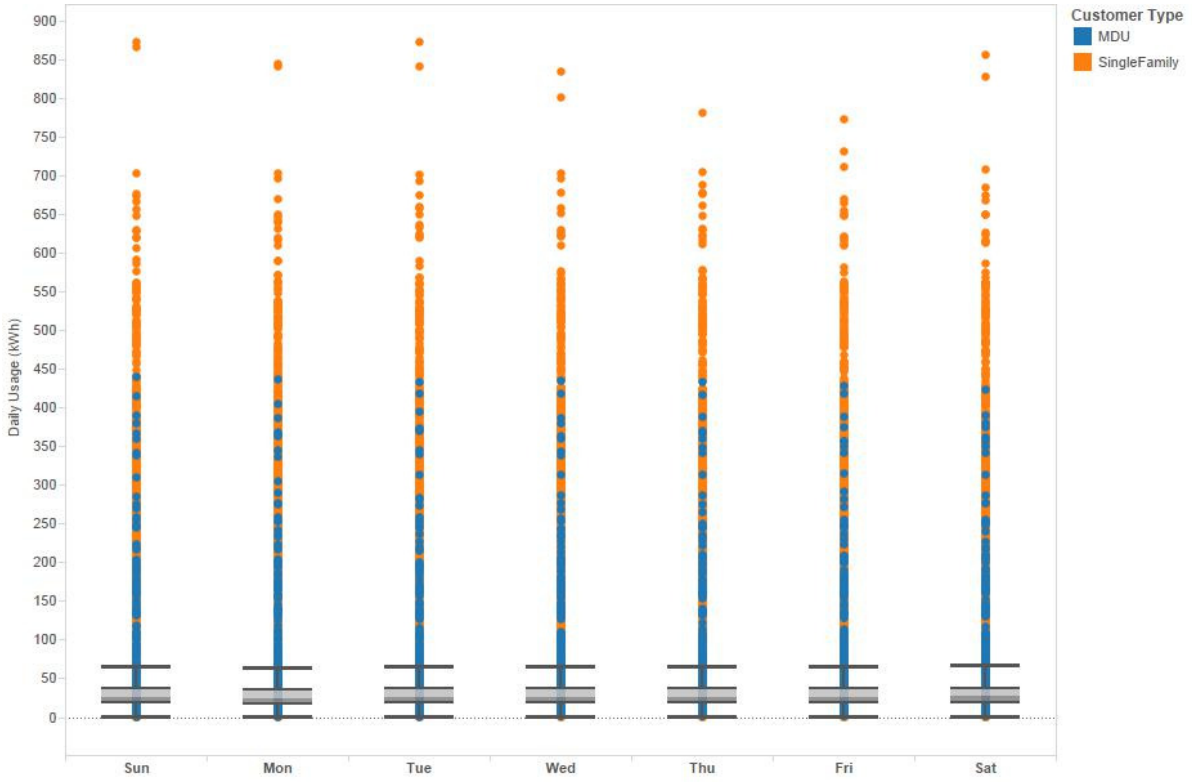
Table PG&E-8: Share of Partial-Peak Usage by Tariff and Customer Type

Year	Month	Total Residential Population*	All Single Metering, excluding NEM	SF Single Metering, excluding NEM	MDU Single Metering, excluding NEM	Single Metering NEM	All Separate Metering excluding NEM	SF Separate Metering, excluding NEM	MDU Separate Metering, excluding NEM	Separate Metering NEM
2015	Sep	25%	22%	22%	21%	9%	8%	8%	7%	1%
2015	Oct	27%	23%	23%	22%	9%	9%	9%	8%	7%
2015	Nov	24%	21%	21%	21%	9%	9%	9%	7%	7%
2015	Dec	27%	22%	22%	21%	12%	7%	6%	7%	12%
2016	Jan	26%	23%	23%	22%	12%	7%	7%	8%	18%
2016	Feb	26%	22%	22%	21%	9%	6%	6%	7%	5%
2016	Mar	28%	23%	23%	22%	7%	10%	9%	10%	5%
2016	Apr	29%	24%	24%	22%	8%	8%	7%	9%	1%
2016	May	25%	23%	23%	22%	8%	6%	5%	8%	2%
2016	Jun	26%	22%	23%	22%	8%	6%	5%	7%	2%
2016	Jul	27%	23%	23%	22%	8%	7%	6%	8%	1%
2016	Aug	24%	23%	23%	22%	9%	7%	6%	8%	1%
Max		29%	24%	24%	22%	12%	10%	9%	10%	18%
Average		26%	23%	23%	22%	9%	7%	7%	8%	5%

* Load data used for the analysis are from January 2015 to December 2015.

Chart PG&E-6 displays a box and whisker plot for energy consumption (kilowatthours- (kWh)) by customer type and day of the week. Looking past the outliers with usage above 65 kWh/day (the approximate value for the upper whisker for each day of the week), the similarity of the interquartile range values depicted by the "boxes" below demonstrate that daily differentiation between average consumption is minimal.

Chart PG&E-6: Box & Whisker Plot for Energy Consumption (kWh) by Customer Type and Day of Week (Sunday through Saturday)



Average Load Profiles for PEV Rates

Depicted below are the average daily load profiles for the EV-A and EV-B rate groups for each sector during the study period. The load profiles demonstrate that for all rates and sectors, high off-peak usage corresponds to the PEV rate price signals, i.e., customers are largely responding to the price signal and charging during off-peak hours (11:00 a.m. to 7:00 a.m. with a bulk of the load occurring from 12:00 a.m. to 5:00 a.m.). This responsiveness is more clearly depicted in the data from the EV-B customers (Chart PG&E-8) where the vast majority of the usage occurs during off-peak hours.

Chart PG&E-7a: Average Load Profile for SF Single Metering by Day of the Week

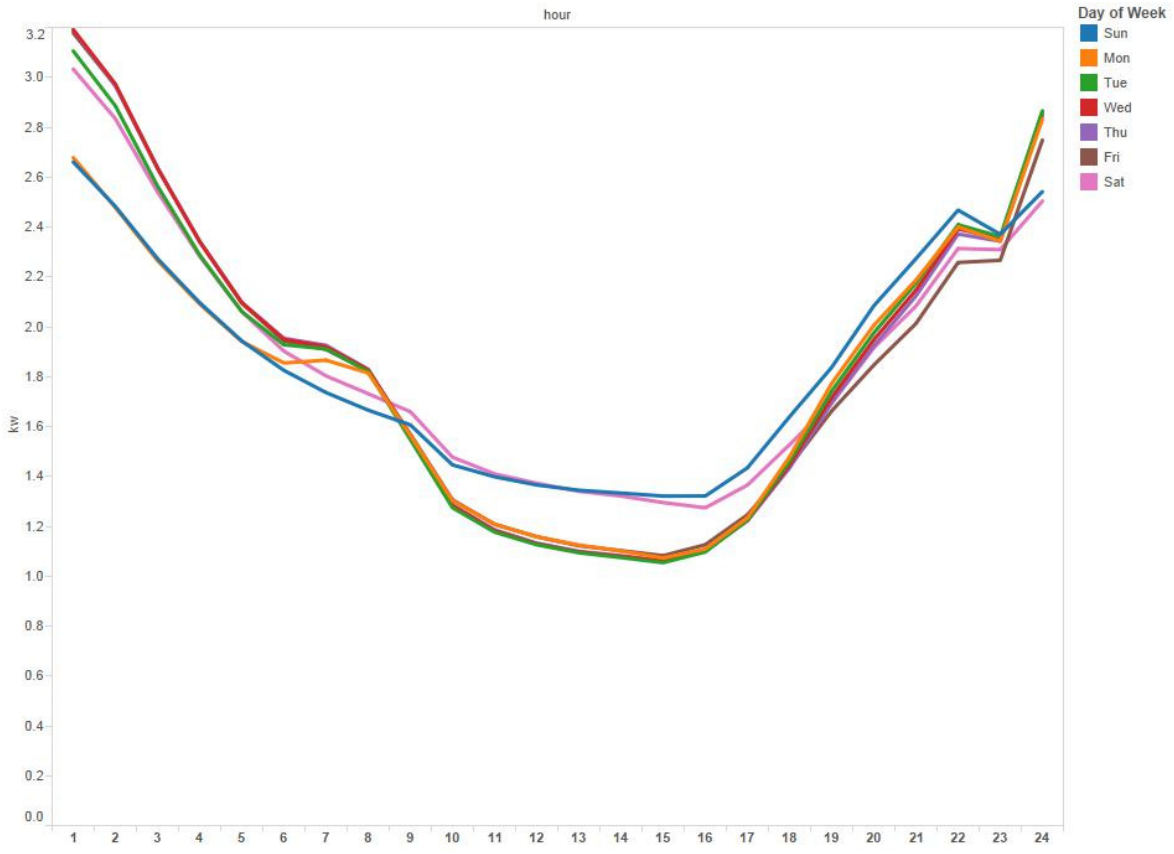


Chart PG&E-7b: Average Load Profile for MDU Single Metering by Day of the Week

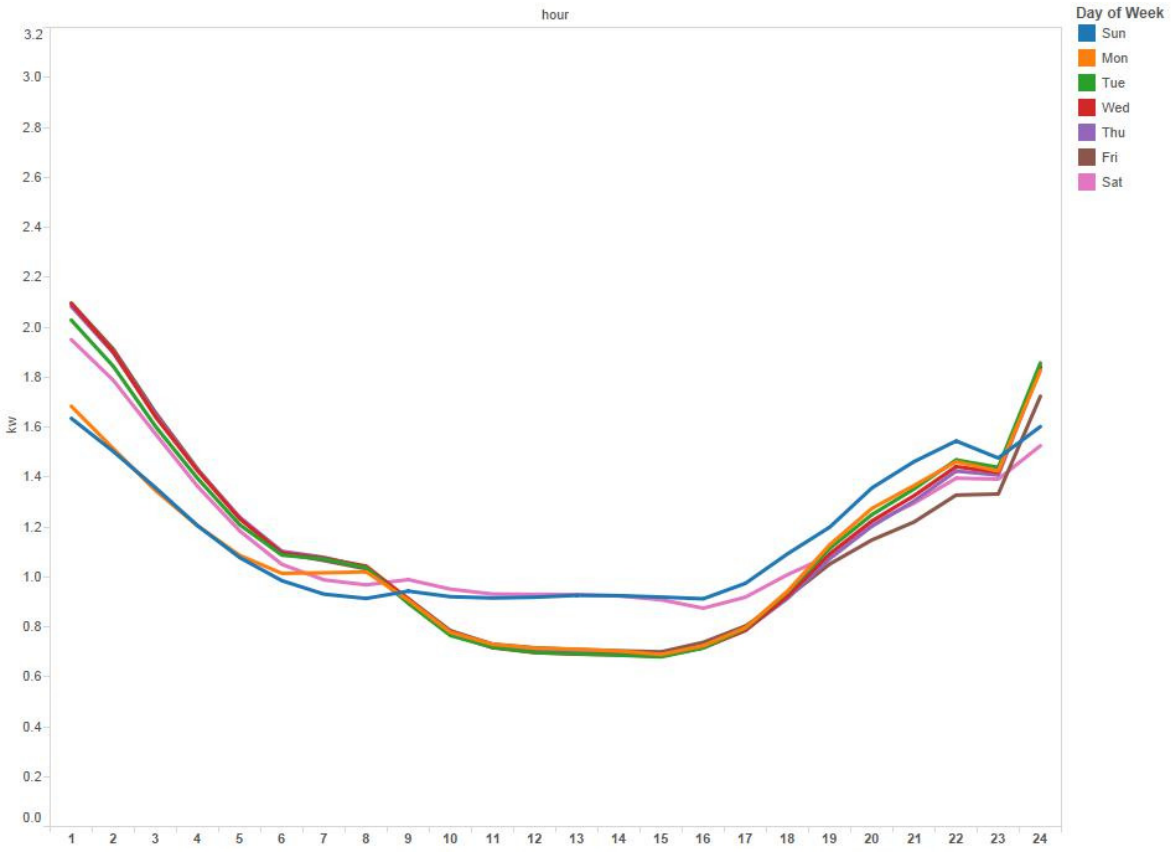
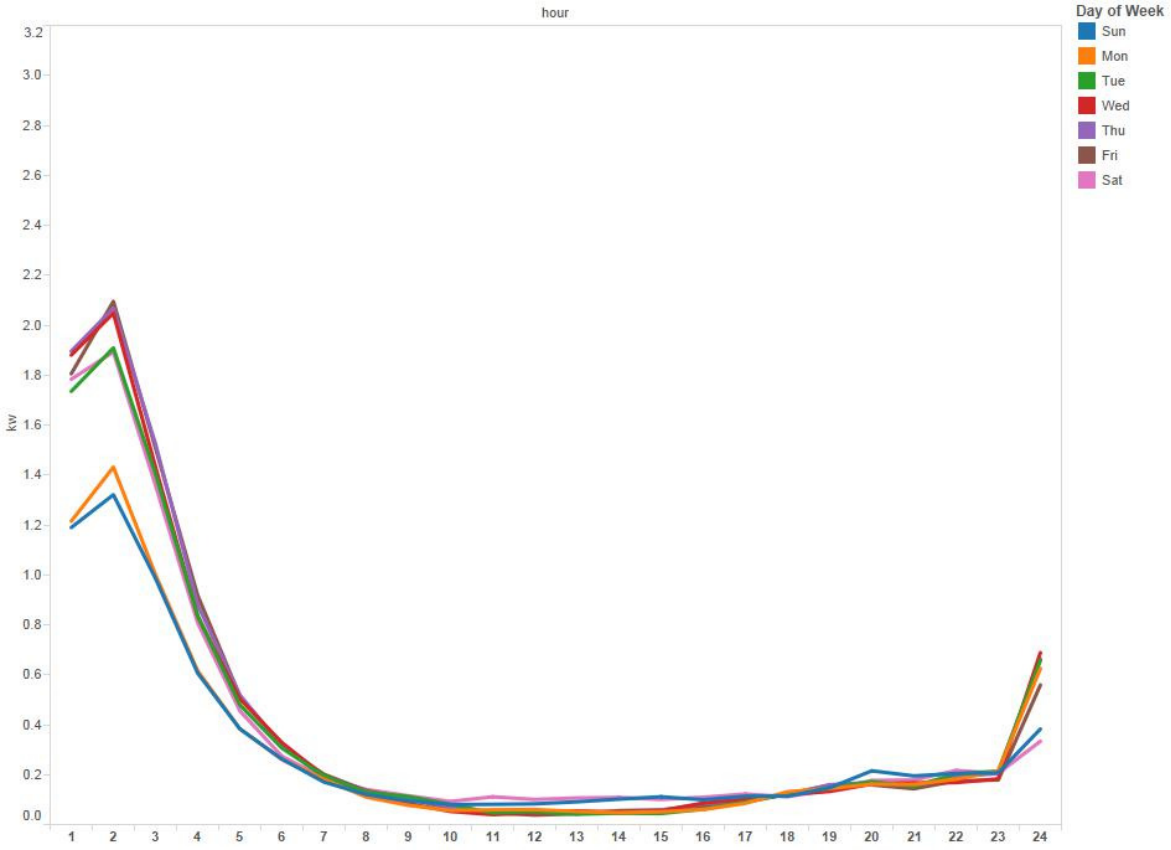


Chart PG&E-8: Average Load Profile for SF Separate Metering by Day of the Week



Non-Coincident Peak Load

Collectively, the data in Table PG&E-9 and Charts 10a, 10b, 11a, and 11b suggest that, even though charging is primarily occurring in the off-peak hours, the average household with a PEV will have a higher maximum demand that must be accommodated by the electric distribution system as compared to the average household without a PEV.

- Table PG&E-9 shows the monthly comparison of the average non-coincident peak for the EV-A and EV-B customer sectors and the full residential population. The average non-coincident peak was 4.08 kW higher for the EV-A group category compared to the average residential peak.[38] This was 3.61 kW higher for single family customers and 3.74 kW higher for multi-family customers. The average non-coincident peak was 3.20 kW higher for the EV-B group category compared to the average residential peak.
- Charts PG&E-9a and 9b display the average monthly non-coincident peak loads for EV-A and EV-B customers, respectively.
- Charts PG&E-10a and 10b display the hour at which the non-coincident peak load occurred for EV-A and EV-B customers, respectively. The accompanying table provides the data points depicted in each chart.

[38] The average non-coincident peak was calculated by denoting the maximum hourly interval for each account within the month. These maximum values were then summed for each category. The average is then calculated by dividing the total by the number of customers. The average non-coincident peak is therefore an approximation of the maximum demand for customer in each stratum.

Table PG&E-9: Monthly Average Non-Coincident Peak Load (kW)

Year	Month	Residential Population*	Single Family Population*	MDU Population*	All Single Metering	Single Family Single Metering	MDU Single Metering	All Separate Metering	Single Family Separate Metering	MDU Separate Metering
2015	Sep	4.15	4.85	2.54	8.22	8.37	6.52	6.97	*7.45*	6.32
2015	Oct	3.76	4.35	2.41	7.86	8.00	6.20	7.05	*7.52*	6.39
2015	Nov	3.92	4.51	2.56	7.97	8.13	6.21	6.94	*7.39*	6.31
2015	Dec	4.22	4.87	2.73	8.22	8.37	6.42	7.03	7.67	6.12
2016	Jan	3.89	4.46	2.57	8.04	8.19	6.30	7.03	*7.61*	6.19
2016	Feb	3.60	4.12	2.40	7.73	7.88	5.99	7.06	7.59	6.30
2016	Mar	3.54	4.05	2.37	7.69	7.83	5.97	7.09	7.37	6.70
2016	Apr	3.54	4.04	2.39	7.66	7.79	6.01	7.17	7.45	6.76
2016	May	3.66	4.17	2.47	7.95	8.10	6.15	7.42	7.84	6.80
2016	Jun	4.23	4.98	2.50	8.30	8.46	6.43	7.26	7.52	6.89
2016	Jul	4.29	5.05	2.53	8.33	8.49	6.37	7.12	7.32	6.85
2016	Aug	4.26	5.02	2.54	8.03	8.17	6.27	7.30	8.03	6.48
Average		3.92	4.54	2.50	8.00	8.15	6.24	7.12	7.56	6.51

* Load data used for the analysis are from January 2015 to December 2015.

** Italicized fields are estimates with a precision greater than +/- 10% at a 90% confidence interval.

Chart PG&E-9a: Average Non-Coincident Peak Load (kW) for Single Metering by Customer Type by Month

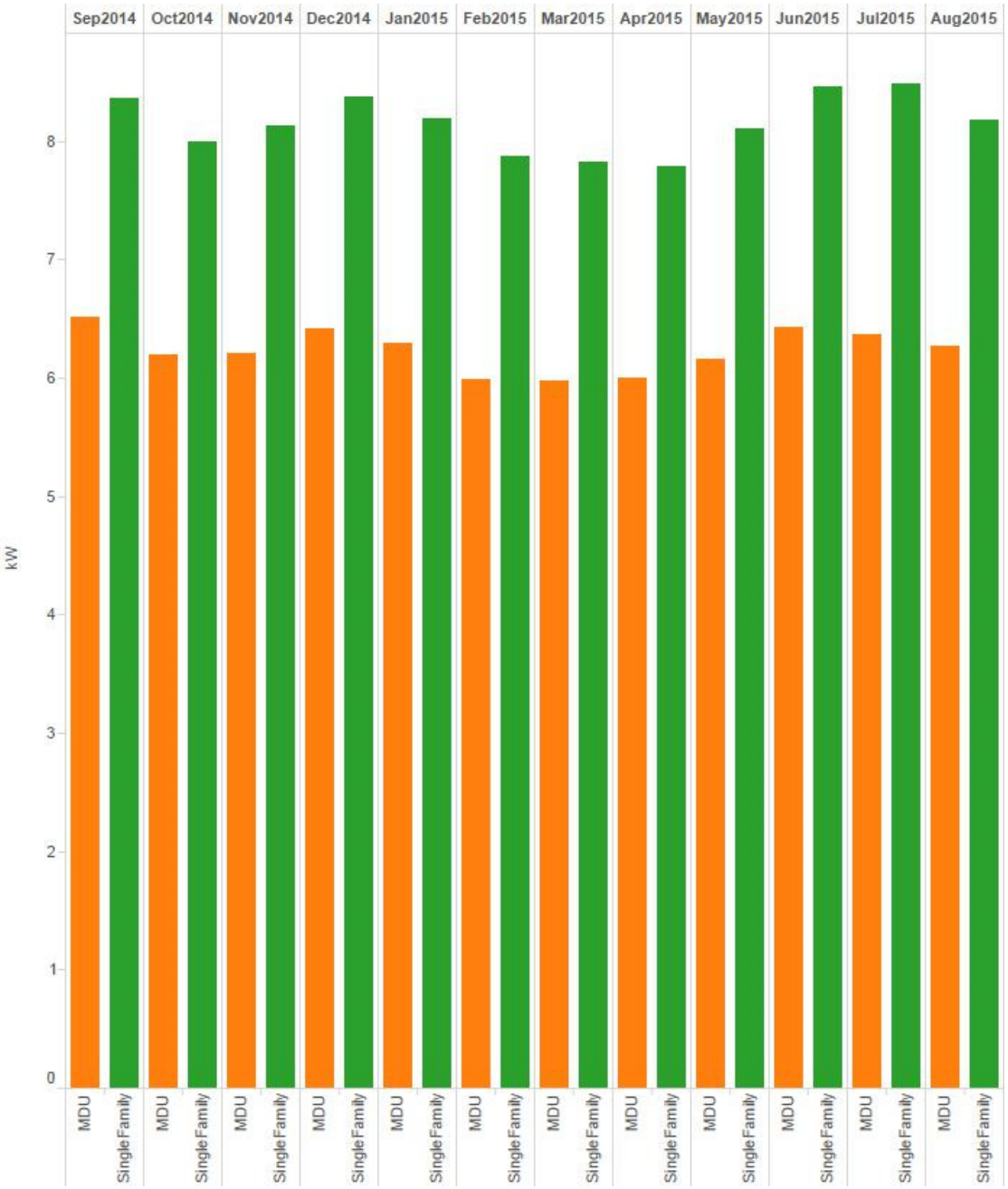


Chart PG&E-9b: Average Non-Coincident Peak Load (kW) for Separate Metering by Customer Type by Month

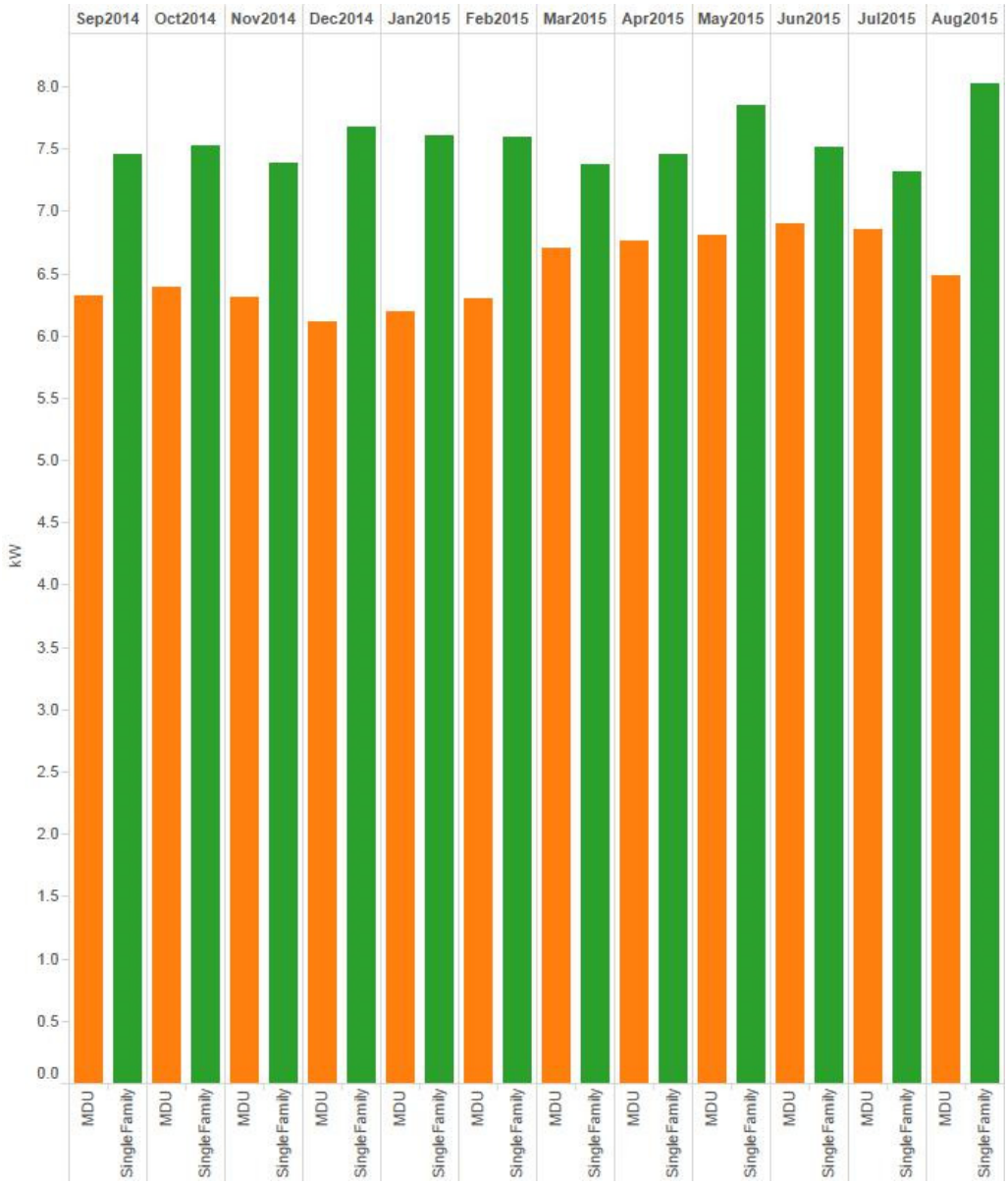


Chart PG&E-10a: Histogram of the Hour at Which the Non-Coincident Peak Load Occurred for Single Metering by Customer Type

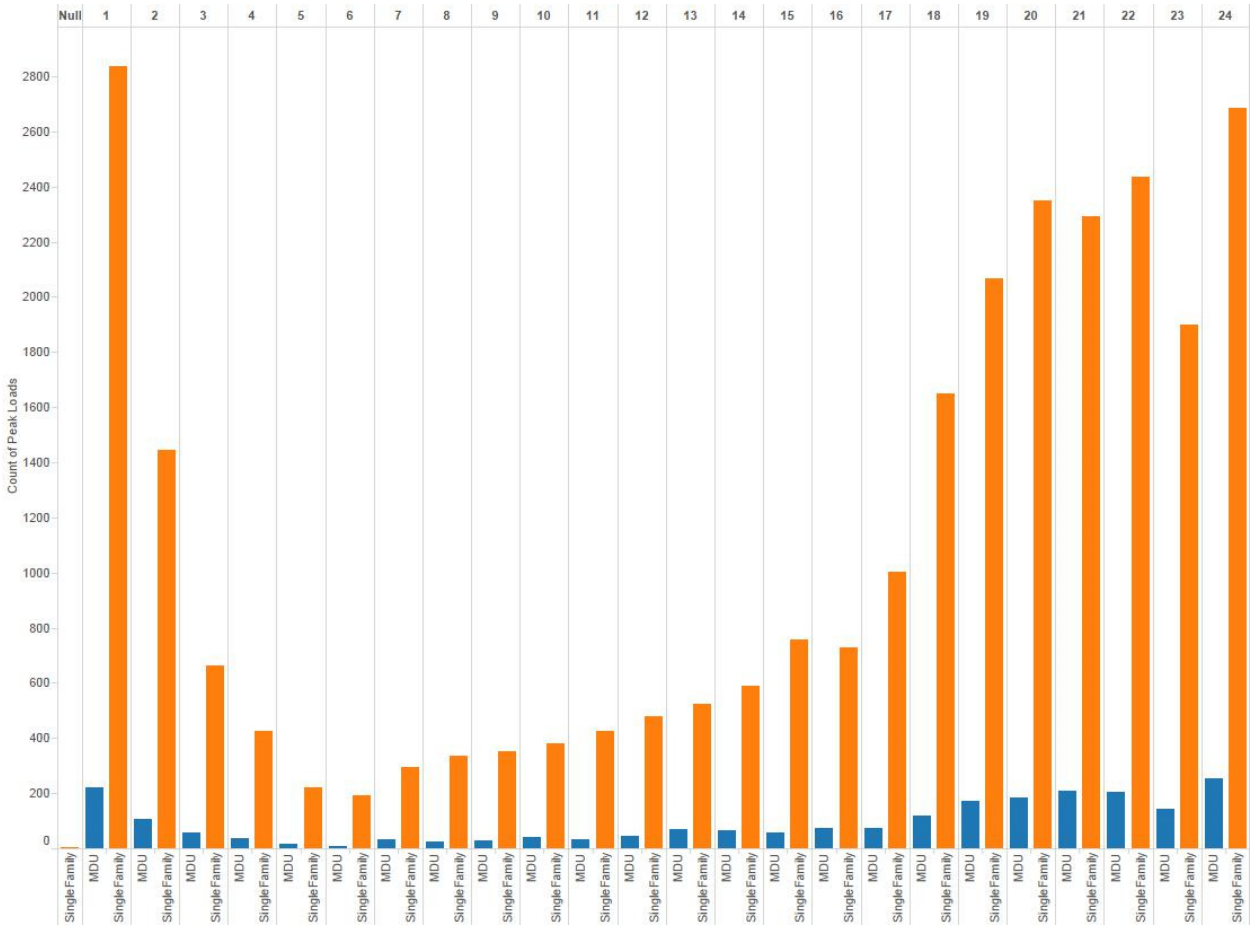
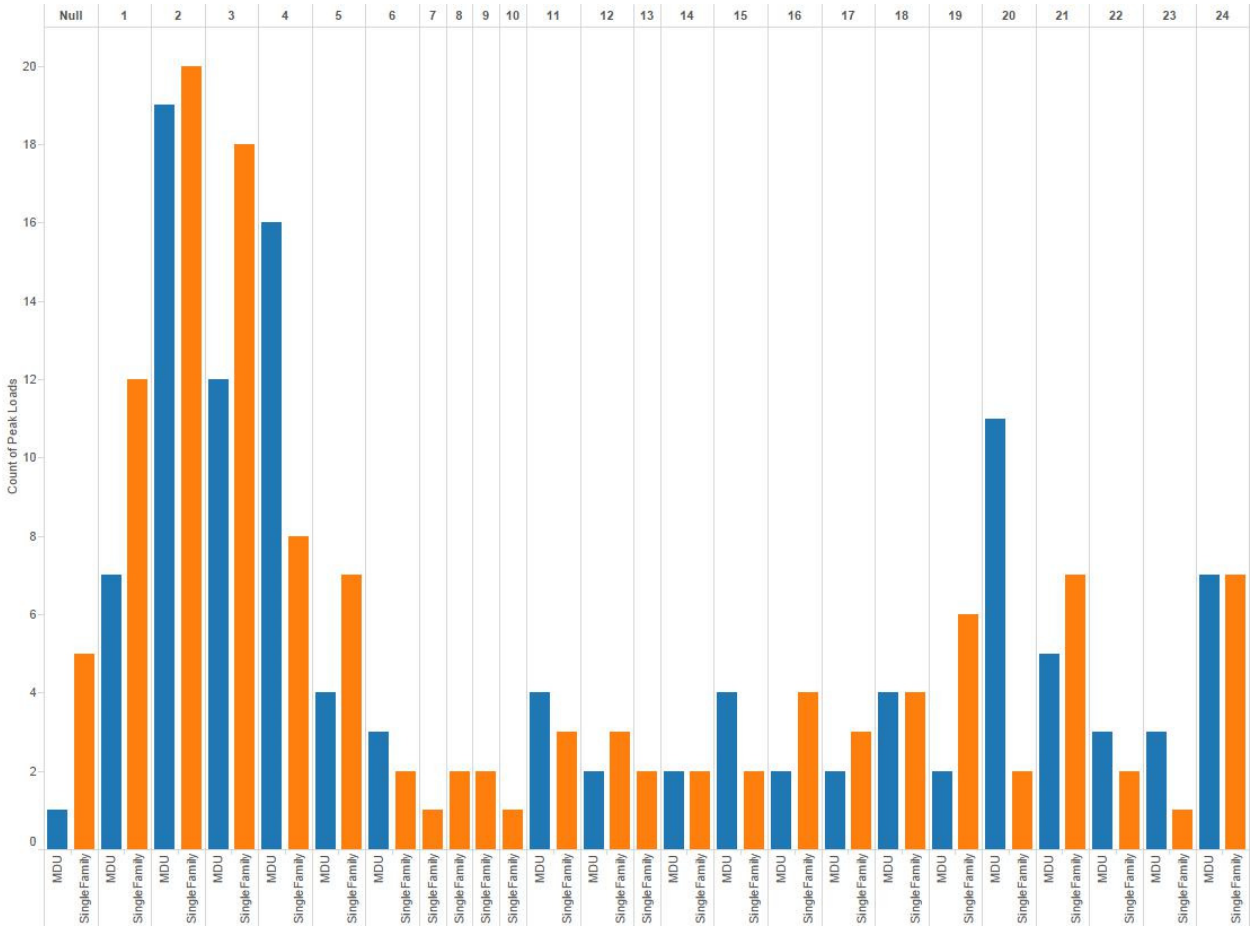


Chart PG&E-10b: Histogram of the Hour at Which the Non-Coincident Peak Load Occurred for Separate Metering by Customer Type


Null
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22
23
24
Count of Peak Loads
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2
4
6
8
10
12
14
16
18
20
MDU
SingleFamily

Data Accompanying Charts PG&E 10a and 10b

Peak Hour	Residential Population	Single Family Population	MDU Population	All Single Metering	SF Single Metering	MDU Single Metering	All Separate Metering	SF Separate Metering	MDU Separate Metering
1	1%	1%	1%	10%	11%	10%	8%	10%	6%
2	1%	1%	1%	5%	5%	5%	16%	16%	17%
3	1%	1%	1%	2%	2%	3%	13%	14%	11%
4	0%	0%	0%	2%	2%	2%	10%	6%	14%
5	0%	0%	0%	1%	1%	1%	5%	6%	4%
6	0%	0%	1%	1%	1%	0%	2%	2%	3%
7	1%	1%	1%	1%	1%	1%	0%	1%	0%
8	2%	2%	1%	1%	1%	1%	1%	2%	0%
9	2%	2%	2%	1%	1%	1%	1%	2%	0%
10	2%	2%	2%	1%	1%	2%	0%	1%	0%
11	2%	2%	2%	2%	2%	1%	3%	2%	4%
12	2%	2%	3%	2%	2%	2%	2%	2%	2%
13	2%	3%	1%	2%	2%	3%	1%	2%	0%
14	3%	3%	3%	2%	2%	3%	2%	2%	2%
15	3%	3%	2%	3%	3%	3%	3%	2%	4%
16	4%	4%	3%	3%	3%	3%	3%	3%	2%
17	5%	5%	7%	4%	4%	3%	2%	2%	2%
18	9%	9%	9%	6%	6%	5%	3%	3%	4%
19	14%	14%	12%	8%	8%	8%	3%	5%	2%
20	15%	15%	14%	9%	9%	8%	5%	2%	10%
21	13%	13%	13%	9%	8%	9%	5%	6%	4%
22	9%	9%	10%	9%	9%	9%	2%	2%	3%
23	6%	5%	6%	7%	7%	6%	2%	1%	3%
24	3%	3%	3%	10%	10%	11%	6%	6%	6%

Diversified Peak Load

The time of diversified peak load gives the time that the group peaks as a whole. The time of diversified (or group) peak load is generally the same for all categories of EV-A and EV-B customers. Table PG&E-10 shows that the diversified peak load occurs between 1am to 2 am for all categories in all months for both EV rates. This suggests that the early adopter group of customers on the PEV rates is charging during the off-peak periods thereby achieving the intent of the rate designs.

Table PG&E-10: Time and Associated Demand of Diversified Peak Load – Entire Residential Population

Year	Month	Residential Population Demand*	Residential Population Hour*	SF Population Demand*	SF Population Hour*	MDU Population Demand*	MDU Population Hour*
2015	Sep	1.59	19	1.88	19	0.94	19
2015	Oct	1.20	20	1.40	20	0.76	20
2015	Nov	1.18	20	1.35	20	0.78	20
2015	Dec	1.24	19	1.44	19	0.81	20
2016	Jan	1.17	20	1.35	20	0.78	19
2016	Feb	0.99	20	1.14	20	0.65	19
2016	Mar	0.96	20	1.10	20	0.65	20
2016	Apr	0.96	21	1.10	21	0.64	21
2016	May	0.97	19	1.09	18	0.69	19
2016	Jun	1.71	19	2.02	19	0.98	19
2016	Jul	1.67	19	2.01	19	0.91	19
2016	Aug	1.73	19	2.06	19	0.99	19

Table PG&E-10 (Cont'd): Time and Associated Demand of Diversified Peak Load – Single Meter EV

Year	Month	Single Metering Demand	Single Metering Hour	Single Family Single Metering Demand	Single Family Single Metering Hour	MDU Single Metering Demand	MDU Single Metering Hour
2015	Sep	3.41	1	3.50	1	2.38	1
2015	Oct	3.20	1	3.28	1	2.32	1
2015	Nov	3.25	1	3.33	1	2.27	1
2015	Dec	3.37	1	3.47	1	2.31	1
2016	Jan	3.28	1	3.37	1	2.29	1
2016	Feb	3.26	1	3.35	1	2.23	1
2016	Mar	3.24	1	3.33	1	2.20	1
2016	Apr	3.06	1	3.14	1	2.13	1
2016	May	3.19	1	3.27	1	2.19	1
2016	Jun	3.33	1	3.41	1	2.26	1
2016	Jul	3.34	1	3.42	1	2.29	1
2016	Aug	3.15	1	3.24	1	2.12	1

Table PG&E-10 (Cont'd): Time and Associated Demand of Diversified Peak Load – Separate Meter EV

Year	Month	Separate Metering Demand	Separate Metering Hour	Single Family Separate Metering Demand	Single Family Separate Metering Hour	MDU Separate Metering Demand	MDU Separate Metering Hour
2015	Sep	*2.54*	2	*2.81*	2	*2.39*	1
2015	Oct	*2.25*	2	*2.48*	2	*2.42*	2
2015	Nov	*2.36*	2	*2.60*	2	2.36	1
2015	Dec	*2.47*	1	*2.81*	1	*2.30*	2
2016	Jan	*2.42*	2	*2.79*	2	*2.18*	1
2016	Feb	*2.35*	2	*2.84*	2	*2.22*	1
2016	Mar	*2.56*	2	*3.02*	2	*2.36*	1
2016	Apr	*2.31*	2	*2.61*	2	2.21	1
2016	May	*2.33*	2	*2.63*	2	*2.29*	1
2016	Jun	*2.37*	2	*2.52*	2	*2.27*	1
2016	Jul	*2.01*	2	*2.26*	1	*1.93*	1
2016	Aug	2.20	2	*2.35*	2	*2.32*	1

* Load data used for the analysis are from January 2015 to December 2015.

** Italicized fields are estimates with a precision greater than +/- 10% at a 90% confidence interval.

Taken together, Table PG&E-10 and Data Accompanying Charts PG&E 10a and 10b suggest that although the early adopter PEV customers may have a higher average maximum demand, those customers on the PEV rates tend to hit their maximum demand while non-PEV customers are at their lowest usage. Thus, there is a diversity benefit created by the TOU rates. However, at the most local service assessment level perspective (i.e., a single household or set of households serviced by a single transformer), the value of this diversity is limited by the fact that the distribution system must still be prepared to accommodate PEV charging during the peak period since these customers can, and occasionally do, charge during those times.

Average Load Coincident With System Peak

The average load coincident with system peak is the average load occurring at the same time that the system peak occurs. The system peak days and times were used to extract the appropriate hourly load at the time of system peak. The average group load coincident with system peak was calculated taking the total group load and dividing by the number of customers.

The average load coincident with system peak amongst the general population is similar to that of each EV-A category, and much higher than that of each EV-B category (See Table PG&E-11). This suggests that, for this particular group of early adopters, customers on a PEV rate are not doing a substantial amount of charging during the on-peak period.

Table PG&E-11: Average Load Coincident With System Peak (kW/Customer)

Year	Month	Residential Population*	Single Family Population*	MDU Population*	All Single Metering	Single Family Single Metering	MDU Single Metering	All Separate Metering	Single Family Separate Metering	MDU Separate Metering
2015	Sep	1.50	1.77	0.86	2.25	2.31	1.59	*0.16*	*0.23*	*0.05*
2015	Oct	1.02	1.20	0.61	1.52	1.56	1.06	*0.27*	*0.24*	*0.31*
2015	Nov	1.13	1.29	0.74	2.11	2.18	1.38	*0.19*	*0.17*	*0.21*
2015	Dec	1.17	1.36	0.73	2.15	2.22	1.32	*0.13*	*0.17*	*0.08*
2016	Jan	1.05	1.22	0.66	1.95	2.00	1.31	*0.26*	*0.33*	*0.17*
2016	Feb	0.85	0.98	0.55	1.94	2.00	1.28	*0.13*	*0.19*	*0.03*
2016	Mar	0.85	0.98	0.56	1.79	1.84	1.15	*0.15*	*0.11*	*0.21*
2016	Apr	0.94	1.08	0.62	2.00	2.06	1.30	*0.13*	*0.07*	*0.22*
2016	May	0.84	0.98	0.53	2.11	2.16	1.42	*0.16*	*0.11*	*0.22*
2016	Jun	1.62	1.92	0.93	2.15	2.21	1.40	*0.08*	*0.10*	*0.04*
2016	Jul	1.61	1.93	0.87	2.15	2.22	1.41	*0.17*	*0.22*	*0.11*
2016	Aug	1.66	1.98	0.94	1.68	1.73	1.11	*0.11*	*0.18*	*0.04*
Average		1.19	1.39	0.72	1.98	2.04	1.31	*0.16*	*0.18*	*0.14*

* Load data used for the analysis are from January 2015 to December 2015.

** Italicized fields are estimates with a precision greater than +/- 10% at a 90% confidence interval.

Geographic Concentration of PEVs

The following tables and figures illustrate the geographic concentrations of PEVs in PG&E's service territory (as of September 2016). Tables PG&E-12a and 12b as well as Figure PG&E-2 demonstrate that PEV customers are predominantly located in the San Francisco Bay Area and Central Coast (California Energy Commission Climate Zones 3 and 4[39]). Furthermore, dual participating NEM and PEV rate customers are highly concentrated in the Bay Area per Figure PG&E-3.

Table PG&E-12a: Geographic Concentration of PEVs by Climate Zone

Climate Zone	% Single Metering	% Separate Metering	%Residential Population
Z01	3%	1%	1%
Z02	10%	4%	8%
Z03	37%	43%	31%
Z04	28%	40%	14%
Z05	1%	1%	3%
Z06	0%	0%	0%
Z09	0%	0%	0%
Z11	2%	0%	7%
Z12	17%	10%	21%
Z13	2%	1%	13%
Z16	0%	0%	1%
Total	100%	100%	100%

Table PG&E-12b: Geographic Concentration of PEVs (Top Five Zip Codes by Rate)

Rate	Zip Code	Customers	% Total
Single Meter	94539	504	2.71%
	95120	386	2.08%
	95070	376	2.02%
	95014	331	1.78%
	94582	321	1.73%
Separate Meter	95035	66	2.82%
	95138	61	2.61%
	95120	58	2.48%
	95014	55	2.35%
	95135	43	1.84%

[39] California Energy Commission (2013). California Building Climate Zones with 2012 Zip Codes. Retrieved from: http://www.energy.ca.gov/maps/renewable/Climate_Zones_Zipcode.pdf.

Figure PG&E-2: Customer on EV Rates by Rate Schedule as of August 2016

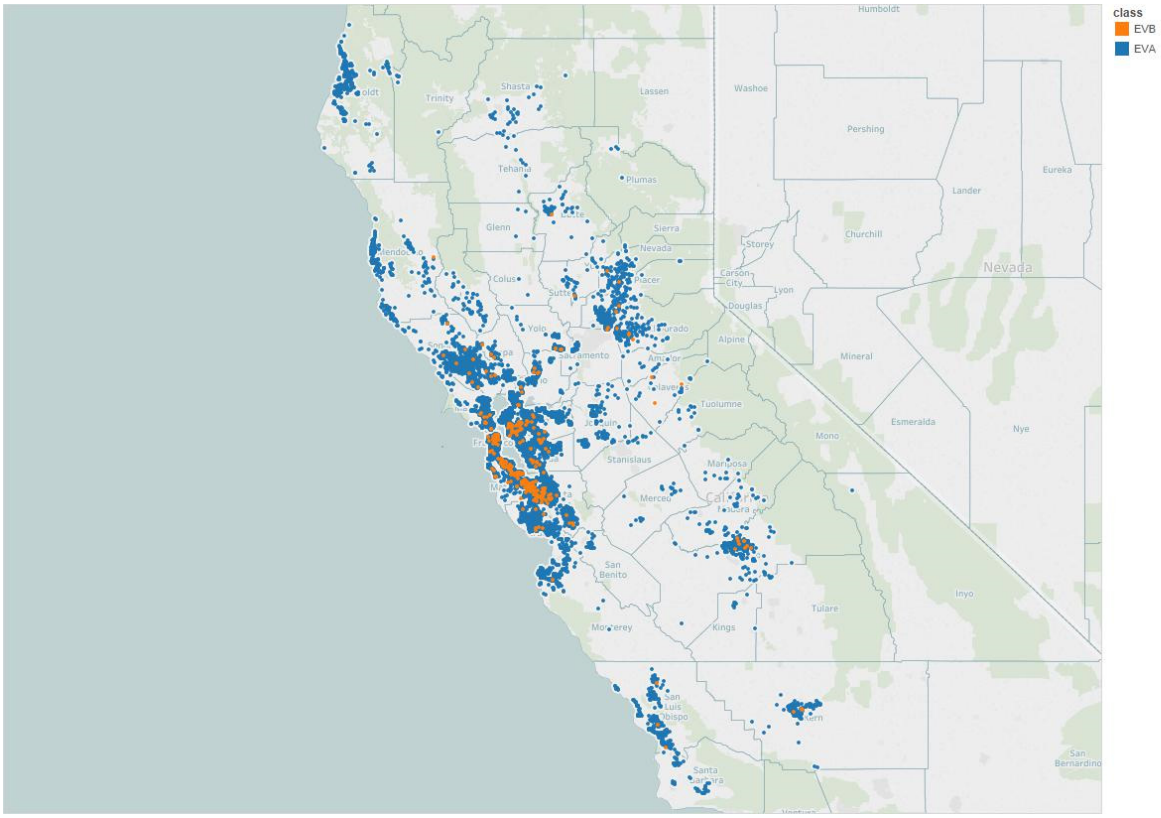
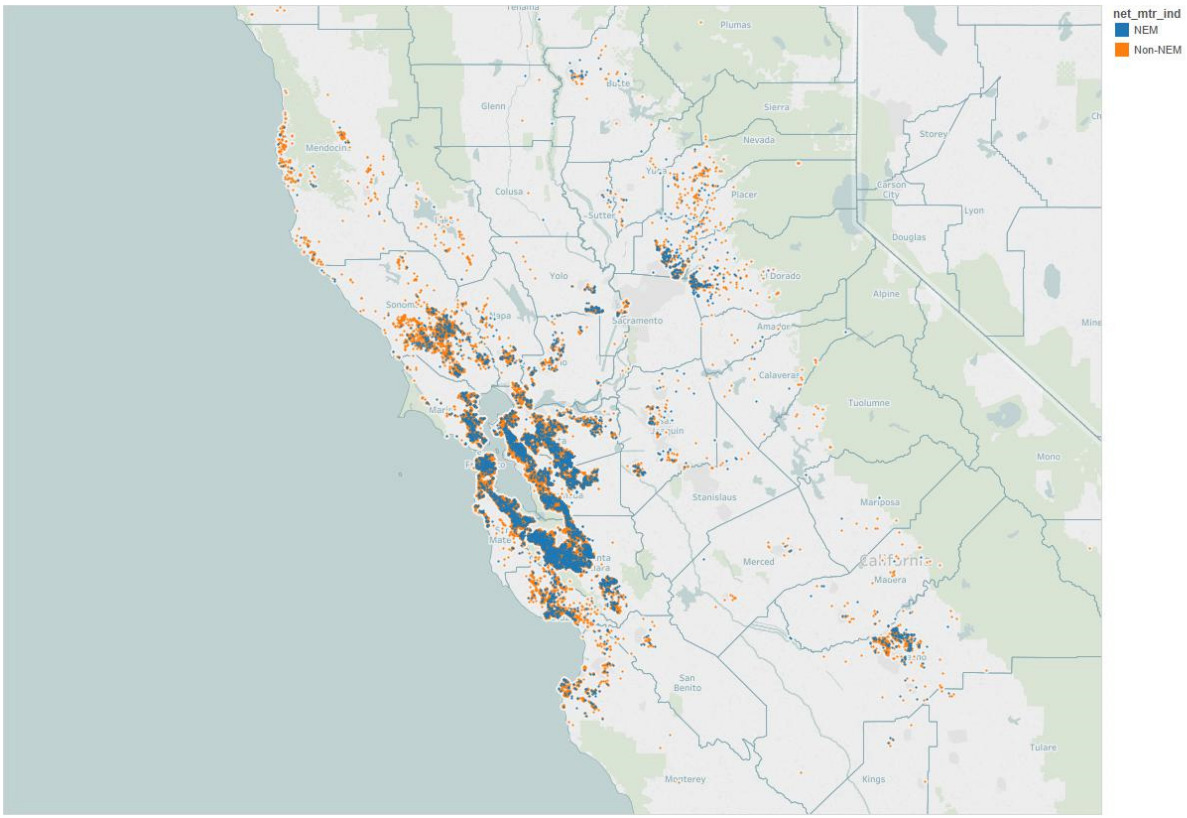


Figure PG&E-3: Customers on EV Rates by NEM/Non-NEM in the PG&E Service Territory as of August 2016



Southern California Edison

SCE currently offers residential customers two rate schedules [40] designed to facilitate the charging of PEVs. Both of these schedules employ price-differentiated time-of-use periods. The following section will report the monthly usage characteristics from September 2015 through August 2016 for the identified PEV owners on these tariffs. The TOU-D tariff allows for both regular household loads and the PEV charging loads to be recorded with a single meter under time-of-use periods designed to accommodate PEV charging requirements. The TOU-EV-1 tariff requires a second meter dedicated to measuring the electricity used at the PEV charger and the rates and time-of-use periods only apply to the electricity consumed for the PEV. Additionally, customers may remain under their existing tariff, likely Schedule D (domestic rate schedule). Based on the number PEVs SCE estimates are within its service territory, the majority of PEV owners choose to remain on the domestic rate plan.

The TOU-D tariff, with Option A and Option B, was designed to provide attractive charging options to PEV owners. TOU-D supersedes the TOU-D-TEV tariff, which was exclusive to PEV owners. The TOU-D-A/B tariff, however, is open to all residential customers whether they own a PEV or not, which means information on PEV ownership must be obtained separately. Accounts that were on TOU-D-TEV after December 2014, when the tariff was closed, were moved to TOU-D Option A or B. These accounts are included in the subsequent analysis, and for this report, SCE assumes that they still possess an electric vehicle. Additionally, any customers who self-identified as PEV owners with SCE and took service under TOU-D Option A or Option B were included in this analysis as of the first full month following their purchase. Customers self-identify either by notifying SCE as a result of applying for a cash incentive at the California Center for Sustainable Energy's (CCSE) website or providing their information through a call center contact. In previous reports, SCE had used information obtained through OEM sources to identify some PEV owners. This data is now three to five years old and is considered too dated to be reliable; therefore, it has been excluded. This has caused the number of accounts reported for the first month of this report, September 2015, to misalign with the last month of the previous report, August 2015.

Single-Metered Whole House Rate

The TOU-D-A/B tariff is the current single-metered TOU tariff aimed at accommodating PEV charging. It has been effective since January 1, 2015, which means this is the first report to feature this tariff as the sole single-meter charging option. This tariff notably has an extended off-peak TOU window of ten hours. Additionally, it has two options the customer can choose from, Option A or Option B. Both Options A and B of the TOU-D tariff maintain the same low rate during the off-peak period throughout the year. Option B however has a Basic Charge of $0.54/meter/day but significantly lower mid-peak and on-peak rates as compared to Option A. Option A also includes a $0.11/kWh Baseline Credit. Both options have pricing which varies seasonally.

[40] SCE also offers two PEV TOU rates for commercial customers: TOU-EV-3 and TOU-EV-4. As of the beginning of August 2016, there were 40 TOU-EV-3 accounts and 84 TOU-EV-4 accounts.

The TOU periods for this tariff are defined as follows:

TOU-D-A/B	
On-peak	2:00 p.m. - 8:00 p.m., weekdays all year, except holidays.
Off-peak	10:00 p.m. - 8:00 a.m., daily.
Mid-peak	All other hours.

The rate factors for the TOU-D-A/B structure were updated four times during the period covered in this report. Table SCE – 1a presents the rates that were effective January 1, 2016, until June 1, 2016, and were effective for the largest portion of the reporting period. The additional iterations of TOU-D-A/B rates can be found in Appendix A in Table A 1a –1d.

Table SCE – 1a: Single Meter (TOU-D-A/B) Tariff[41] ($/kWh) – Effective 1/1/2016

[41] https://www.sce.com/wps/portal/home/regulatory/tariff-books.

	Option A				Option B			
Clock Hour Ending	Winter		Summer		Winter		Summer	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
2	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
3	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
4	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
5	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
6	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
7	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
8	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
9	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
10	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
11	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
12	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
13	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
14	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
15	0.28	0.28	0.48	0.31	0.16	0.16	0.36	0.18
16	0.28	0.28	0.48	0.31	0.16	0.16	0.36	0.18
17	0.28	0.28	0.48	0.31	0.16	0.16	0.36	0.18
18	0.28	0.28	0.48	0.31	0.16	0.16	0.36	0.18
19	0.28	0.28	0.48	0.31	0.16	0.16	0.36	0.18
20	0.28	0.28	0.48	0.31	0.16	0.16	0.36	0.18
21	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
22	0.28	0.28	0.31	0.31	0.16	0.16	0.18	0.18
23	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
24	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

Option A: 0.11 Baseline Credit

Option B: 0.54 meter/day Basic Charge

Table SCE – 2a: Single-Metered PEV Rate (TOU-D-A/B) Price Ratios

		Summer On-peak : Mid-peak : Off-peak	Winter On-peak : Mid-peak : Off-peak
Option A	Weekday	4.0 : 2.6 : 1.0	2.3 : 2.3 : 1.0
	Weekend	2.6 : 2.6 : 1.0	same as weekday
Option B	Weekday	3.0 : 1.5 : 1.0	1.3 : 1.3: 1.0
	Weekend	1.5 : 1.5 : 1.0	same as weekday

Separately-Metered PEV Rate

The TOU-EV-1 rate is designed for residential customers who have a separate meter exclusively for PEV charging. Therefore, the TOU-EV-1 rate only reflects the customer's PEV charging load. The second meter is provided and installed at no additional cost, however the home's electrical infrastructure may need to be upgraded with a second panel and wiring to the charging location. Any costs related to the changes to the home's electrical infrastructure are the responsibility of the customer. For this rate plan, lower rates apply during off-peak hours of 9:00 p.m. to 12:00 noon, and rates change seasonally. For usage between noon and 9 p.m., rates are higher in summer. The following are the TOU periods for the separately-metered rate:

On-peak	12:00 noon – 9:00 p.m., daily
Off-peak	All other hours.

The TOU-EV-1 rate underwent multiple rate changes over the course of the reporting period. The most relevant rate factors are reported in the following table, Table SCE – 1b. Other applicable rate factors for the TOU-EV-1 tariff are listed in Appendix A, Table B 1a –1d.

Table SCE – 1b: Separate Meter (TOU-EV-1) Tariff ($/kWh) – Effective 1/1/2016

Clock Hour Ending	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
1	0.12	0.12	0.13	0.13
2	0.12	0.12	0.13	0.13
3	0.12	0.12	0.13	0.13
4	0.12	0.12	0.13	0.13
5	0.12	0.12	0.13	0.13
6	0.12	0.12	0.13	0.13
7	0.12	0.12	0.13	0.13
8	0.12	0.12	0.13	0.13
9	0.12	0.12	0.13	0.13
10	0.12	0.12	0.13	0.13
11	0.12	0.12	0.13	0.13
12	0.12	0.12	0.13	0.13
13	0.22	0.12	0.33	0.13
14	0.22	0.12	0.33	0.13
15	0.22	0.12	0.33	0.13
16	0.22	0.12	0.33	0.13
17	0.22	0.12	0.33	0.13
18	0.22	0.12	0.33	0.13
19	0.22	0.12	0.33	0.13
20	0.22	0.12	0.33	0.13
21	0.22	0.12	0.33	0.13
22	0.12	0.12	0.13	0.13
23	0.12	0.12	0.13	0.13
24	0.12	0.12	0.13	0.13

Meter Charge: $2.95/month

Table SCE – 2b: Separately-Metered PEV Rate (TOU-EV-1) Price Ratios

	Summer On-peak : Off-peak	Winter On-peak : Off-peak
Weekday	2.5 : 1.0	1.8 : 1.0
Weekend	1.0 : 1.0	1.0 : 1.0

Program Enrollment

The coincidence of PEV ownership and enrollment in the NEM rate option for these twelve months remains very consistent with the previous reports. As shown in Table SCE – 3a, roughly 26% of PEV owners with a single meter are also NEM. The percent of single-metered accounts on DR, shown in Table SCE – 4, also remained very stable at about 17%. This is a about 3% lower than previous reports, however during

the period covered by this report, participation in the DR program is occuring entirely under the new TOU tariff.

Table SCE – 3a: NEM Program Enrollment for Single Metering by Customer Type

Month	NEM Customers with Single Metering	NEM as % Single Metering	NEM as % SF Single Metering	NEM as % MDU Single Metering
Sep. 2015	1,638	28%	31%	12%
Oct. 2015	1,655	28%	31%	12%
Nov. 2015	1,687	27%	30%	12%
Dec. 2015	1,742	27%	30%	11%
Jan. 2016	1,799	27%	30%	11%
Feb. 2016	1,851	26%	29%	11%
Mar. 2016	1,910	26%	29%	10%
Apr. 2016	1,962	26%	29%	10%
May 2016	2,007	26%	29%	10%
Jun. 2016	2,030	25%	28%	10%
Jul. 2016	2,060	25%	28%	10%
Aug. 2016	2,088	25%	28%	10%

Table SCE – 4: DR Program Enrollment for Single Metering by Customer Type

Month	DR Customers with Single Metering	DR as % Single Metering	DR as % SF Single Metering	DR as % MDU Single Metering
Sep. 2015	1,043	18%	19%	12%
Oct. 2015	1,044	18%	19%	12%
Nov. 2015	1,057	17%	18%	11%
Dec. 2015	1,094	17%	18%	11%
Jan. 2016	1,122	17%	18%	12%
Feb. 2016	1,161	17%	18%	11%
Mar. 2016	1,195	16%	17%	11%
Apr. 2016	1,250	16%	17%	11%
May 2016	1,276	16%	17%	11%
Jun. 2016	1,305	16%	17%	11%
Jul. 2016	1,318	16%	17%	11%
Aug. 2016	1,309	16%	16%	11%

There are fewer than 15 separately-metered accounts which have the NEM option, therefore Table SCE – 3b has not been included. Also, DR is associated with the energy use from central air conditioning, which is prohibited under the separately-metered TOU-EV-1 tariff, therefore there are no separately-metered DR customers (i.e. Table 5: DR Program Enrollment by Separate Metering is not applicable for SCE).

Number of PEV Time-of-Use Accounts

As noted previously, SCE is less able to identify new accounts with PEVs with this year's report because the current tariff is open to all residential customers. In addition, the vast majority of PEV owners remain on their current rate, likely Schedule D, and are therefore unidentified. Nevertheless, a mild but

consistent increase in accounts with PEVs for both single-family and multi-family units can be seen in Chart SCE – 1. It is not known if this growth is reflective of growth in the overall market as there are other factors which might influence the rates of self-identification. As of August 2016 there were 8,440 known single-metered PEV owners of which 84% were in single-family residences.

Chart SCE – 1: Single Meter (TOU-D-TEV and TOU-D-A/B) –
Number of Accounts by Customer Type at the Beginning of Each Month

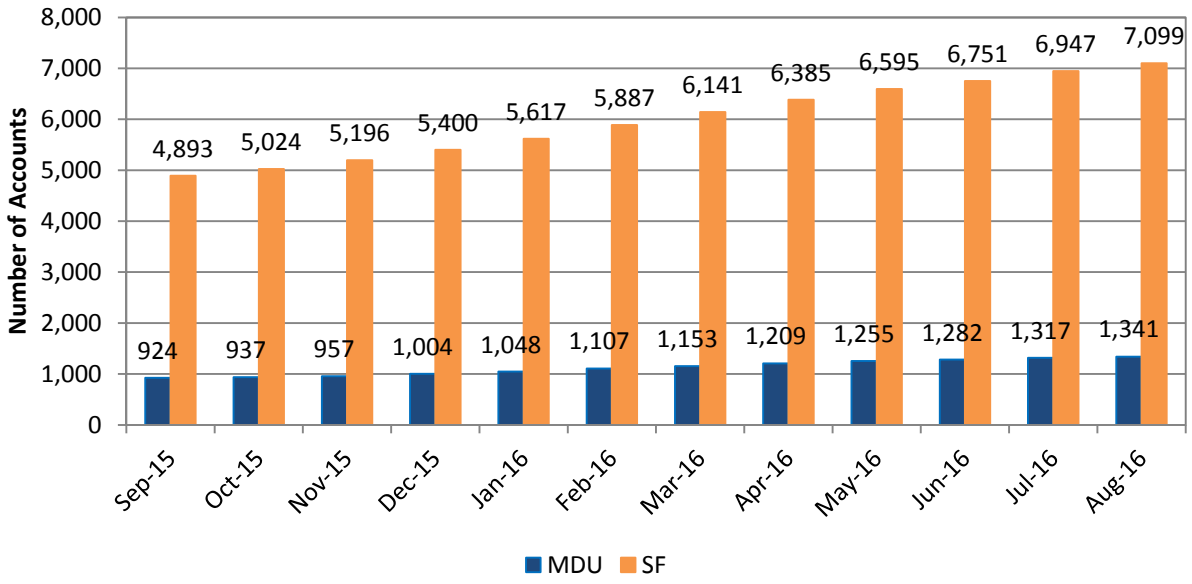
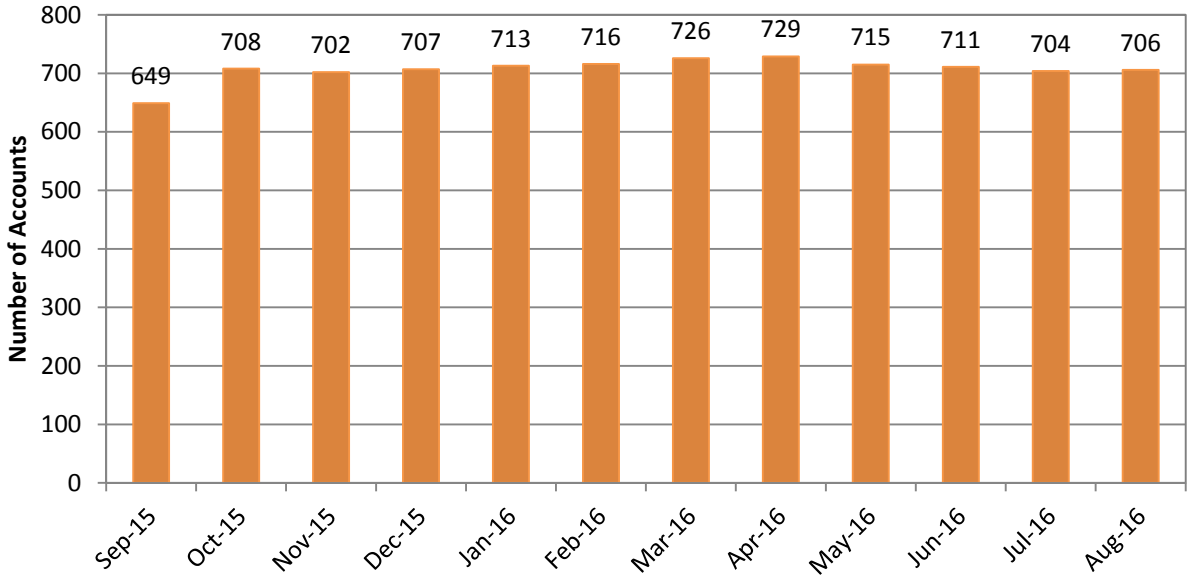


Chart SCE – 2 shows more active separately-metered accounts during this reporting period than in the previous report. As of August 2016, there were 706 separately-metered accounts, up nearly 12% from August 2015, however the net number of accounts has been trending downward since peaking at 729 in April of 2016. After April, SCE experienced more separately-metered accounts closing than opening.

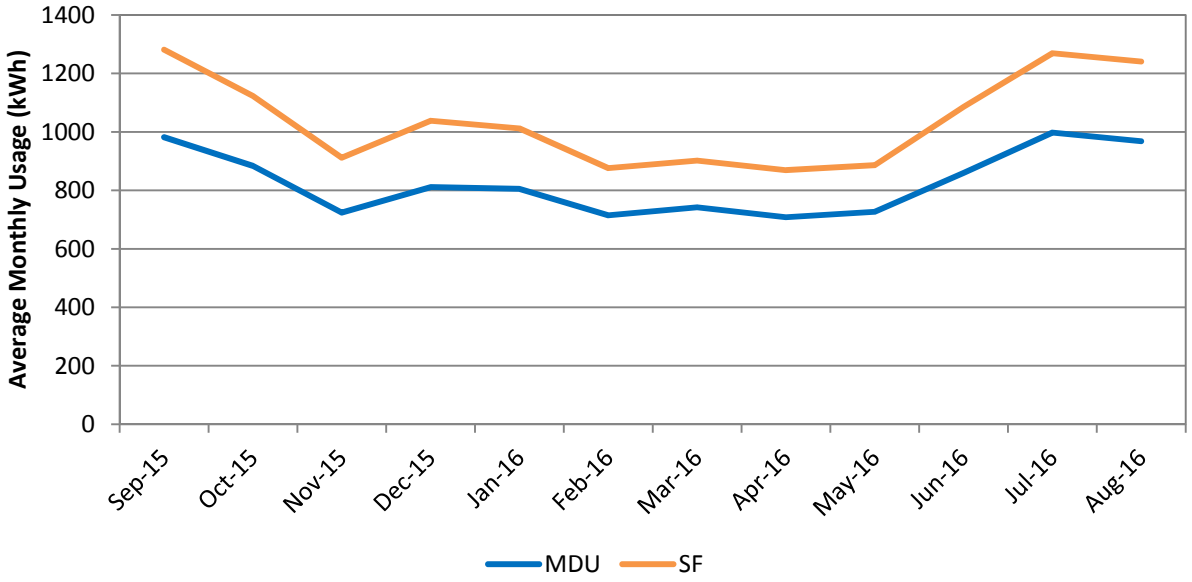
Chart SCE – 2: Separate Meter (TOU-EV-1) – Number of Accounts at the Beginning of Each Month



Average Monthly Usage for TOU Accounts with a PEV

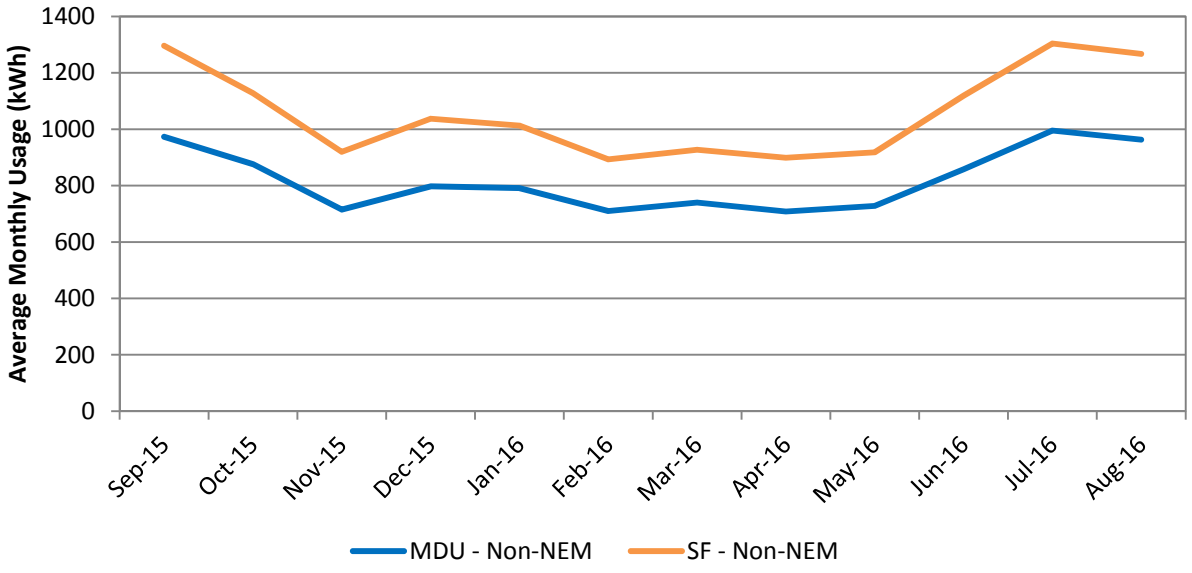
The average monthly household usage for single-metered households with a PEV shown in Chart SCE – 3 depicts very similar behavior as seen in previous years. Single-family dwellings have higher usage levels than multi-family units, but the same pattern over the course of the year with usage trending down into the winter and then trending up from February into the summer months. This is the typical seasonal behavior of residential households, which is primarily driven by cooling. The greatest usage for SF occurs in September, with 1,281 kWh, and for MDU in July, with 998 kWh.

Chart SCE – 3: Single Meter (TOU-D-A/B) –
Average Monthly Usage (kWh) by Customer Type Including NEM



The NEM accounts have very little impact on the average monthly usage of PEV owners as seen in Chart SCE – 4. The annual monthly usage pattern remains identical to that in Chart SCE – 3. The usage is slightly lower than when NEM accounts are excluded indicating that the NEM housholds are larger electricity consumers than the non-NEM PEV owners.

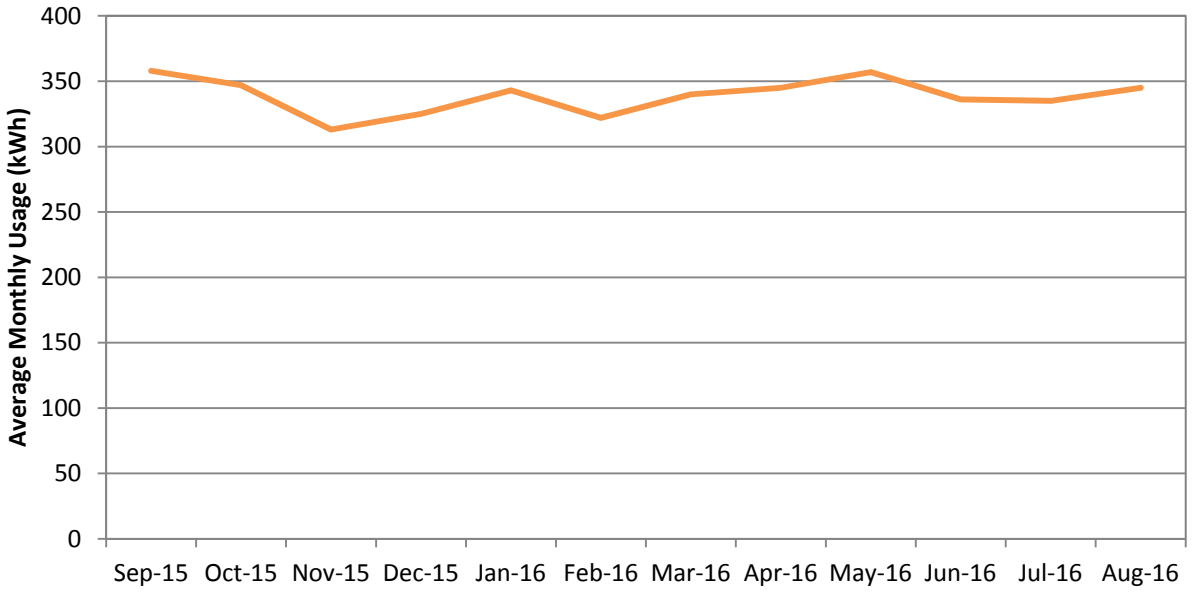
Chart SCE – 4: Single Meter (TOU-D-A/B) –
Average Monthly Usage (kWh) by Customer Type Excluding NEM



The average monthly usage dislplayed in Chart SCE – 5 for separately-metered PEVs was rather flat, ranging from 313 to 358 kWh each month. The average of 339 kWh per month is slightly below the 356 averaged during the previous reporting period. The consistent usage by the separately-metered PEVs

supports the presumption that the seasonal trends seen in the household usage of single-metered PEV owners is not inherent to PEV charging.

Chart SCE – 5: Separate Meter (TOU-EV-1) – Average Monthly Usage



Average Usage during Time-of-Use Periods

Some of the subsequent load profiles and demand metrics will also include the average residential customer as a benchmark for the single-metered PEV customers. This data is derived from SCE's 2015 Domestic Rate Group Load Study, which is based on the 2015 calendar year. As such, the statistics for the residential population are not in chronological order and the months January 2016 through August 2016 are from the corresponding months in 2015.

Table SCE – 6a, – 7, and – 8 each show the monthly percentage of usage during the on-peak, mid-peak and off-peak periods, respectively, for the single-metered tariff. PEV owners have the greatest share of their usage within the 10-hour off-peak window of the TOU-D-A/B tariff, as shown in Table SCE – 8. Forty-eight percent of usage by PEV owners without NEM occurs between the hours of 10 p.m. and 8 a.m. In contrast, Table SCE – 7 shows the residential population as a whole has the greatest portion of their usage, 44%, falling within the six hours of the mid-peak period. From Table SCE – 6a, all groups have the lowest amount of monthly usage falling in the on-peak eight hours from 2 p.m. to 8 p.m. p

Table SCE – 6a: Single Meter (TOU-D-A/B) – On-Peak* TOU Distribution

Month	All Residential	Single: Non-NEM	SF: Non-NEM	MDU: Non-NEM	NEM
Sep. 2015	23.8%	17.6%	17.8%	16.9%	16.3%
Oct. 2015	23.1%	16.8%	16.9%	16.1%	15.9%
Nov. 2015	18.6%	14.0%	14.1%	13.4%	14.9%
Dec. 2015	20.5%	16.2%	16.3%	15.5%	17.1%
Jan. 2016	19.2%	14.0%	14.1%	13.5%	14.2%
Feb. 2016	19.9%	14.9%	15.0%	14.3%	14.6%
Mar. 2016	20.8%	15.0%	15.1%	14.4%	12.0%
Apr. 2016	21.7%	14.3%	14.3%	14.0%	10.3%
May 2016	18.2%	13.6%	13.6%	13.6%	9.1%
Jun. 2016	25.1%	17.9%	18.0%	17.5%	14.4%
Jul. 2016	26.0%	17.7%	17.8%	17.1%	15.3%
Aug. 2016	24.0%	20.3%	20.4%	19.5%	17.9%

* On-peak period is defined as 2:00 p.m. - 8:00 p.m., weekdays all year, except holidays.

Table SCE – 7: Single Meter (TOU-D-A/B) – Mid-Peak* TOU Distribution

Month	All Residential	Single: Non-NEM	SF: Non-NEM	MDU: Non-NEM	NEM
Sep. 2015	45.3%	38.4%	38.5%	37.6%	29.0%
Oct. 2015	43.8%	36.3%	36.5%	35.4%	26.5%
Nov. 2015	44.7%	37.1%	37.2%	36.2%	25.7%
Dec. 2015	41.4%	35.3%	35.5%	34.4%	24.9%
Jan. 2016	44.2%	36.9%	37.0%	36.2%	27.3%
Feb. 2016	44.2%	34.8%	35.0%	34.0%	22.6%
Mar. 2016	43.7%	33.6%	33.8%	32.7%	22.0%
Apr. 2016	42.4%	34.8%	34.9%	34.2%	22.3%
May 2016	46.1%	35.5%	35.6%	34.8%	23.2%
Jun. 2016	43.0%	36.4%	36.5%	35.5%	26.3%
Jul. 2016	41.9%	39.2%	39.4%	38.4%	28.7%
Aug. 2016	45.5%	35.9%	36.1%	35.2%	26.2%

* Mid-peak period is defined as all other hours that are not On-peak or Off-peak.

Table SCE – 8: Single Meter (TOU-D-A/B) – Off-Peak* TOU Distribution

Month	All Residential	Single: Non-NEM	SF: Non-NEM	MDU: Non-NEM	NEM
Sep. 2015	30.9%	44.0%	43.7%	45.5%	54.6%
Oct. 2015	33.1%	46.9%	46.6%	48.5%	57.6%
Nov. 2015	36.8%	49.0%	48.7%	50.4%	59.3%
Dec. 2015	38.1%	48.5%	48.2%	50.1%	57.9%
Jan. 2016	36.6%	49.1%	48.9%	50.3%	58.5%
Feb. 2016	35.9%	50.3%	50.0%	51.7%	62.8%
Mar. 2016	35.5%	51.4%	51.1%	52.9%	66.0%
Apr. 2016	35.8%	50.9%	50.8%	51.8%	67.4%
May 2016	35.7%	50.9%	50.7%	51.6%	67.7%
Jun. 2016	31.9%	45.7%	45.5%	47.0%	59.4%
Jul. 2016	32.1%	43.1%	42.8%	44.5%	56.0%
Aug. 2016	30.6%	43.8%	43.5%	45.3%	55.9%
* Off-peak period is defined as 10:00 p.m. - 8:00 a.m., daily.					

PEV owners with a separate meter for their vehicle charge nearly 90% of their usage during the off-peak- period, as shown in Table SCE – 6c. Very similar results were found in previous reports as well.

Table SCE – 6b: Separate Meter (TOU-EV-1) – Usage During Time-of-Use Periods

Month	On-peak	Off-peak
Sep. 2015	11.7%	88.3%
Oct. 2015	11.2%	88.8%
Nov. 2015	12.0%	88.0%
Dec. 2015	12.1%	87.9%
Jan. 2016	12.2%	87.8%
Feb. 2016	11.7%	88.3%
Mar. 2016	11.3%	88.7%
Apr. 2016	11.3%	88.7%
May 2016	11.4%	88.6%
Jun. 2016	10.9%	89.1%
Jul. 2016	11.1%	88.9%
Aug. 2016	10.6%	89.4%

The following three charts, Charts SCE – 6a-6c, show boxplots[42] depicting the distribution of average daily usage for individual accounts. The average consumption for each account was calculated for each day of the week and then the distribution of all accounts is displayed for each day. Charts SCE – 6a for SF with a single meter, 6b for MDU with a single meter, and 6c for separately-metered PEVs illustrate the dispersion of individual average consumption for each day of the week. The median usage for individual accounts and the inter-quartile range are quite similar for each day of the week for the single-metered groups. The separately-metered PEV median usage shown in Chart SCE – 6c is lowest on

[42] Rectangular boxes represent the range of the middle 50% of the accounts by size (inter-quartile range), where the middle value (median) is denoted by a line and separates the upper and lower halves of the distribution. The whiskers extend 1.5 times the inter-quartile range above the 75th percentile and below the 25th percentile. Points farther than the whisker from the interquartile range are commonly considered outliers and are plotted individually.

Saturday and Sunday. The average amount of energy consumed by the separately-metered PEVs will depend both on the size of the battery and how frequent charging is necessary.

What is most notable for both metering arrangements and both SF and MDU accounts is the prevalence of accounts with extremely high average usage. However within the single-metered group, the MDU accounts tend to have lower usage and do not have any accounts that average more than 180 kWh for any day of the week, whereas the SF customers have a handful of accounts with average consumption greater than 200 kWh and up to about 535 kWh per day. It is not apparent how much of this consumption is the result of PEV charging.

Chart SCE – 6a: Single Meter (TOU-D-A/B), SF –
Box-and-Whisker Plot of Individual Average Daily Consumption(kWh) by Day of the Week

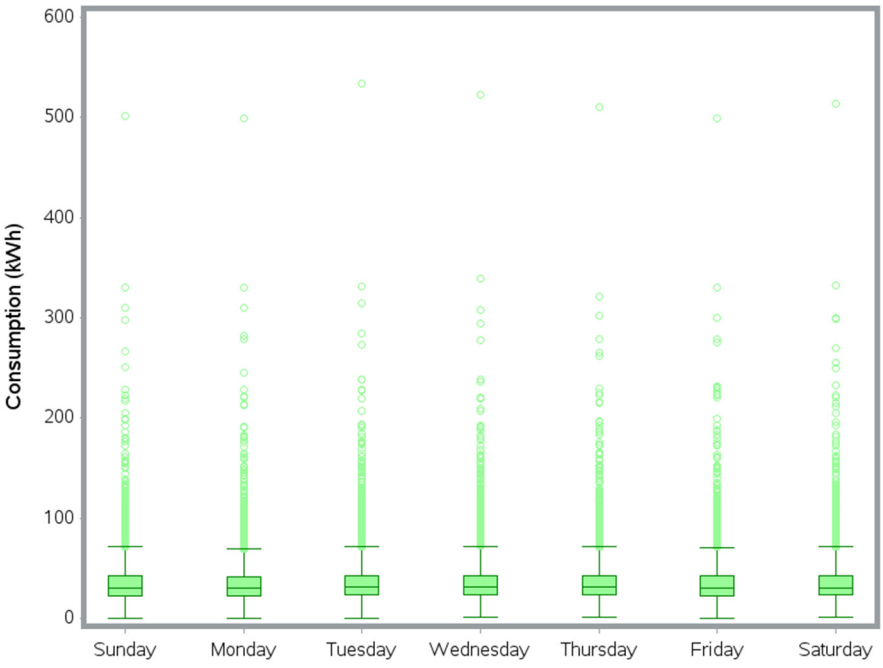


Chart SCE – 6b: Single Meter (TOU-D-A/B), MDU –
Box-and-Whisker Plot of Individual Average Daily Consumption(kWh) by Day of the Week

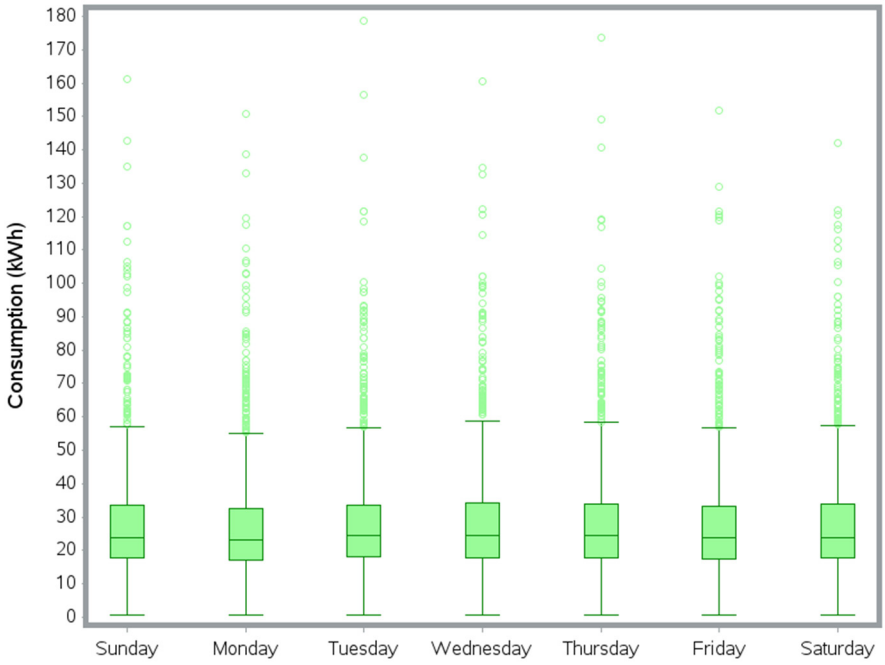
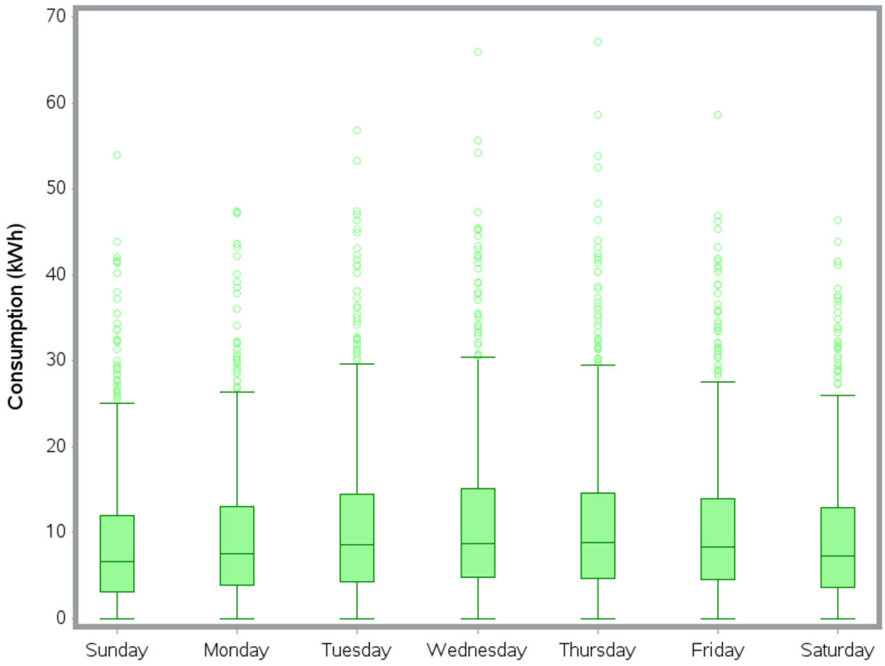


Chart SCE – 6c: Separate Meter (TOU-EV-1), SF –
Box-and-Whisker Plot of Individual Average Daily Consumption(kWh) by Day of the Week



Average Load Profiles

Average hourly load profiles provide a clear visual depiction of the daily usage patterns. As with the boxplots, the average hourly profile is computed for each day of the week for both single-metered and separately-metered accounts. Load profiles are shown separately for single and multi-family dwellings. Additionally, average hourly load profiles are shown for each day of the week for accounts which self-identified with SCE as PEV owners and remain on the regular domestic, Schedule D, tariff.

The load profiles for single-family households with a PEV that have opted for the TOU-D-A/B tariff are shown in Chart SCE – 7a. As is typical with residential annual average hourly usage, usage peaks in the evening around 8:00 p.m. Midday usage is lower but slightly higher on weekend days. Rather than declining into the morning hours, however, these profiles exhibit a large spike occuring at 10 p.m. and then again at midnight before tapering until 7:00 a.m. This spike peaks at 2.4 kWh (as an average of seven days), 26% greater than the 1.9 average usage at 8:00 p.m. The earlier spike at 10 p.m. corresponds directly with the off-peak time period of the TOU-D-A/B tariff while the second spike around midnight corresponds with the previous off-peak period of the TOU-D-TEV tariff. While all the usage in these profiles occurs under the TOU-D-A/B tariff, it appears that customers who were migrated from the former TOU-D-TEV rate maintained the same charging behavior. One explanation may be that the owners had pre-programmed the on-board technology to commence charging according to the former tariff. Altogether it appears that the PEV owners who choose a TOU rate for their household and PEV electricity needs are very responsive to the TOU period prices. Also recall Table SCE – 3a, which shows that approximately 29% of single-metered TOU accounts are NEM. This will lower the average energy use during the hours in the middle of the day and accentuate the bowl-shaped pattern.

Very similar behavior is observed with MDU customers in Chart SCE – 7b with the exception that the average hourly usage is lower, peaking around 1.9 kW on average.

Chart SCE – 7a: Single Meter (TOU-D-A/B), SF – Average Hourly Load Profile for Each Day of the Week

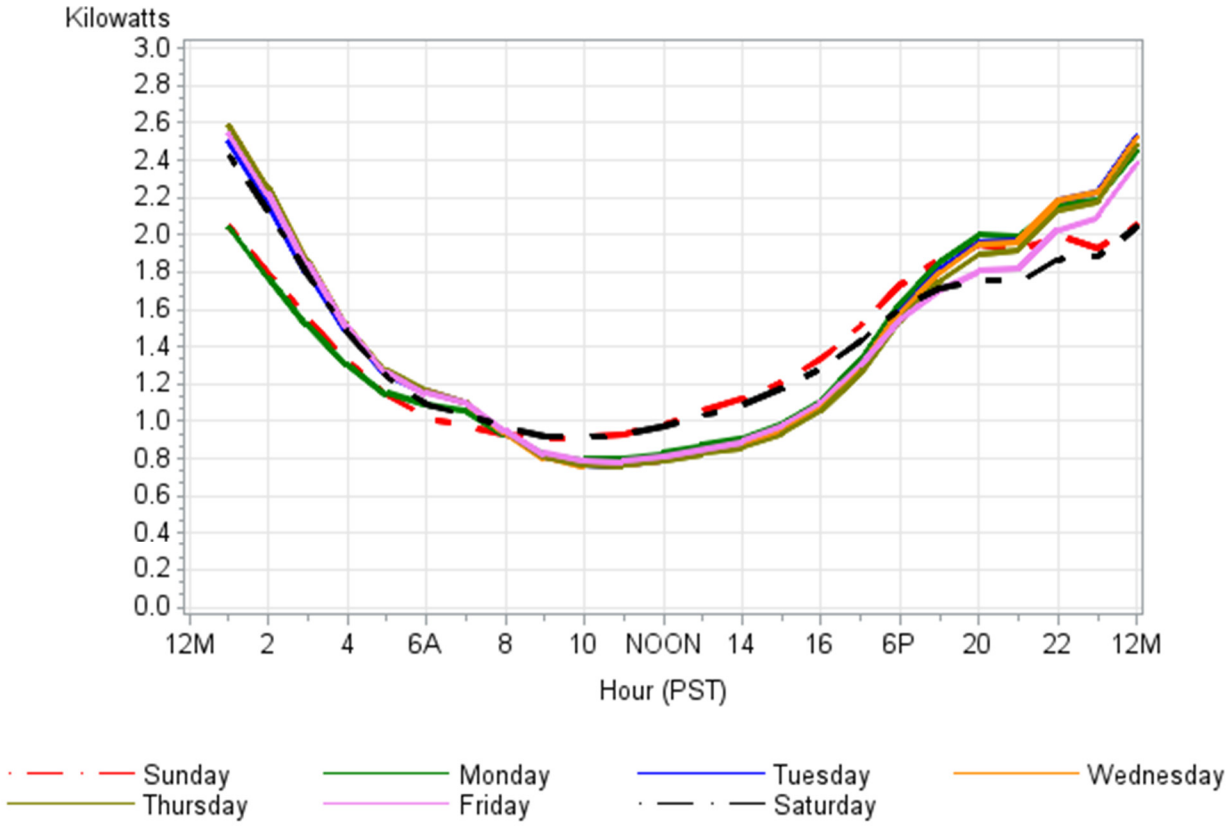
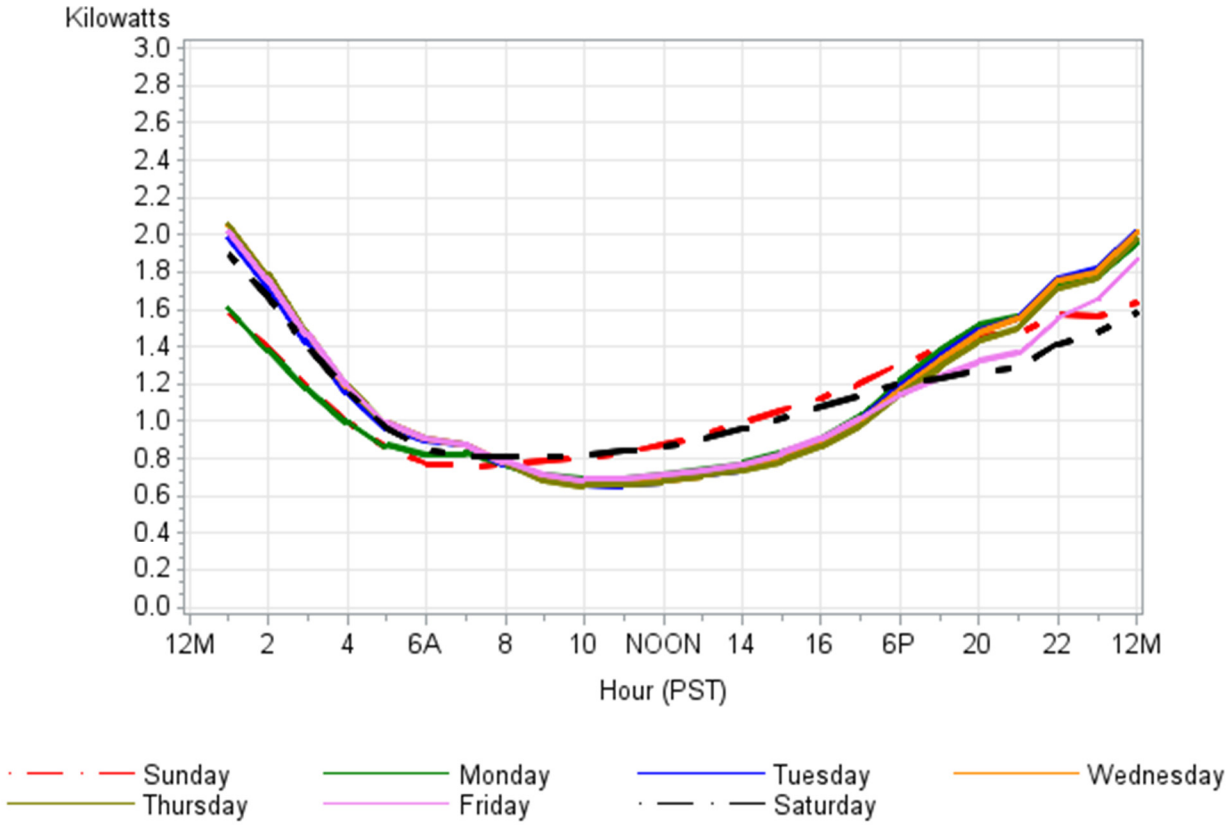


Chart SCE – 7b: Single Meter (TOU-D-A/B), MDU –
Average Hourly Load Profile for Each Day of the Week



Separately-metered PEVs commence charging promptly at the beging of the off-peak interval at 10:00 p.m. After 12:00 a.m. demands begin to taper off as vehicles reach full charges. The highest demand occurs Monday through Thursday and has an average hourly demand of 1.6 kW. Weekend peak demand is around 1.1 kW. Charging during the day between 7:00 a.m. and 8:00 p.m. is very low.

Chart SCE – 8: Separate Meter (TOU-EV-1) - Average Hourly Load Profile for Each Day of the Week

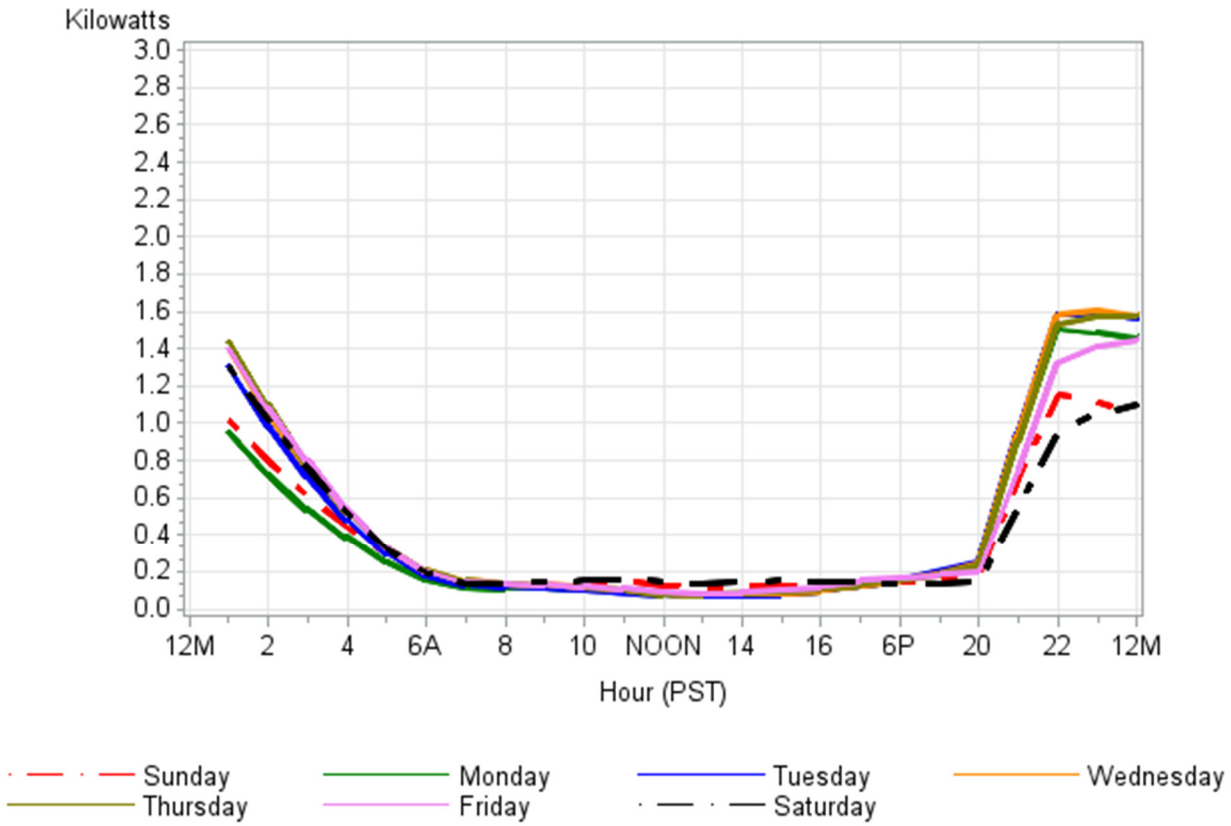
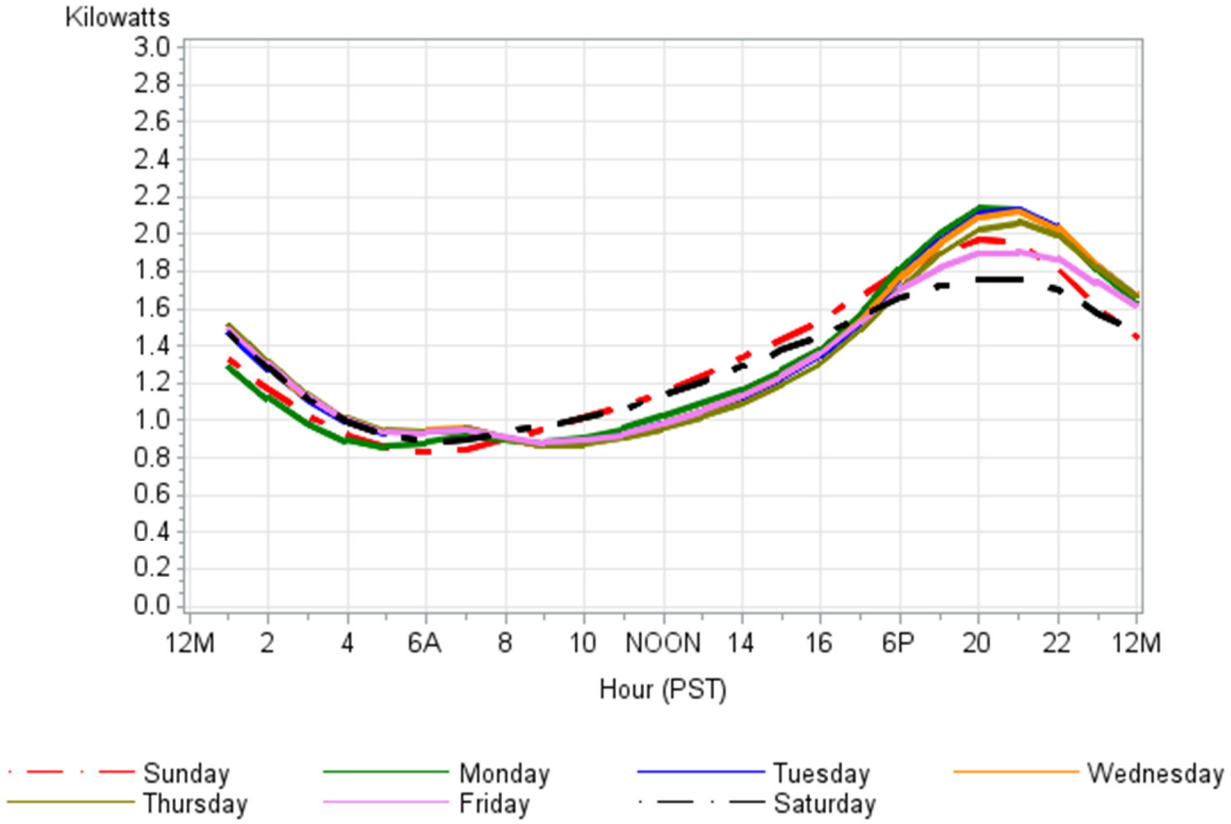


Chart SCE – 9 shows the load profile for a portion of the SF customers who are believed by SCE to own a PEV but choose to remain on the regular, tiered domestic rate. Their daytime demand begins to rise around 9:00 a.m. at 0.9 kW and accelerates gradually until it peaks in the evening at 8:00 p.m. at about 2.0 kW on average. As compared to the single-family, single-metered TOU customers in Chart SCE – 7a these non-TOU customers lack the larger peak occurring at midnight. They also have slightly higher afternoon levels of demand which may be a factor in their decision to remain on the regular residential rate as opposed to the TOU rate.

Chart SCE – 9: Single Meter, SF PEV Owners[43] on a Non-TOU Rate – Average Hourly Load Profile for Each Day of the Week



Average Non-Coincident Peak Load

The size and time of demands occuring on the distribution system as a result of PEV charging is necessary to understand any potential impacts on reliability. This first section will look at the non-coincident peaks for the indvidual accounts with PEVs. Subsequently the diversified group peak will be considered including the group's average demand coincident with the system peak hour of each month.

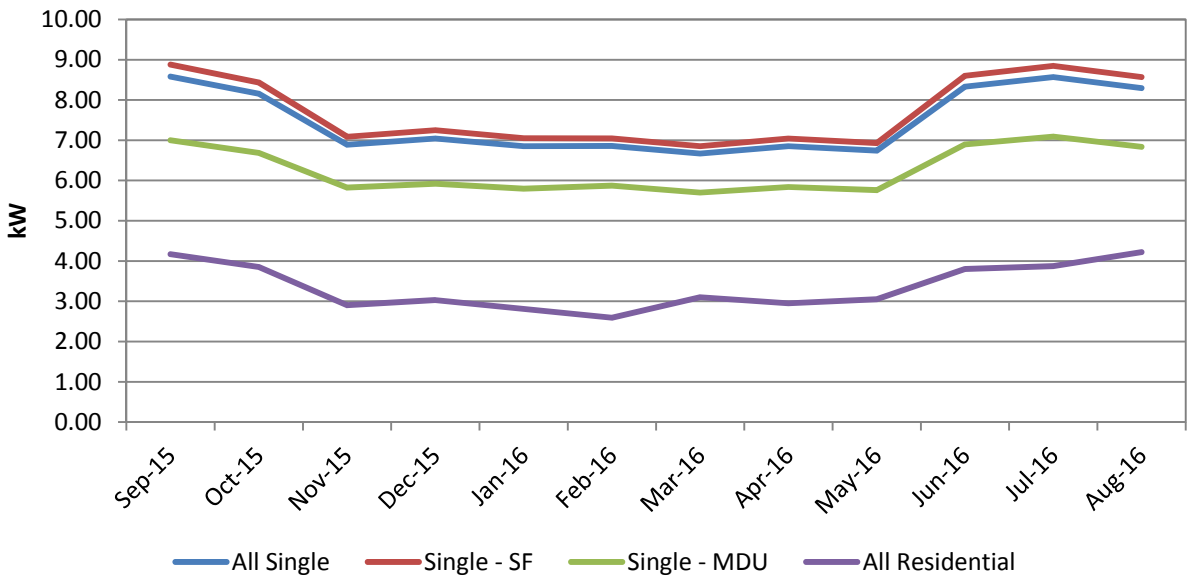
The average monthly non-coincident peak for all single-metered PEV households of 7.5 kW in Table SCE – 9a is on average 4.1 kW higher than the residential population as a whole. Chart SCE – 10a shows the same seasonal behaviour in non-coincident demand for the whole house loads as was seen in usage in Chart SCE – 3.

[43] 5,014 accounts on the regular Domestic rate schedule (including NEM customers) with load data between September 1, 2015, and August 31, 2016, and a known purchase date of the PEV.

Table SCE – 9a: Single Meter (TOU-D-A/B) –
Monthly Average Non-Coincident Peak Load (kW)

Month	Residential Pop.	SF Pop.	MDU Pop.	All Single Metering	SF Single Metering	MDU Single Metering
Sep. 2015	4.17	4.95	3.02	8.58	8.88	7.00
Oct. 2015	3.85	4.51	2.86	8.16	8.43	6.68
Nov. 2015	2.90	3.21	2.43	6.89	7.09	5.82
Dec. 2015	3.03	3.31	2.61	7.04	7.25	5.92
Jan. 2016	2.81	3.05	2.45	6.85	7.05	5.80
Feb. 2016	2.59	2.85	2.20	6.86	7.04	5.87
Mar. 2016	3.10	3.47	2.55	6.67	6.85	5.70
Apr. 2016	2.95	3.32	2.41	6.85	7.04	5.84
May 2016	3.05	3.50	2.38	6.74	6.93	5.76
Jun. 2016	3.80	4.49	2.76	8.33	8.60	6.90
Jul. 2016	3.87	4.58	2.82	8.57	8.85	7.09
Aug. 2016	4.22	5.02	3.02	8.29	8.57	6.83

Chart SCE – 10a: Single Meter (TOU-D-A/B) –
Monthly Average Non-Coincident Peak Load (kW)



For separately-metered PEV loads, Table SCE – 9b and Chart SCE – 10b show a very stable monthly non-coincident demand averaging 7.5 kW. This is nearly identical to those in prior reports.

Table SCE – 9b: Separate Meter (TOU-EV-1) – Monthly Average Non-Coincident Peak Load (kW)

Month	Separate Metering
Sep. 2015	7.59
Oct. 2015	7.33
Nov. 2015	7.28
Dec. 2015	7.23
Jan. 2016	7.42
Feb. 2016	7.35
Mar. 2016	7.50
Apr. 2016	7.57
May 2016	7.61
Jun. 2016	7.68
Jul. 2016	7.68
Aug. 2016	7.53

Chart SCE – 10b: Separate Meter (TOU-EV-1) – Monthly Average Non-Coincident Peak Load (kW)

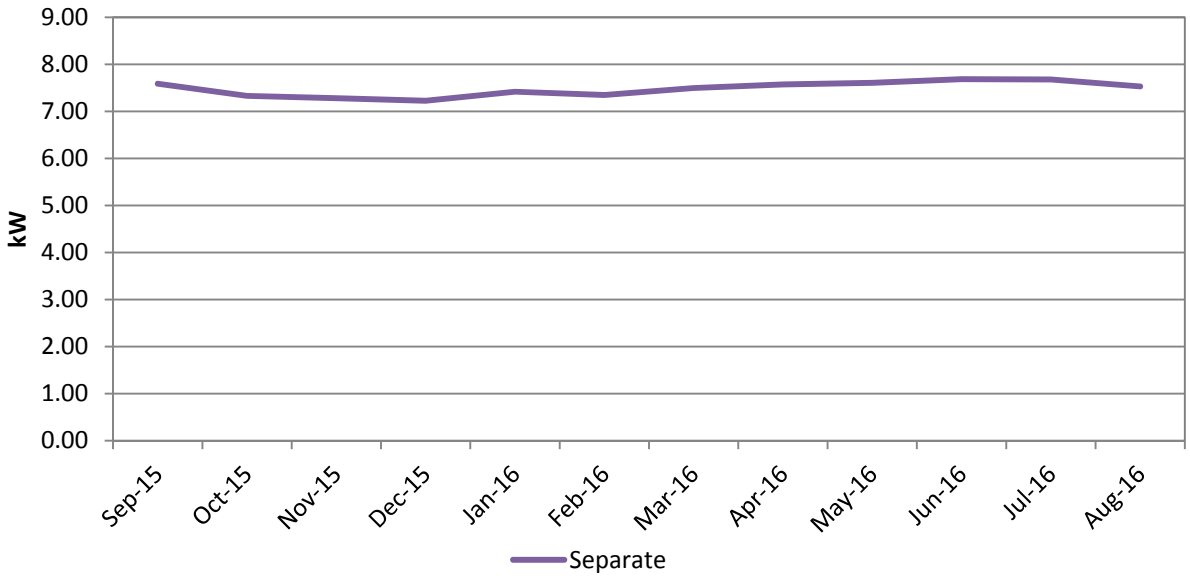
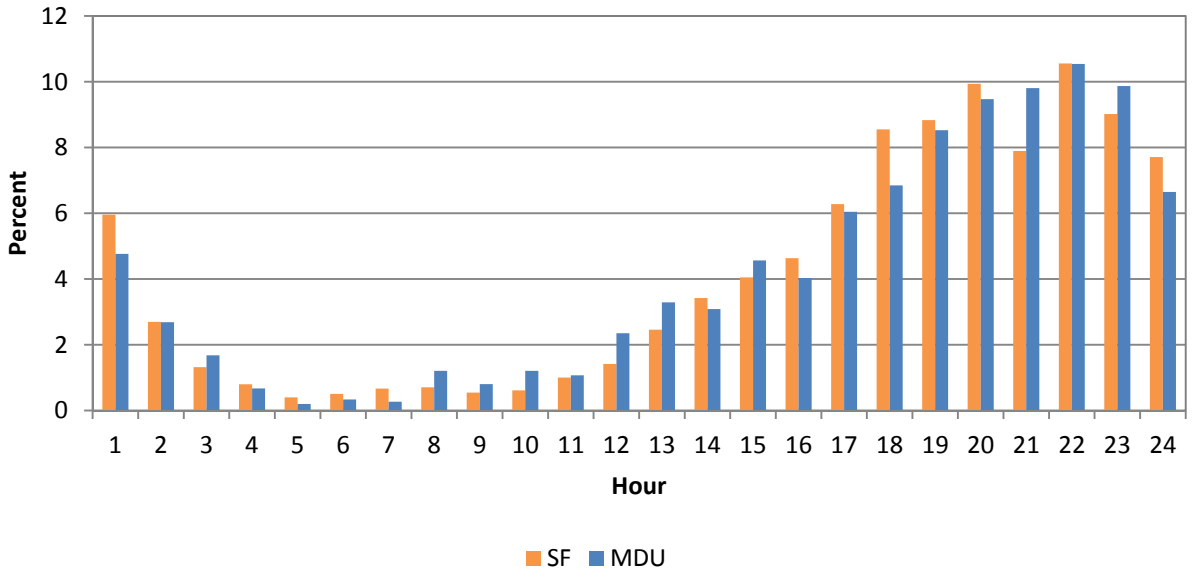


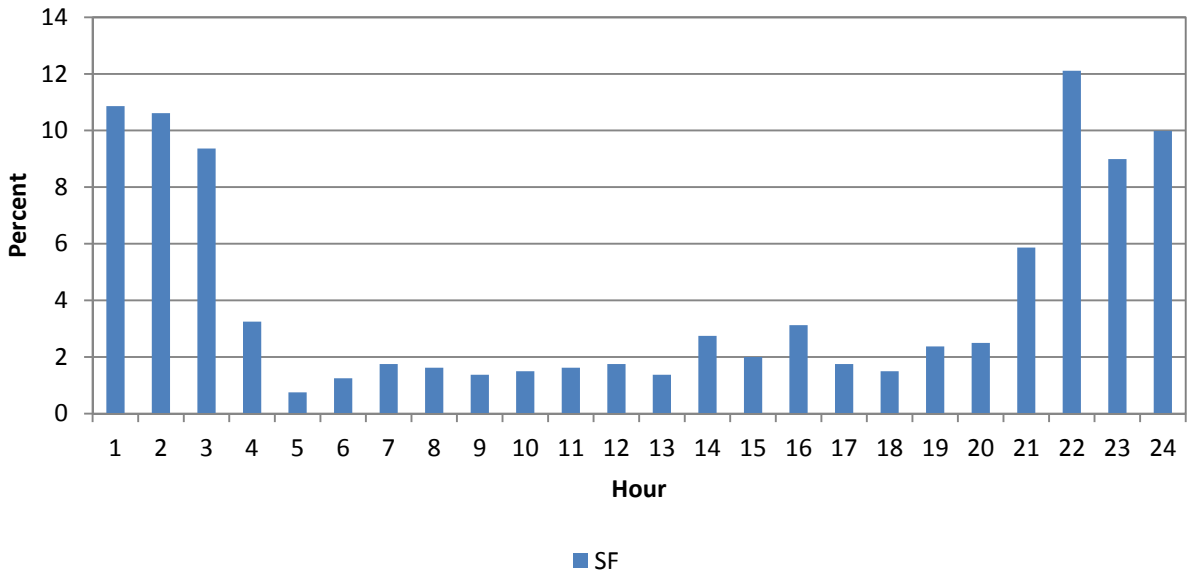
Chart SCE – 11a provides a contrast to the average hourly demands seen in the load profiles previously. For single-metered households, while the average demand is highest during the off-peak hours in the early morning, the hour of the annual non-coincident peak most frequently occurs in the evening. MDUs peak around 10 p.m. While SF households have the most annual hourly peaks at 10 p.m. as well, they also have a peak in the frequency of non-coincident peaks between 6 and 8 p.m. The residential population as a whole has the most peaks during a longer, earlier window from 3 to 8 p.m. as shown in the subsequent table.

Chart SCE – 11a: Single Meter (TOU-D-A/B) –
Histogram of Hour of Non-Coincident Peak Load Occurrence for Each Account by Customer Type



Separately-metered PEVs have annual non-coincident peaks which occur overwhelmingly more frequently during their off-peak period. Unlike the single-metered households, there are no other loads which coincide with PEV charging causing the peak to shift.

Chart SCE – 11b: Separate Meter (TOU-EV-1) –
Histogram of Hour of Non-Coincident Peak Load Occurrence for Each Account by Customer Type



Data Accompanying Chart SCE – 11a, b

Hour	Residential Pop.	SF Pop.	MDU Pop.	All Single Metering	SF Single Metering	MDU Single Metering	Separate Metering
1	1%	1%	1%	6%	6%	5%	11%
2	0%	0%	1%	3%	3%	3%	11%
3	0%	0%	1%	1%	1%	2%	9%
4	0%	0%	0%	1%	1%	1%	3%
5	0%	0%	0%	0%	0%	0%	1%
6	0%	0%	1%	0%	1%	0%	1%
7	1%	1%	1%	1%	1%	0%	2%
8	2%	1%	2%	1%	1%	1%	2%
9	2%	1%	2%	1%	1%	1%	1%
10	2%	1%	3%	1%	1%	1%	1%
11	3%	3%	4%	1%	1%	1%	2%
12	4%	4%	4%	2%	1%	2%	2%
13	6%	6%	7%	3%	2%	3%	1%
14	7%	8%	6%	3%	3%	3%	3%
15	10%	11%	7%	4%	4%	5%	2%
16	9%	11%	7%	5%	5%	4%	3%
17	9%	9%	8%	6%	6%	6%	2%
18	9%	9%	8%	8%	9%	7%	1%
19	9%	9%	9%	9%	9%	9%	2%
20	10%	10%	9%	10%	10%	9%	2%
21	7%	7%	8%	8%	8%	10%	6%
22	4%	4%	5%	11%	11%	11%	12%
23	2%	2%	3%	9%	9%	10%	9%
24	1%	1%	2%	8%	8%	7%	10%

Time and Average Diversified Peak Load

The time of residential peak loads varies throughout the year, ranging from roughtly 5:00 p.m. in the summer to 8:00 p.m. in the winter. The magnitude of these peaks also varies, presumably due to different uses. The peak load for the single-metered PEV owners is much more consistent month-to-month, averaging 2.4 kW and occuring at 1:00 a.m. (or midnight during daylight savings time). The larger demands occuring on the accounts of PEV owners, presumably due to PEV charging, supplants the lower household demands occurring at other hours of the day.

Table SCE – 10a: Single Meter (TOU-D-A/B) – Time and Average Diversified Peak Load

Month	Residential Demand (kW)	Hour of Residential Demand	SF Population Demand (kW)	Hour of SF Population Demand	MDU Population Demand (kW)	Hour of MDU Population Demand
Sep. 2015	2.24	17	2.75	17	1.38	16
Oct. 2015	2.01	16	2.42	16	1.30	16
Nov. 2015	1.11	20	1.29	20	0.78	20
Dec. 2015	1.28	20	1.50	20	0.94	20
Jan. 2016	1.17	20	1.35	19	0.85	20
Feb. 2016	0.97	20	1.13	20	0.69	20
Mar. 2016	1.14	19	1.34	19	0.80	19
Apr. 2016	1.19	20	1.40	20	0.84	18
May-16	1.14	17	1.34	17	0.78	17
Jun. 2016	1.75	18	2.14	18	1.09	18
Jul. 2016	1.79	17	2.20	17	1.09	18
Aug. 2016	2.31	17	2.85	17	1.40	17

Table SCE – 10a cont'd: Single Meter (TOU-D-A/B) – Time and Average Diversified Peak Load

Month	Single Metering Demand (kW)	Hour of Single Metering Demand	SF Single Metering Demand (kW)	Hour of SF Single Metering Demand	MDU Single Metering Demand (kW)	Hour of MDU Single Metering Demand
Sep. 2015	2.85	24	2.95	24	2.28	24
Oct. 2015	2.59	24	2.68	24	2.10	24
Nov. 2015	2.29	1	2.36	1	1.86	1
Dec. 2015	2.42	1	2.50	1	1.97	1
Jan. 2016	2.34	1	2.42	1	1.91	1
Feb. 2016	2.29	1	2.36	1	1.91	1
Mar. 2016	2.19	1	2.26	1	1.83	1
Apr. 2016	2.27	24	2.35	24	1.85	24
May-16	2.26	24	2.34	24	1.84	24
Jun. 2016	2.52	24	2.62	24	2.02	24
Jul. 2016	2.65	24	2.75	24	2.13	24
Aug. 2016	2.64	24	2.74	24	2.12	24

Average monthly diversified peak loads for separately-metered PEVs is 1.5 kW, with the peaks occuring between 10:00 p.m. and midnight. This indicates a significant amount of diversity in charging as the non-coincident peak loads were 7.5 kW on average. The profiles in Chart SCE – 8 show a rather narrow peak in charging so the most plausible reason that this diversity would arise would be through vehicles not being charged daily at home.

Table SCE – 10b: Separate Meter (TOU-EV-1) – Time and Average Diversified Peak Load

Month	Separate Metering Demand (kW)	Hour of Separate Metering Demand
Sep. 2015	1.63	22
Oct. 2015	1.53	22
Nov. 2015	1.49	23
Dec. 2015	1.44	23
Jan. 2016	1.55	23
Feb. 2016	1.54	23
Mar. 2016	1.44	24
Apr. 2016	1.57	22
May-16	1.61	22
Jun. 2016	1.56	22
Jul. 2016	1.49	22
Aug. 2016	1.56	24

Average Load Coincident With System Peak

The average load coincident with system peak is the average load of the group occcurring at the same time that the system peak occurs. The system peak days and times were used to extract the appropriate hourly load at the time of system peak. The average group load coincident with system peak was calculated taking the total group load during this hour and dividing by the number of customers.

The load of the single-metered PEV owners coincident with the monthly system peak varies much more from month-to-month than the group's monthly diversified group peak. The coincident load is also lower at 1.8 kW compared to the 2.5 kW diversified peak. Comparing the coincident loads of the residential population with the PEV owners is not very meaningful as the underlying residential population data for January through August is from 2015 and thus the peak loads and hours might be different than the PEV group.

Table SCE –11a: Single Meter (TOU-D-A/B) –
Average Load Coincident With System Peak (kW/Customer)

Month	Residential Population	SF Population	MDU Population	All Single Metering	SF Single Metering	MDU Single Metering
Sep. 2015	2.02	2.46	1.25	2.11	2.20	1.63
Oct. 2015	1.82	2.20	1.16	2.34	2.45	1.75
Nov. 2015	0.91	1.07	0.63	1.48	1.56	1.07
Dec. 2015	1.21	1.42	0.85	1.85	1.93	1.40
Jan. 2016	0.89	1.05	0.60	1.58	1.65	1.17
Feb. 2016	0.90	1.05	0.62	1.57	1.64	1.20
Mar. 2016	0.93	1.08	0.66	1.44	1.50	1.12
Apr. 2016	1.12	1.31	0.78	0.97	1.00	0.84
May-16	1.09	1.27	0.75	0.79	0.81	0.72
Jun. 2016	1.56	1.91	0.96	2.40	2.49	1.90
Jul. 2016	1.74	2.15	1.05	2.21	2.29	1.77
Aug. 2016	2.02	2.47	1.25	2.25	2.34	1.73

Table SCE –11a- cont'd: Single Meter (TOU-D-A/B) –
Average Load Coincident With System Peak (kW/Customer)

Month	NEM	DR
Sep. 2015	1.57	2.27
Oct. 2015	2.14	2.36
Nov. 2015	1.76	1.35
Dec. 2015	2.18	1.70
Jan. 2016	1.85	1.42
Feb. 2016	1.93	1.44
Mar. 2016	1.70	1.33
Apr. 2016	0.48	0.86
May-16	0.30	0.74
Jun. 2016	1.64	2.41
Jul. 2016	1.45	2.28
Aug. 2016	1.79	2.30

Table SCE – 11b corroborates with the load profiles in Chart SCE – 8 showing very low levels of demand from separately-metered PEVs coincident with system peaks.

Table SCE –11b: Separate Meter (TOU-EV-1) -
Average Load Coincident With System Peak (kW/Customer)

Month	Separate Metering
Sep. 2015	0.10
Oct. 2015	0.11
Nov. 2015	0.12
Dec. 2015	0.26
Jan. 2016	0.17
Feb. 2016	0.15
Mar. 2016	0.21
Apr. 2016	0.08
May-16	0.12
Jun. 2016	0.07
Jul. 2016	0.07
Aug. 2016	0.10

The geographic distribution of identified PEV owners within SCE's service territory is shown in Table SCE – 12a. These results are nearly unchanged from the previous year and show that these PEV owners remain disproportionately located in milder, coastal zones. The majority of PEV owners, 62% of single-metered and 57% of separately-metered, are in the mild climate. By contrast, only 45% of residential general population accounts are in these zones.

Table SCE –12a: Percentage of PEV Customers on
TOU Rates by Zone[44] as Compared to Residential Population

Climate	Zone(s)	Residential Population*	Single Meter	Separate Meter
mild	5, 6, 8, 16	45%	62%	57%
moderate/hot	9, 10, 13, 14, 15	55%	38%	43%

*Percentages are based on residential customers at the end of November 2016.

The following observations of this sub-population have been made previously and continue to be relevant:

- Their socio-demographic attributes such as income, education, and housing type correlate with those of coastal dwellers.
- Coastal dwellers have less air conditioning load, which may make them less resistant to TOU rates and their higher on-peak prices.
- Residents in the more densely populated zones such as Zones 6, 8, and parts of 9 may have shorter commutes that are within the range of PEVs, allowing easier adoption.

[44] SCE's baseline information can be found at: http://www.sce.com/NR/sc3/tm2/pdf/ce63map.pdf.

Nearly the same zip codes maintain the greatest prevelance of PEVs as in the previous report. Table SCE 12 – b shows zip codes in Manhattan Beach, Rancho Palos Verdes, Palos Verde Peninsula, Huntington Beach and Irvine are all in the top five zip codes by single-metered households as last year. Most notable is 92620 in Irvine, which had disproportionately large growth over the reporting period. This zip code went from having 88 in the previous report to 152 as of August 2016, placing it in the second most populous zip code for PEVs with a single meter. For the separately-metered PEVs, only four zip codes have greater than the 15 necessary accounts to report publicly. Santa Monica zip code 90402 remains the most populous zip code for separately metered PEVs. Interestingly, it was also the only one of the top five zip codes to have an increase in the number of PEVs, from 23 to 30.

Table SCE –12b: Top Five Most Populous Zip Codes With PEVs by Tariff

Rate Type	Zip Code(s)	City of Zip Code	Total Number of Accounts with PEV
Single Meter	90266	Manhattan Beach	183
	92620	Irvine	152
	90275	Rancho Palos Verde	138
	90274	Palos Verde Peninsula	136
	92648	Huntington Beach	125
Separate Meter	90402	Santa Monica	30
	91302, 91108, 91302	Calabasas, San Marino, Manhattan Beach	15
	Undisclosed	Undisclosed	<15

It is interesting that the greatest growth in PEVs by zip codes over this last reporting period occurred in relatively more populous urban areas for both single-metered and separately-metered PEVs. While these areas are still quite affluent, they represent much larger segments of the population than other top five zip codes.

Figure SCE – 3: Geographic Location PEV TOU Accounts by Tariff Type

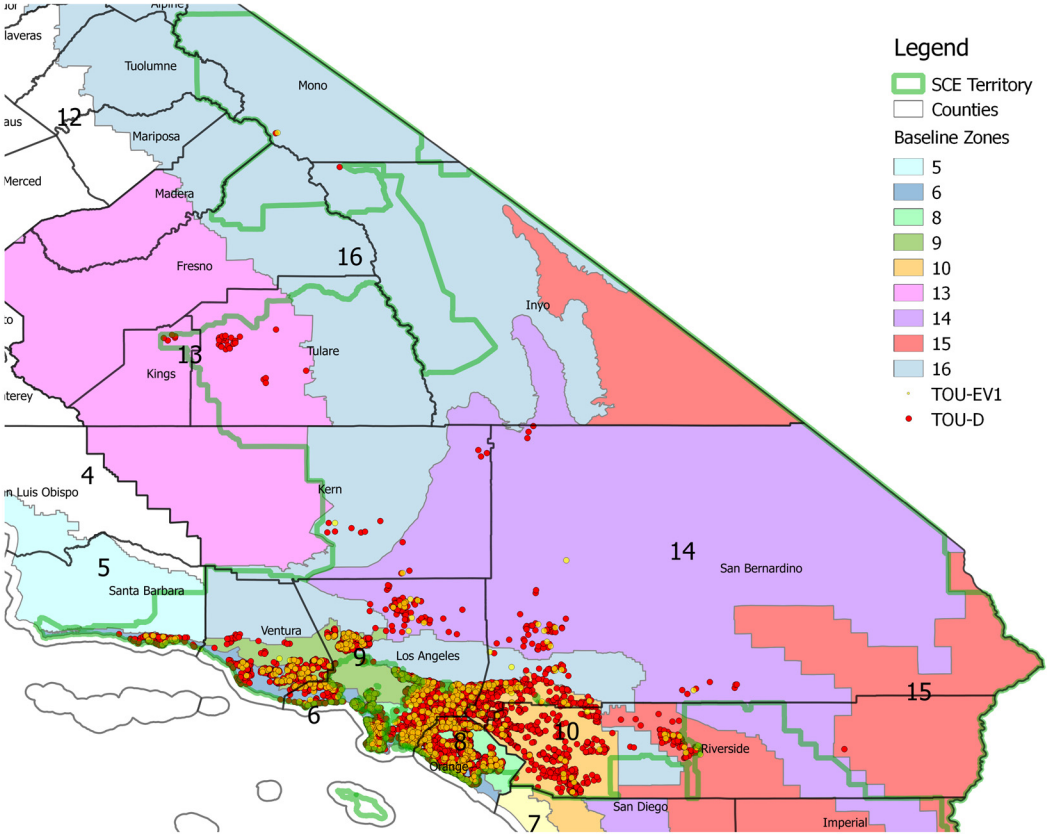
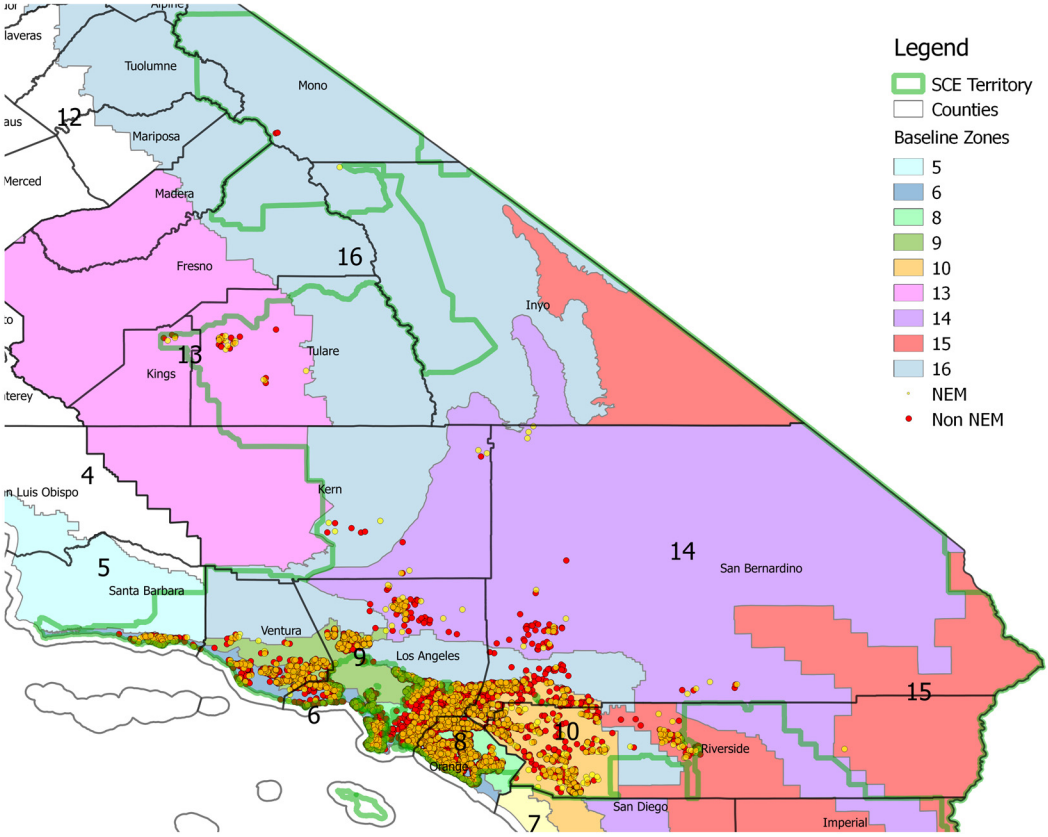


Figure SCE – 4: Geographic Location PEV TOU Accounts by NEM Designation



San Diego Gas and Electric

SDG&E offers residential customers two rates with two different meter configurations for PEV owners. First, a single-meter rate (EVTOU-2) captures load associated with both the PEV and the whole house. Second, is currently one separately-metered rate (EVTOU) which captures load associated with EV charging only. SDG&E is only reporting on customers on these two PEV rate options, however SDG&E estimates that approximately 64% of its PEV population are not on these two rates. The rates provided below were effective November 1, 2015 through August 1, 2016 and were effective for the period for which the data was collected. The three experimental rates (EPEV-X, EPEV-Y and EPEV-Z) were closed December 31st, 2014 and therefore not within this EV Load Study timeframe and were reported in the previous four years of this study. Customers on those experimental rates were transitioned off of them to either EVTOU, EVTOU-2 or to another residential rate option. SDG&E does not currently offer a commercial EV rate option. Table 1a provides the TOU periods for the two rates and their respective seasonal prices per kWh.

SDG&E Table 1a: Tariff (¢/kWh)

Tariff	TOU	Hour Beginning	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
EVTOU	Super Off Peak	Midnight to 5 am	19.0	19.0	18.0	18.0
	On Peak	Noon to 8 pm	22	22	46.1	46.1
	Off Peak	All Other Hours	21	21	22.1	22.1
EVTOU-2	Super Off Peak	Midnight to 5 am	19	19	18.8	18.8
	On Peak	Noon to 6 pm	22	22	46.2	46.2
	Off Peak	All Other Hours	21.0	21.0	22.4	22.4

Table 1b provides the price ratios between the different TOU periods for each rate. Both rates have the largest difference between on-peak and super off-peak prices during the summer period.

SDG&E Table 1b: Price Ratios

Tariff	Winter		Summer	
	Off-Peak and Super Off-Peak	On-Peak and Super Off-Peak	Off-Peak and Super Off-Peak	On-Peak and Super Off-Peak
EVTOU	1:1	1:1	1:1	3:1
EVTOU-2	1:1	1:1	1:1	3:1

Tariff	Winter		Summer	
	Off-Peak and Super Off-Peak	On-Peak and Super Off-Peak	Off-Peak and Super Off-Peak	On-Peak and Super Off-Peak
EVTOU	1:1	1:1	1:1	3:1
EVTOU-2	1:1	1:1	1:1	3:1
EPEV-X	1:1	1:1	1:1	2:1
EPEV-Y	2:1	3:1	2:1	4:1
EPEV-Z	2:1	5:1	2:1	6:1

SDG&E Single-Meter PEV Rate (EVTOU-2):

The EVTOU-2 rate option is designed for residential customers that have both their household load and PEV load on the same meter. Service under this optional rate is specifically limited to residential customers who require service for charging of a currently registered motor vehicle which is: (1) a battery electric vehicle (BEV) or plug-in hybrid vehicle (PHEV) recharged via a recharging outlet at the customer's premise; or, (2) a natural gas vehicle (NGV) refueled via a home refueling appliance (HRA) at the customer's premise. The on-peak period is 12:00 – 18:00 daily (excluding holidays), the off-peak- period is 05:00 – 12:00 and 18:00 – 24:00 daily, and the super off-peak period is 24:00 – 05:00 daily.

Please note that the current information drawn from this subgroup is preliminary and any judgments and/or policy decisions made from this information would be premature. As can be seen form the information presented in this document, the number of customers taking service under a PEV rate is continuing rapid growth and the demand/energy data may not be stable enough to draw any major

conclusions. Since September 2015, the number of customers taking service under EVTOU-2 has grown 27%.

SDG&E Table 2: NEM and DR Program Enrollment for Single-Meter Rate

Month	Total Customers on Single-Metering	Total Customers On NEM	NEM as a % of Single-Metering	Total Customers on DR	DR as a % of Single-Metering
Sep 15	5888	1423	24.17%	1409	23.93%
Oct 15	6087	1516	24.91%	1449	23.80%
Nov 15	6283	1593	25.35%	1471	23.41%
Dec 15	6465	1682	26.02%	1503	23.25%
Jan 16	6632	1788	26.96%	1531	23.09%
Feb 16	6813	1891	27.76%	1579	23.18%
Mar 16	6966	1983	28.47%	1615	23.18%
Apr 16	7100	2094	29.49%	1645	23.17%
May 16	7255	2197	30.28%	1692	23.32%
Jun 16	7372	2265	30.72%	1732	23.49%
Jul 16	7409	2279	30.76%	1754	23.67%
Aug 16	7486	2308	30.83%	1788	23.88%

The research presented herein analyzes usage patterns of early adopter customers whose characteristics (including consumption patterns) are often markedly different from the general population. One characteristic in particular is the penetration of PV systems. Currently PV owners are over represented in the PEV rates class. The residential population in SDG&E's service territory consists of approximately 8% to 9% NEM customers while NEM customers represent 24%-30% of the single-meter PEV rate class as seen in Table 2. SDG&E believes that customers with PV systems tend to be more affluent with higher monthly consumption and greater awareness/desire to modify usage behavior when compared to the general residential population. We cannot conjecture what the penetration of NEM will be in the future as the adoption of PEVs continues to grow. DR enrollment has stayed fairly consistent throughout the past year. Prior years had seen expansive growth, which was attributed to more aggressive recruitment strategies.

SDG&E Separate-Meter PEV Rate (EVTOU):

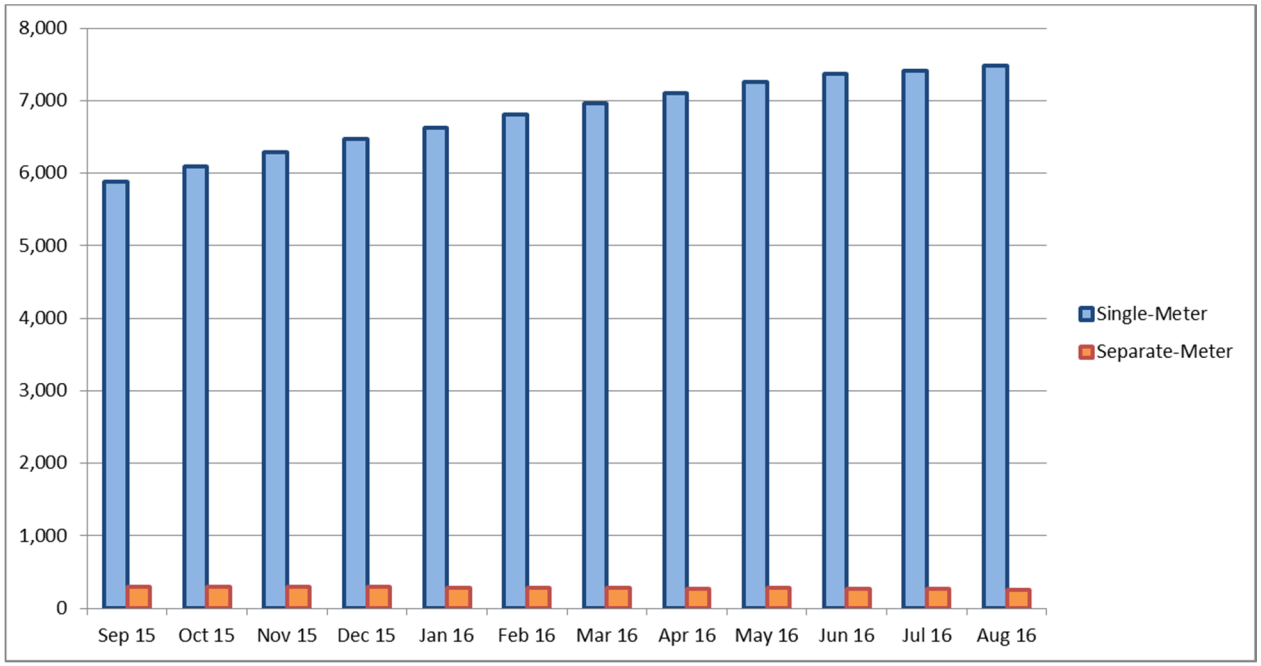
EVTOU:

The EVTOU rate option is designed for residential customers that have their PEV load on a dedicated meter. This is an optional rate to domestic service for charging of a currently registers motor vehicle which is one of the following: (1) a BEV or plug-in hybrid electric vehicle (PHEV) recharged via a recharging outlet at the customer's premise; or, (2) an NGV refueled via an HRA at the customer's premise. The point of service must contain facilities to separately meter PEV or Compressed Natural Gas (CNG) charging. The on-peak period for this rate is 12:00 – 20:00 daily.

SDG&E Table 3: NEM and DR Program Enrollment for Separate-Meter Rates

Month	Total Customers on Separate-Metering	Total Customers on NEM	NEM as a % of Separate-Metering	Total Customers on DR	DR as a % of Separate-Metering
Sep 15	297	96	32.32%	42	14.14%
Oct 15	296	98	33.11%	44	14.86%
Nov 15	293	97	33.11%	46	15.70%
Dec 15	291	99	34.02%	46	15.81%
Jan 16	285	98	34.39%	46	16.14%
Feb 16	282	97	34.40%	47	16.67%
Mar 16	279	97	34.77%	47	16.85%
Apr 16	273	98	35.90%	47	17.22%
May 16	276	99	35.87%	46	16.67%
Jun 16	270	96	35.56%	47	17.41%
Jul 16	263	96	36.50%	45	17.11%
Aug 16	258	97	37.60%	43	16.67%

SDG&E Chart 1: Number of PEV Customers over Time by Meter Configuration

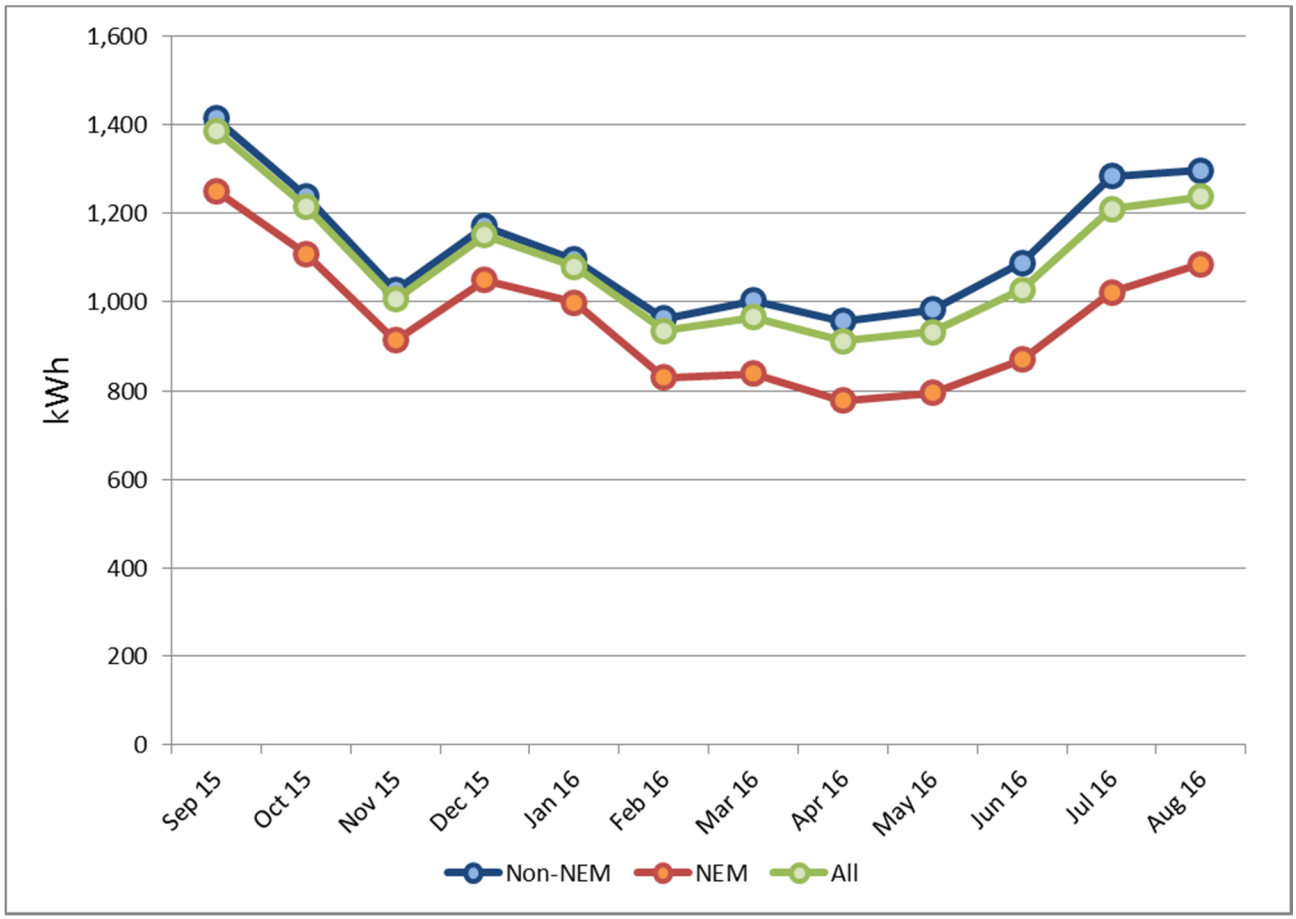


Looking at Table 3 and Chart 1, we can see that the number of customers taking service under these separate-metered rates have remained relatively constant over the past 12 months. The disparity in growth rates between single- and separate-meter customers can be attributed to three factors: (1) only customers who purchased Nissan Leafs or Chevy Volts were eligible for the EPEV rates, (2) the EPEV rates were originally scheduled to close at the end of 2013, and (3) the EPEV rates were closed to new customers in the 2nd quarter of 2013.

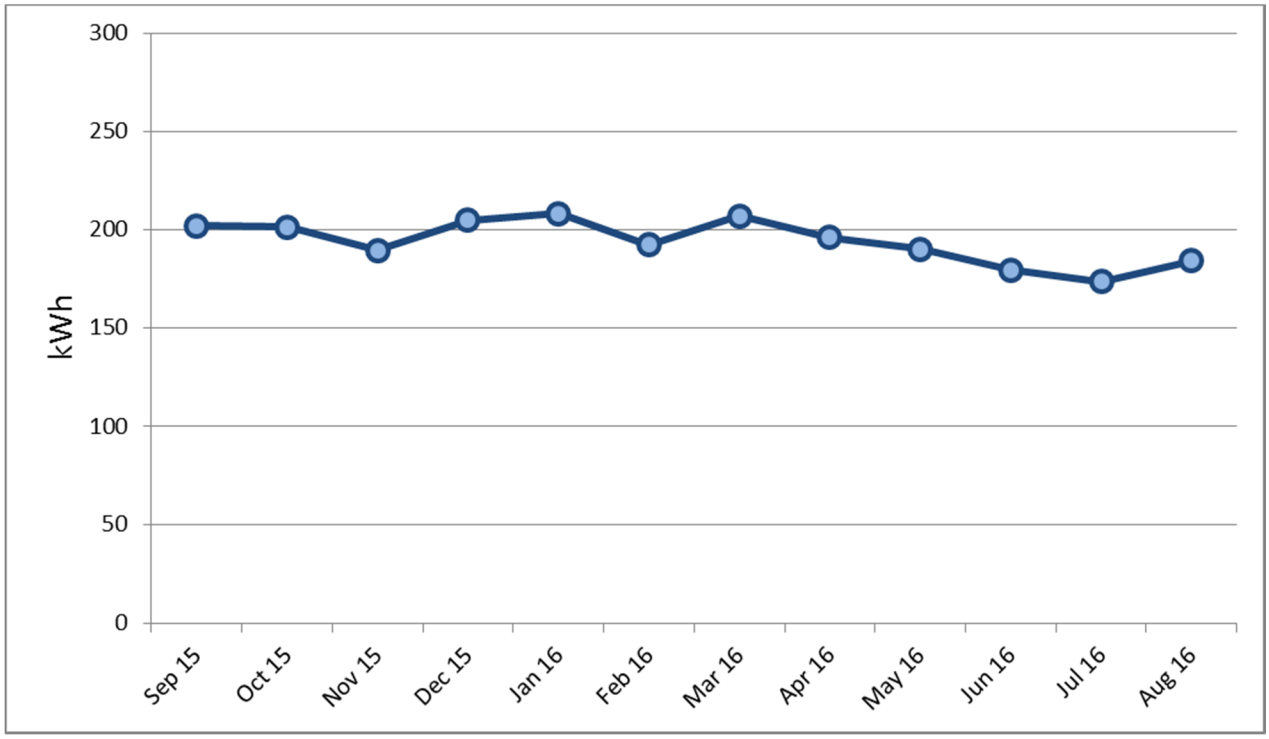
NEM penetration is higher in the separately-metered rates compared to single-meter customers.

Roughly 38% of separate-meter EV customers had solar generation on their house meter compared to 23% for single-meter customers. The average monthly usage follows similar seasonal patterns when comparing NEM and non-NEM single-meter PEV customers. Assuming the car load is approximately 220-260 kWh, the household load for customers on EVTOU-2 is a little less than double the average residential customer load of 485 kWh per month. For comparison purposes, Chart 2 and Chart 3 are included. The shapes on Chart 2 and the data in Tables 6, 7, and 8 are based on delivered energy, and does not net exported energy for NEM customers. The difference between net and delivered energy is about 50%, and applies to 30% of the EVTOU-2 population.

SDG&E Chart 2: Average Monthly Usage for Single-Meter Customers



SDG&E Chart 3: Average Monthly Usage for Separate-Meter Customers



Time of Use Analysis of Single- and Separate-Meter Customers

SDG&E Table 6: Percentage of On-Peak Usage by Meter Configuration

Year	Month	Single-Metering Non-NEM	Single-Metering NEM	Single-Metering	Separate-Metering
2015	9	24.75%	14.22%	22.40%	11.37%
2015	10	22.51%	12.39%	20.18%	11.80%
2015	11	19.21%	13.34%	17.83%	12.68%
2015	12	20.51%	14.76%	19.10%	12.36%
2016	1	19.70%	13.53%	18.12%	13.96%
2016	2	19.74%	10.01%	17.29%	13.62%
2016	3	20.19%	6.98%	16.82%	13.37%
2016	4	20.77%	6.02%	16.98%	12.61%
2016	5	19.84%	5.73%	16.15%	11.21%
2016	6	23.26%	8.27%	19.32%	11.14%
2016	7	24.82%	10.76%	21.14%	11.97%
2016	8	25.21%	11.29%	21.41%	12.51%

One of the questions attempted to be answered by the PEV Pricing Experiment relates to whether the EV rates act as an effective signal to deter on-peak charging. The load shapes provided in Charts 7 and 8 suggest that customers respond to differences in prices and charge their vehicles when electricity is the cheapest. Tables 6, 7, and 8 below provide the percentage share of monthly kWh for single and separate-meter rates. Single-meter customers as a class consume about 50% of their energy during the off-peak TOU period and split the rest evenly between on-peak and super-off peak at 25% each; however, single-meter customers with NEM consume between 5% and 15% of their monthly energy during the on-peak TOU period reflecting usage that is offset by generation. Separate-Meter customers respond well to the signal created by the TOU price differential and consume 73% of their energy during the super-off peak TOU period.

SDG&E Table 7: Percentage of Off-Peak Usage by Meter Configuration

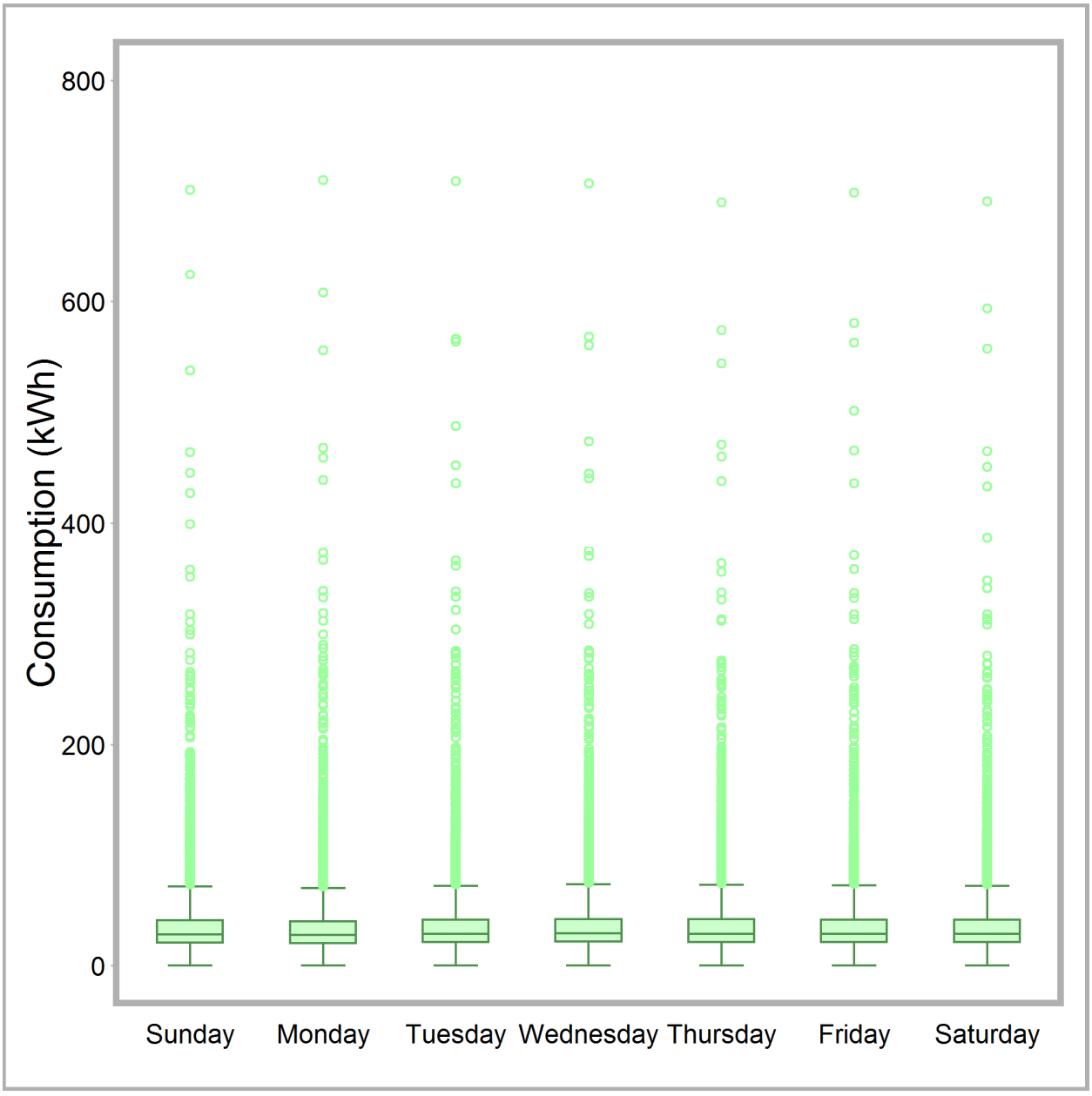
Year	Month	Single-Metering Non-NEM	Single-Metering Non-NEM	Single-Metering	Separate-Metering
2015	9	52.36%	53.72%	52.66%	15.49%
2015	10	52.90%	53.33%	53.00%	13.90%
2015	11	55.71%	51.02%	54.60%	15.40%
2015	12	55.39%	51.89%	54.53%	14.85%
2016	1	55.59%	52.02%	54.68%	15.73%
2016	2	54.61%	51.96%	53.94%	15.67%
2016	3	53.62%	53.28%	53.53%	16.26%
2016	4	52.73%	52.69%	52.72%	15.44%
2016	5	53.61%	52.88%	53.42%	15.76%
2016	6	51.92%	52.79%	52.15%	16.21%
2016	7	52.08%	53.75%	52.52%	15.97%
2016	8	51.42%	54.07%	52.14%	15.09%

SDG&E Table 8: Percentage of Super Off-Peak Usage by Meter Configuration

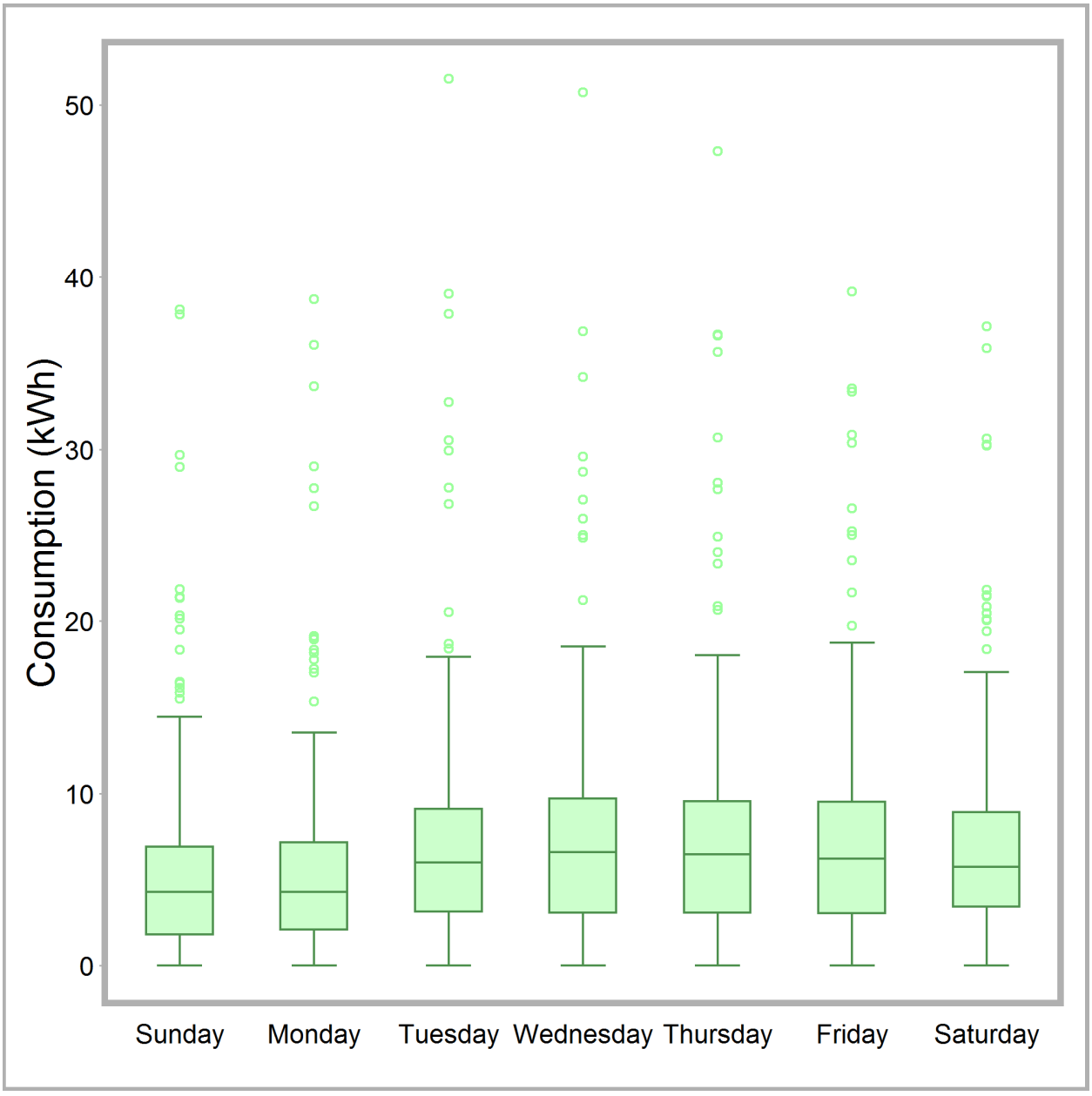
Year	Month	Single-Metering Non-NEM	Single-Metering NEM	Single-Metering	Separate-Metering
2015	9	22.89%	32.06%	24.94%	73.14%
2015	10	24.59%	34.27%	26.82%	74.30%
2015	11	25.08%	35.64%	27.57%	71.92%
2015	12	24.10%	33.35%	26.37%	72.79%
2016	1	24.71%	34.45%	27.20%	70.31%
2016	2	25.64%	38.02%	28.77%	70.72%
2016	3	26.19%	39.74%	29.65%	70.37%
2016	4	26.50%	41.28%	30.30%	71.95%
2016	5	26.55%	41.39%	30.43%	73.02%
2016	6	24.82%	38.93%	28.53%	72.65%
2016	7	23.09%	35.49%	26.34%	72.06%
2016	8	23.38%	34.64%	26.45%	72.41%

The box and whisker plots in Charts 6a and 6b show the distribution of customers' average daily usage by day of the week. As you can see, there is a lot of variation in the single-meter rate but not in the separate-meter rates. We would expect this since there are fewer factors that can affect consumption on a meter solely designated for PEV charging compared to consumption for a whole house. It is clear to see in Chart 6b, that Sunday and Monday have lower kWh on average than the rest of the week. We further explore this finding in the load profiles for each meter type in Chart 7 and 8 below.

SDG&E Chart 6a: Box and Whisker Plot for Single-Meter Energy Consumption by Day of the Week



SDG&E Chart 6b: Box and Whisker Plot for Separate-Meter Energy Consumption by Day of the Week



Average Load Profiles

Chart 7 looks at the average load profile for each day of the week for single-meter PEV customers. The load shapes remain relatively flat during the day with an increase in evening consumption. This behavior is similar to a typical residential load profile except that we see a large spike in the early morning (super off-peak) hours. This is the effect of customers taking advantage of the super off-peak- pricing to charge their vehicles. You'll notice that Sundays and Mondays exhibit similar charging patterns. Since customers change their behavior to take advantage of super off-peak pricing, charging occurs in the early morning on the day after the vehicle was used (presumable driving to work Monday –

Friday). If the electric vehicle sits idle during the weekend (Saturday and Sunday) significant charging is not conducted on Sunday and Monday.

SDG&E Chart 7: Average Load Profile for Single-Meter Customers by Day of the Week

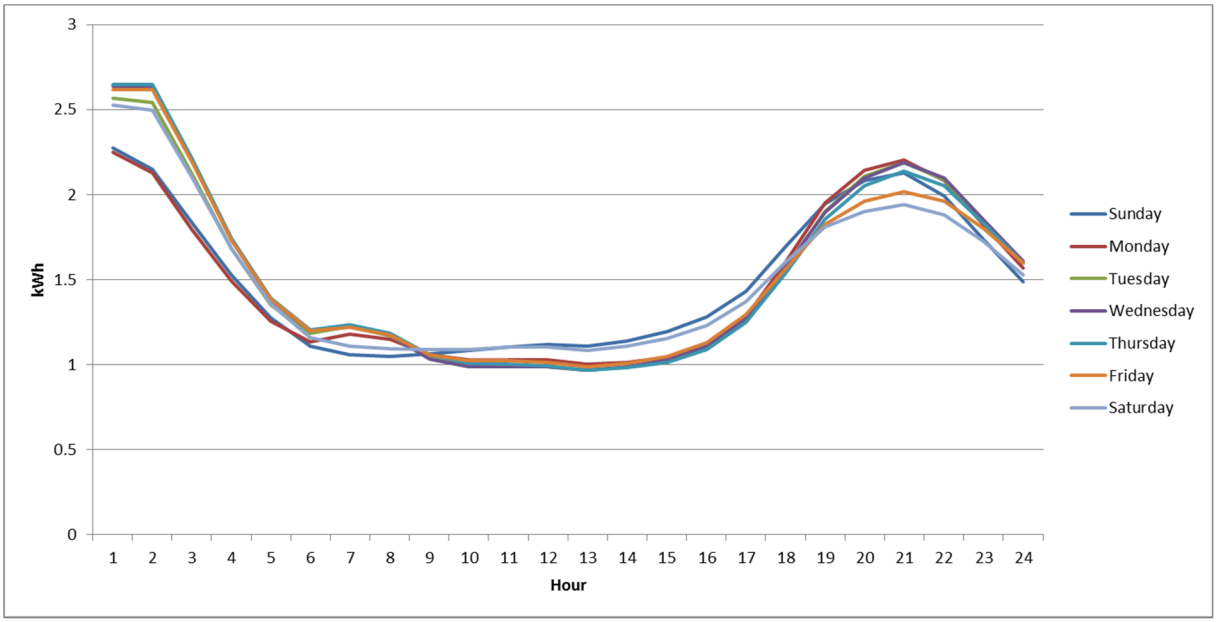
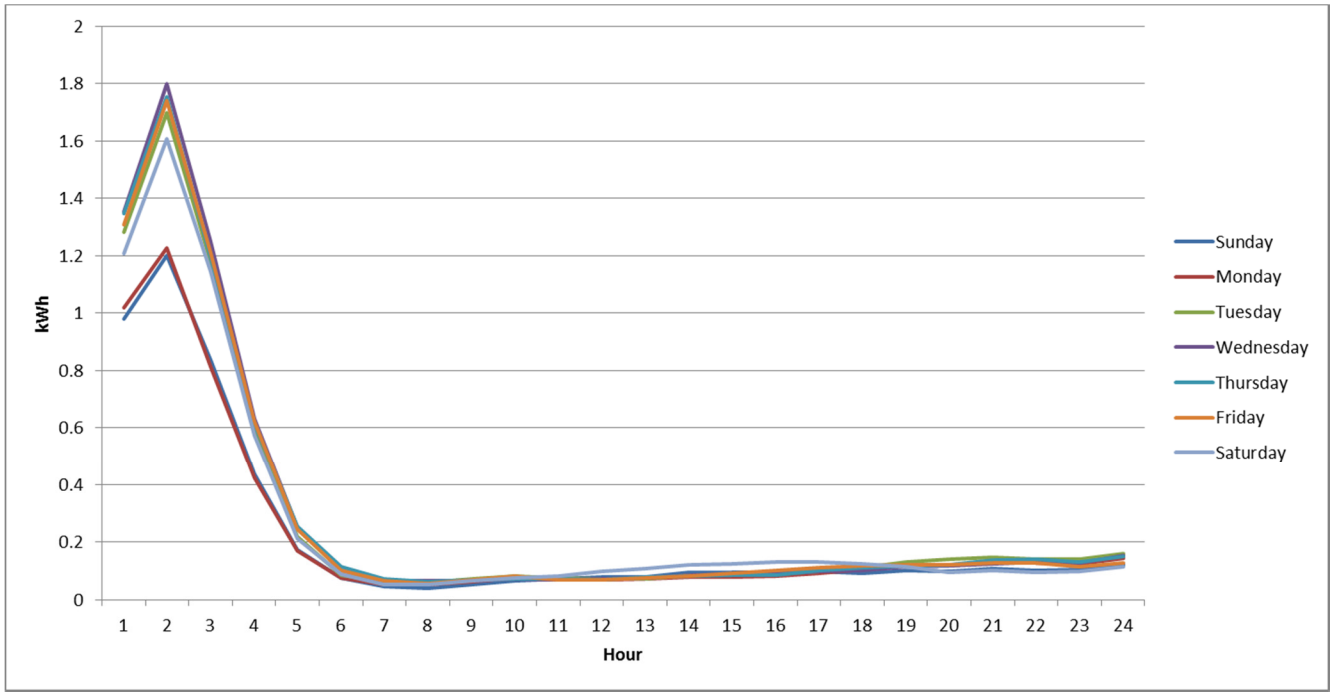


Chart 8 takes the same approach except for separate-meter PEV customers. These accounts peak in the 01:00 – 02:00 hours and have virtually zero consumption during the rest of the day. This would indicate that the rates and enabling technology are extremely successful in encouraging charging during super off-peak hours. This chart also shows that consumption on Sundays and Mondays is substantially lower than the rest of the week. Again, Sunday and Monday exhibit similar charging patterns that are consistent with the single-meter customers.

SDG&E Chart 8: Average Load Profile for Separate-Meter Customers by Day of the Week



SDG&E Chart 9: Average Load Profile for PEV Owners on a Non-PEV Rate by Day of the Week

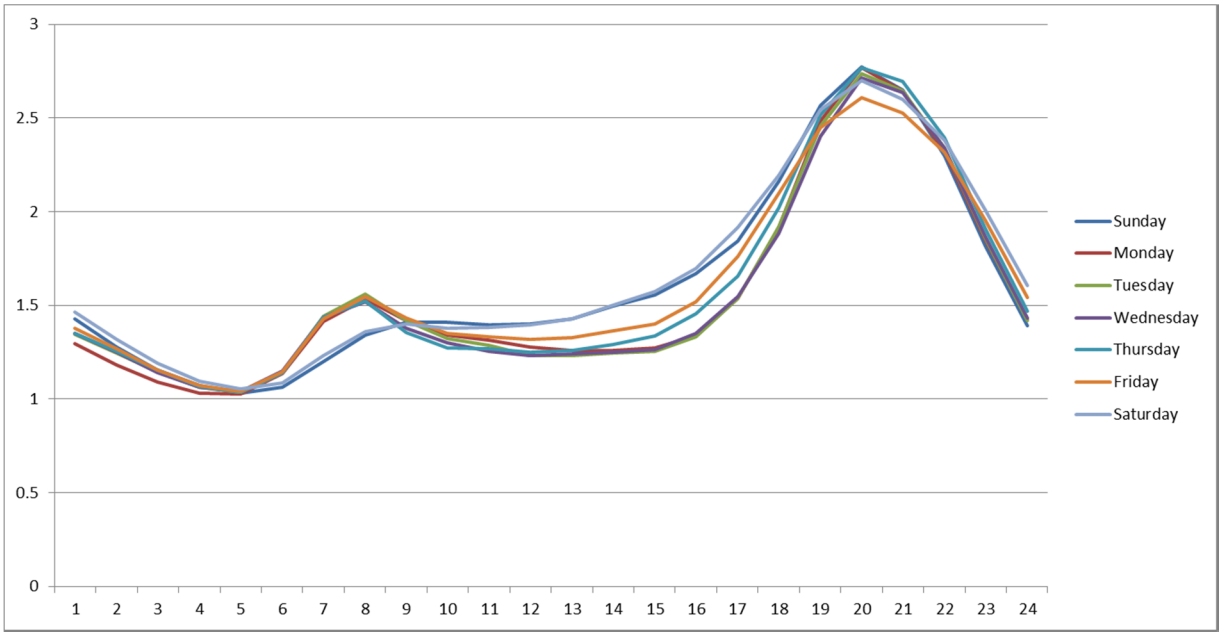


Chart 9 shows the same daily load profiles for customers who we believe to own a PEV, but are not currently taking service under one of the aforementioned PEV rates. We do not have a way to verify whether or not these customers actually own a PEV, but SDG&E has developed an algorithm to attempt

to identify PEV owners. Since we cannot definitively say that all of these customers own a PEV, we should use caution when making inferences about the data presented in Chart 9.

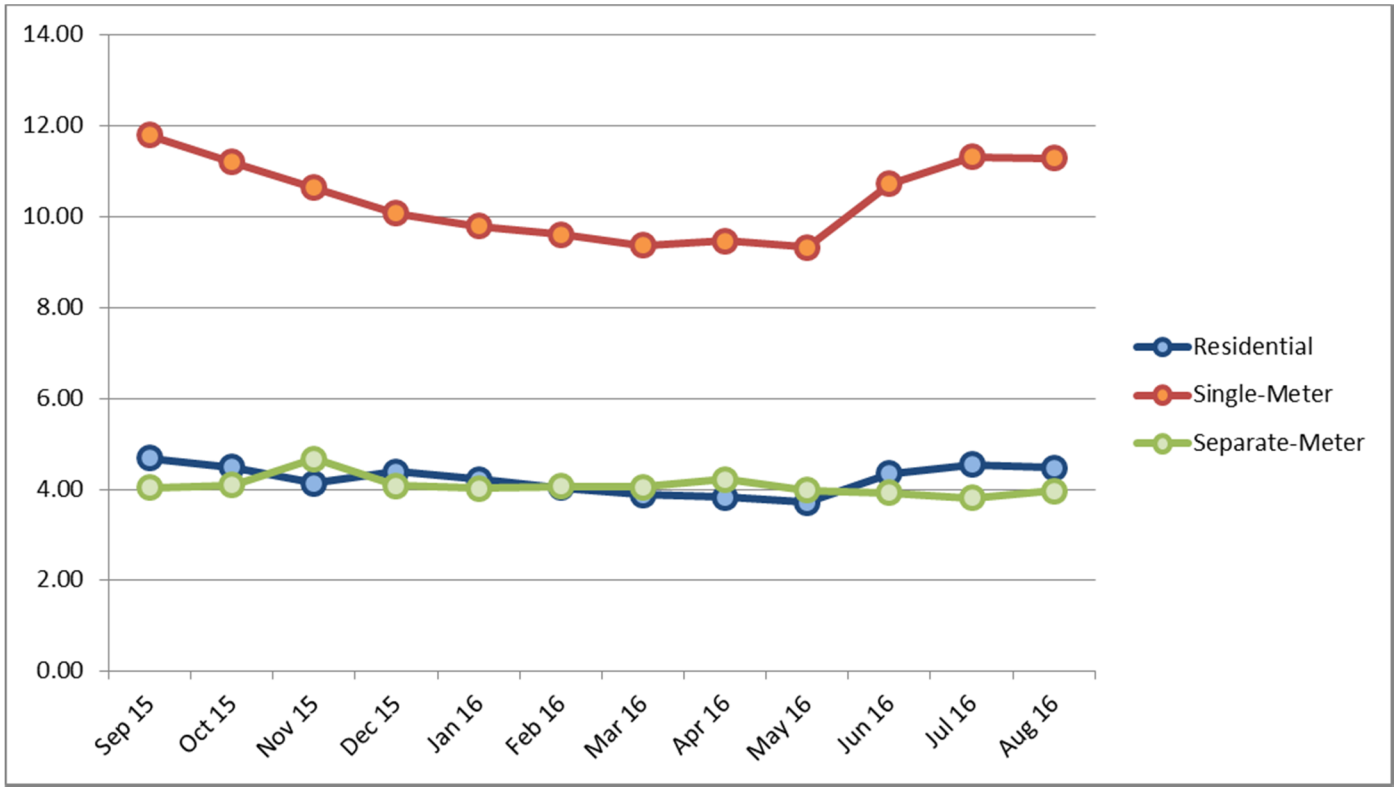
Average Non-Coincident Peak Load

Table 9 shows that the average non-coincident peak load for separate-meter customers is nearly constant at 4.20 kW as this is roughly the max setting on the Leaf EVSEs. Single-Meter customers have a non-coincident demand more than twice that of the average residential customer.

SDG&E Table 9: Monthly Average Non-Coincident Peak Load (kW)

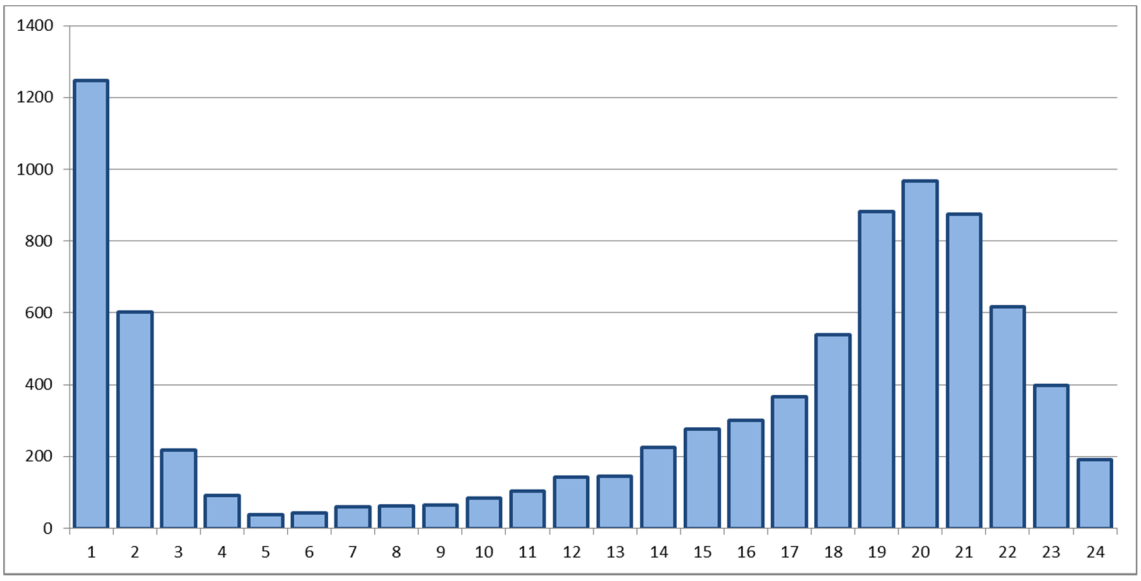
Month	Residential Pop.	Single-Meter	Separate-Meter
Sep 15	4.69	11.78	4.04
Oct 15	4.49	11.19	4.09
Nov 15	4.13	10.62	4.68
Dec 15	4.38	10.07	4.08
Jan 16	4.22	9.79	4.02
Feb 16	4.04	9.60	4.06
Mar 16	3.88	9.36	4.05
Apr 16	3.82	9.46	4.22
May 16	3.71	9.33	3.98
Jun 16	4.35	10.71	3.92
Jul 16	4.55	11.31	3.82
Aug 16	4.47	11.28	3.97

SDG&E Chart 10: Average Non-Coincident Peak Load (kW) by Customer Type and Month



The histogram in Chart 11 provides a distribution of the hours in which single-meter customers' non-coincident peak demand occurs. The majority of peaks for single-meter customers occur in the super off-peak TOU period, but 33% of the peaks still occur between 19:00 and 21:00.

SDG&E Chart 11: Hourly Occurrence of Non-Coincident Peak Load for Single-Meter Customers



Time and Average Diversified Peak Load

SDG&E Table 10: Time and Associated Demand of Diversified Peak Load

Month	Resdiential		Single-Meter		Separate-Meter	
	Time	kW	Time	kW	Time	kW
Sep 15	8:00PM	1.75	8:30 PM	4.84	1:30 AM	2.13
Oct 15	5:00 PM	1.44	1:15 AM	3.94	1:30 AM	2.21
Nov 15	6:45PM	1.03	12:30 AM	5.08	12:30 AM	2.26
Dec 15	7:00 PM	1.14	1:15 AM	3.51	1:30 AM	2.31
Jan 16	6:45PM	1.08	1:15 AM	3.30	1:30 AM	2.19
Feb 16	6:45PM	1.05	1:15 AM	3.42	1:30 AM	2.15
Mar 16	6:45PM	0.98	1:15 AM	3.16	1:30 AM	2.13
Apr 16	8:15 PM	0.90	1:15 AM	3.21	1:30 AM	2.07
May 16	8:30 PM	0.82	1:15 AM	3.16	1:30 AM	2.00
Jun 16	6:30PM	1.40	12:30 AM	3.60	1:30 AM	1.97
Jul 16	6:30 PM	1.51	12:30 AM	4.00	1:30 AM	1.85
Aug 16	6:30 PM	1.44	8:30 PM	3.86	1:30 AM	1.93

With the exception of single-meter customers in August and September, both single-meter and separate-meter customers peak as a class around 01:15 and 01:45 driven by PEV charging behavior. The residential class peaks in the early evening hours.

Table Accompanying Chart 11

Hour	Count	%
1	1247	15%
2	602	7%
3	218	3%
4	92	1%
5	37	0%
6	42	0%
7	60	1%
8	62	1%
9	65	1%
10	85	1%
11	103	1%
12	142	2%
13	145	2%
14	226	3%
15	277	3%
16	301	4%
17	366	4%
18	539	6%
19	882	10%
20	967	11%
21	876	10%
22	616	7%
23	398	5%
24	190	2%

Average Load Coincident With System Peak

SDG&E Table 11: Average Load Coincident With System Peak

Month	Residential	Single-Meter	Separate-Meter
Sep 14	1.44	3.22	0.09
Oct 14	1.23	2.82	0.09
Nov 14	0.99	2.48	0.14
Dec 14	1.09	2.72	0.07
Jan 15	1.06	2.55	0.20
Feb 15	0.82	2.10	0.11
Mar 15	0.97	2.39	0.11
Apr 15	0.79	2.04	0.09
May 15	0.53	0.93	0.07
Jun 15	1.22	2.06	0.06
Jul 15	1.36	2.53	0.18
Aug 15	1.23	2.21	0.09

Separate-Meter customers have extremely low demand coincident with system peak because this is when their cost per kWh is the highest. Single-Meter customers on the other hand more than double the coincident demand of the average residential customers.

Geographic Concentration of PEV Owners

SDG&E Table 12a: Geographic Concentration of PEVs (Top Five Zip Codes by Meter Configuration)

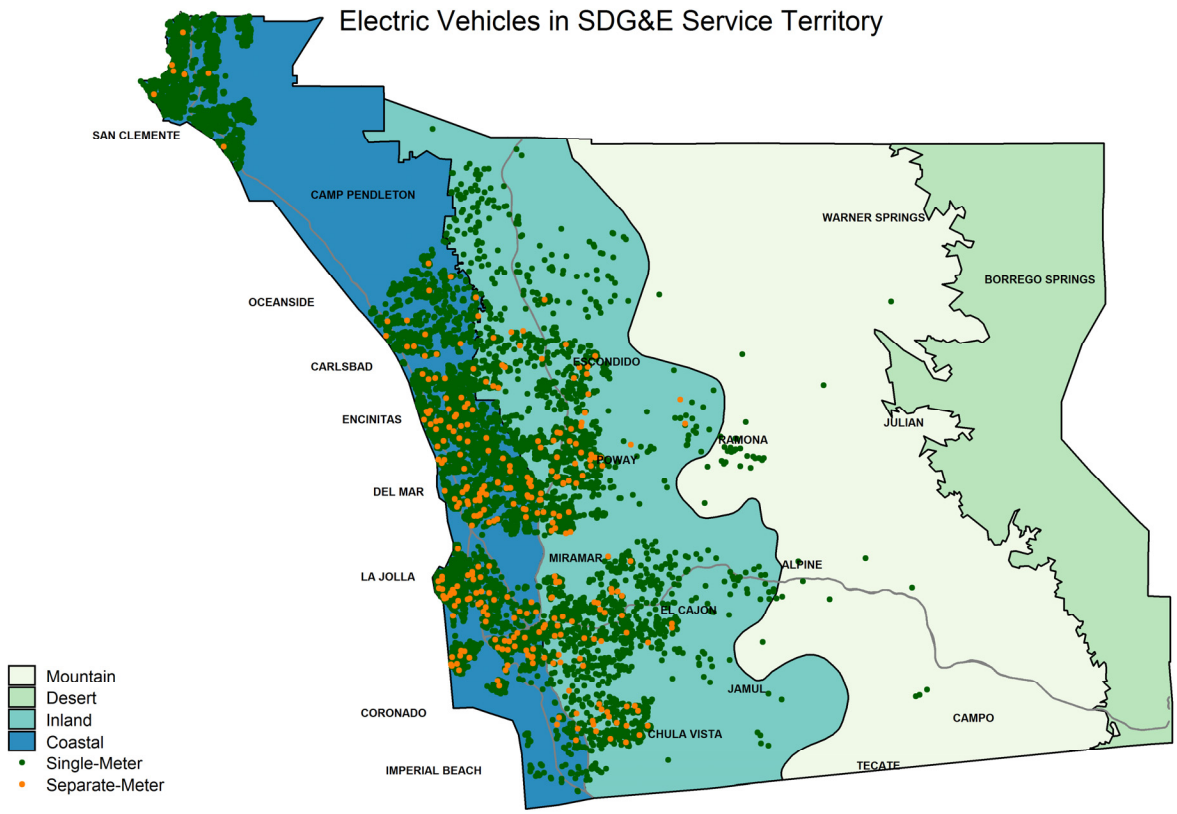
Rate	Zip Code	Area	Number of Customers	Percent of Total
Single-Meter	92037	La Jolla	382	4%
	92128	San Diego	339	4%
	92064	Poway	339	4%
	92131	Scripps Ranch	329	4%
	92117	Clairemont	306	4%
Separate-Meter	92037	La Jolla	16	5%
	92067	Rancho Santa Fe	12	4%
	92127	San Diego	11	3%
	92024	Encinitas	10	3%
	92677	Laguna Nigel	10	3%

SDG&E Table 12b: Geographic Concentration of PEVs by Climate Zone and Meter Configuration

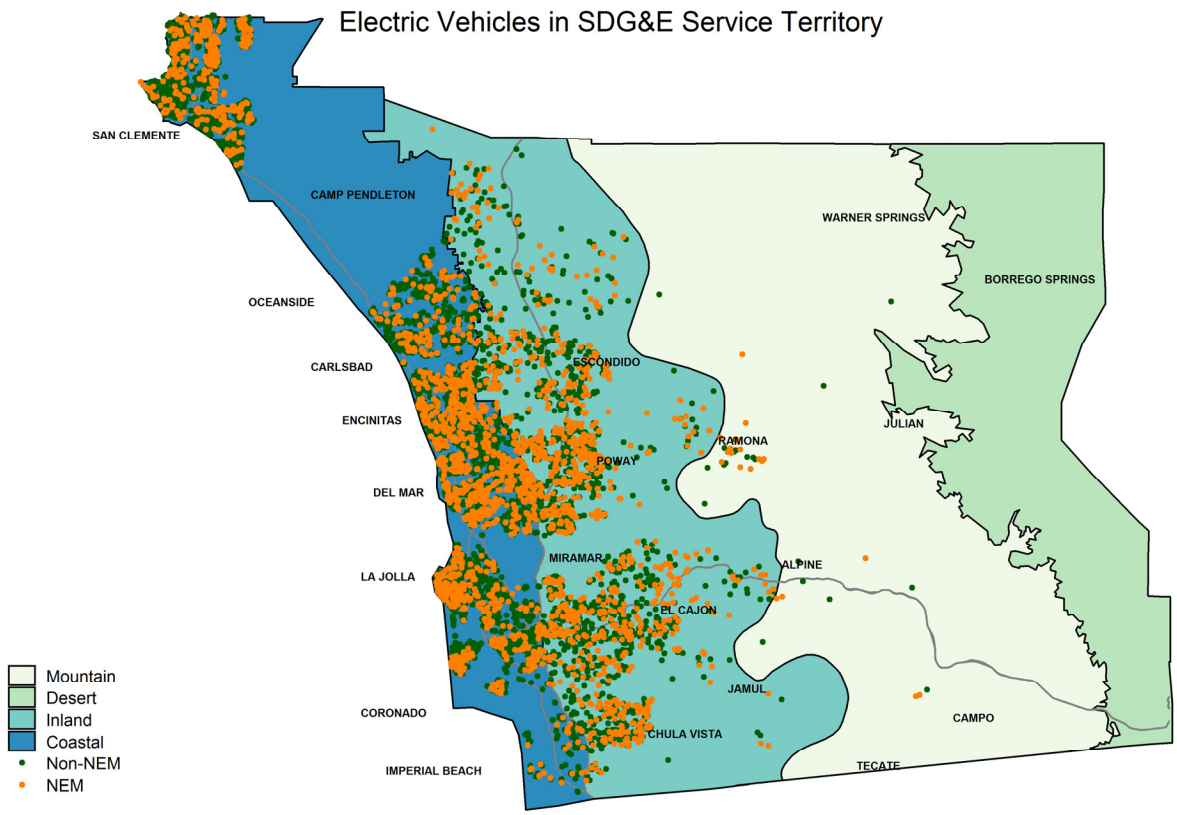
Climate Zone	Single-Meter	Separate-Meter	Total	Percent of Total
Coastal	6,017	208	6,225	70%
Mountain/Desert	45	0	45	0%
Inland	2,502	130	2,632	30%

70% of PEV owners are located in the coastal climate zone with the remaining 30% located in the inland zone. The results presented in Table 12a, Chart 12a, and Chart 12b show that PEV ownership is heavily concentrated in more affluent areas in the service territory (La Jolla, Rancho Santa Fe, etc.)

SDG&E Figure 1: Geographic Concentration of PEVs by Meter Configuration



SDG&E Figure 2: Geographic Concentration of PEVs by NEM



Conclusions and Observations

PG&E

- While the data collected are illustrative of the behaviors of early PEV adopters, one cannot conclude that these behavior patterns will hold as PEV technology matures, charging technology and charging behaviors evolve, and PEVs achieve greater market adoption beyond the early adopter phase. Consequently, data that is sufficiently reliable for policymaking can only be obtained via an appropriately funded and carefully designed study that controls for the above issues.
- There is evidence that, amongst this group of early adopters and for this current composition of vehicles, customers on TOU PEV rates are charging during off-peak periods: all EV-A customers use a lower percentage of energy in the on-peak period and a higher percentage in the off-peak period as compared to the residential population; and the diversified peak for customers on EV-A or EV-B occurs between 12am – 2am.
- On average, the PEV early adopters have a higher maximum demand that must be accommodated by the electric distribution system as compared to the average household without a PEV.
- Although the early adopter PEV customers may have a higher average maximum demand, those customers on the PEV rates tend to hit their maximum demand while non-PEV customers are at their lowest usage. Thus, there appears to be a diversity benefit created by the TOU rates. However, from the most local service assessment level perspective (i.e., a single household or set of households serviced by a single transformer), the value of this diversity is limited by the fact that the distribution system must still be prepared to accommodate PEV charging during the peak period since these customers can, and occasionally do, charge during those times.
- All of the above conclusions are subject to change as the mix of customers and vehicles changes over time. During the study timeframe, the rapidly changing nature of PEV ownership was clearly evident in the changes that occurred in the mix of customers who own PEVs and types of PEVs available. These changes will need to be considered in ratemaking and cost allocation policymaking. Therefore, California will need to continue to be flexible and adaptable with respect to PEV policies.

SCE

- Identification of single-metered TOU and regular domestic accounts of PEV owners relies on self-identification and therefore is subject to large selection bias. Furthermore, present ownership of a PEV is unknown, thus whether PEV charging load is a component of the metered household load cannot be determined. The reliability of this information therefore cannot be guaranteed. SCE believes that more PEV owners will self-identify in 2017 in order to claim the rebate that will be offered through the Clean Fuel Reward Program.
- The statistics and metrics found in this report are based on a relatively small sub-population of the total numbers of vehicles sold. As fuel and materials costs fluctuate, vehicle options expand, and technology continues to adapt to customer needs, the future population of owners may have different characteristics and behaviors than the current group. To date, each subsequent report has contained more PEVs but the electric use patterns have remained very consistent.

- This report is the first to exclusively report on the TOU-D-A/B tariff as the single-metered PEV charging option. This tariff offers a ten-hour off-peak window and the choice of a Baseline Credit and higher on- and mid-peak rates (Options A) or a Basic Charge coupled with lower on and mid-peak rates (Option B). Though the rate is designed to accommodate the charging of PEVs, it is open to any residential customer.
- In each of the load research reports filed, accounts with the NEM rate option have consistently comprised 25%-30% of single-metered households on a TOU rate. TOU accounts with self-generation will have significantly different load shapes than TOU accounts without.
- A total of 8,440 accounts believed to have a PEV charging under the single-meter TOU-D-A/B tariff existed as of the beginning of August 2016. However, as this rate is open to all residential customers, SCE must rely on self- identification. Therefore, account growth may not represent the actual numbers of PEVs on the single-metered TOU option or the broader PEV market growth.
- Separately-metered PEV owners maintained a monthly average usage of 339 kWh, which is slightly smaller from the 350 kWh/month reported during the previous two reports.
- Non-coincident peak demand for the separately-metered PEVs on average remained unchanged from the prior reported year at 7.5 kW. Sixty-two percent of the annual non-coincident peak demands during the current reporting period occurred in the six hours from 10 p.m. to 3 a.m.
- Charging continues to appear concentrated in the off-peak TOU period for single-metered PEV customers. For the separately-metered PEVs, off-peak charging remained just under 90% as in the previous two reports.
- There are no appreciable seasonal charging patterns from the identified PEVs, but charging appears to be lower on weekends.
- In contrast to SCE's general residential population, PEV owners identified for this report reside disproportionately -in milder coastal areas, which tend to be more densely populated and likely require shorter commutes with greater access to charging infrastructure.
- Of zip codes with the most PEVs, Irvine exhibited the largest growth of PEVs under the single-metered tariff. For separately-metered PEVs, Santa Monica had the largest growth of accounts.

SDG&E

- Current TOU rates coupled with charging timers result in super off-peak PEV charging.
- Customers with PEVs that stay on SDG&E's typical residential non-TOU rate tend to show less usage during the super off peak period and increased usage during the afternoon-evening hours relative to those on PEV rates.
- NEM customers with PEVs respond to TOU rates.
- Demand and usage levels for these PEV adopters are nearly double that of the average residential customer.
- Peak times for PEV Demands are typically in the early morning hours compared to evenings for typical residential customers.
- Sundays & Mondays have the lowest daily kWh consumed, for PEV customers on TOU rates.
- EV-TOU-2 (SDG&E's whole-house TOU rate) customer growth has increased 27% from September 2015 to August 2016, which may cause instability in current Load Research results.

Appendix A: Additional Rates for the Tariffs Offered by Southern California Edison from September 2015 to August 2016

Table A – 1a: Single Meter (TOU-D-A/B) Tariff ($/kWh) – Effective 6/1/2015

	Option A				Option B			
Clock Hour Ending	Winter		Summer		Winter		Summer	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
2	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
4	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
6	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
7	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
8	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
9	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
10	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
11	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
12	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
13	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
14	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
15	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
16	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
17	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
18	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
19	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
20	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
21	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
22	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
23	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
24	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11

Option A: 0.10 Baseline Credit

Option B: 0.54 meter/day Basic Charge

Table A – 1b: Single Meter (TOU-D-A/B) Tariff ($/kWh) – Effective 10/1/2015

	Option A				Option B			
Clock Hour Ending	Winter		Summer		Winter		Summer	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
2	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
4	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
6	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
7	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
8	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
9	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
10	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
11	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
12	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
13	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
14	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
15	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
16	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
17	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
18	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
19	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
20	0.36	0.26	0.46	0.30	0.25	0.14	0.35	0.18
21	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
22	0.26	0.26	0.30	0.30	0.14	0.14	0.18	0.18
23	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
24	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11

Option A: 0.10 Baseline Credit

Option B: 0.54 meter/day Basic Charge

Table A – 1c: Single Meter (TOU-D-A/B) Tariff ($/kWh) – Effective 11/24/2016

	Option A				Option B			
Clock Hour Ending	Winter		Summer		Winter		Summer	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
2	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
4	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
6	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
7	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
8	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
9	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
10	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
11	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
12	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
13	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
14	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
15	0.35	0.25	0.45	0.29	0.24	0.14	0.34	0.18
16	0.35	0.25	0.45	0.29	0.24	0.14	0.34	0.18
17	0.35	0.25	0.45	0.29	0.24	0.14	0.34	0.18
18	0.35	0.25	0.45	0.29	0.24	0.14	0.34	0.18
19	0.35	0.25	0.45	0.29	0.24	0.14	0.34	0.18
20	0.35	0.25	0.45	0.29	0.24	0.14	0.34	0.18
21	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
22	0.25	0.25	0.29	0.29	0.14	0.14	0.18	0.18
23	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
24	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11

Option A: 0.10 Baseline Credit

Option B: 0.54 meter/day Basic Charge

Table A – 1d: Single Meter (TOU-D-A/B) Tariff ($/kWh) – Effective 6/1/2016

	Option A				Option B			
Clock Hour Ending	Winter		Summer		Winter		Summer	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
2	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
3	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
4	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
5	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
6	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
7	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
8	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
9	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
10	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
11	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
12	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
13	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
14	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
15	0.33	0.28	0.44	0.28	0.22	0.16	0.32	0.17
16	0.33	0.28	0.44	0.28	0.22	0.16	0.32	0.17
17	0.33	0.28	0.44	0.28	0.22	0.16	0.32	0.17
18	0.33	0.28	0.44	0.28	0.22	0.16	0.32	0.17
19	0.33	0.28	0.44	0.28	0.22	0.16	0.32	0.17
20	0.33	0.28	0.44	0.28	0.22	0.16	0.32	0.17
21	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
22	0.28	0.28	0.28	0.28	0.16	0.16	0.17	0.17
23	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13
24	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13

Option A: 0.10 Baseline Credit

Option B: 0.54 meter/day Basic Charge

Table B – 1a: Separate Meter (TOU-EV-1) Tariff ($/kWh) – Effective 6/1/2015

Clock Hour Ending	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
1	0.11	0.11	0.12	0.12
2	0.11	0.11	0.12	0.12
3	0.11	0.11	0.12	0.12
4	0.11	0.11	0.12	0.12
5	0.11	0.11	0.12	0.12
6	0.11	0.11	0.12	0.12
7	0.11	0.11	0.12	0.12
8	0.11	0.11	0.12	0.12
9	0.11	0.11	0.12	0.12
10	0.11	0.11	0.12	0.12
11	0.11	0.11	0.12	0.12
12	0.11	0.11	0.12	0.12
13	0.23	0.11	0.36	0.12
14	0.23	0.11	0.36	0.12
15	0.23	0.11	0.36	0.12
16	0.23	0.11	0.36	0.12
17	0.23	0.11	0.36	0.12
18	0.23	0.11	0.36	0.12
19	0.23	0.11	0.36	0.12
20	0.23	0.11	0.36	0.12
21	0.23	0.11	0.36	0.12
22	0.11	0.11	0.12	0.12
23	0.11	0.11	0.12	0.12
24	0.11	0.11	0.12	0.12

Meter Charge: $2.64/month

Table B – 1b: Separate Meter (TOU-EV-1) Tariff ($/kWh) – Effective 10/1/2015

Clock Hour Ending	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
1	0.11	0.11	0.12	0.12
2	0.11	0.11	0.12	0.12
3	0.11	0.11	0.12	0.12
4	0.11	0.11	0.12	0.12
5	0.11	0.11	0.12	0.12
6	0.11	0.11	0.12	0.12
7	0.11	0.11	0.12	0.12
8	0.11	0.11	0.12	0.12
9	0.11	0.11	0.12	0.12
10	0.11	0.11	0.12	0.12
11	0.11	0.11	0.12	0.12
12	0.11	0.11	0.12	0.12
13	0.22	0.11	0.36	0.12
14	0.22	0.11	0.36	0.12
15	0.22	0.11	0.36	0.12
16	0.22	0.11	0.36	0.12
17	0.22	0.11	0.36	0.12
18	0.22	0.11	0.36	0.12
19	0.22	0.11	0.36	0.12
20	0.22	0.11	0.36	0.12
21	0.22	0.11	0.36	0.12
22	0.11	0.11	0.12	0.12
23	0.11	0.11	0.12	0.12
24	0.11	0.11	0.12	0.12

Meter Charge: $2.64/month

Table B – 1c: Separate Meter (TOU-EV-1) Tariff ($/kWh) – Effective 11/24/2016

Clock Hour Ending	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
1	0.11	0.11	0.12	0.12
2	0.11	0.11	0.12	0.12
3	0.11	0.11	0.12	0.12
4	0.11	0.11	0.12	0.12
5	0.11	0.11	0.12	0.12
6	0.11	0.11	0.12	0.12
7	0.11	0.11	0.12	0.12
8	0.11	0.11	0.12	0.12
9	0.11	0.11	0.12	0.12
10	0.11	0.11	0.12	0.12
11	0.11	0.11	0.12	0.12
12	0.11	0.11	0.12	0.12
13	0.22	0.11	0.35	0.12
14	0.22	0.11	0.35	0.12
15	0.22	0.11	0.35	0.12
16	0.22	0.11	0.35	0.12
17	0.22	0.11	0.35	0.12
18	0.22	0.11	0.35	0.12
19	0.22	0.11	0.35	0.12
20	0.22	0.11	0.35	0.12
21	0.22	0.11	0.35	0.12
22	0.11	0.11	0.12	0.12
23	0.11	0.11	0.12	0.12
24	0.11	0.11	0.12	0.12

Meter Charge: $2.64/month

Table B – 1d: Separate Meter (TOU-EV-1) Tariff ($/kWh) – Effective 6/1/2016

Clock Hour Ending	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
1	0.14	0.14	0.14	0.14
2	0.14	0.14	0.14	0.14
3	0.14	0.14	0.14	0.14
4	0.14	0.14	0.14	0.14
5	0.14	0.14	0.14	0.14
6	0.14	0.14	0.14	0.14
7	0.14	0.14	0.14	0.14
8	0.14	0.14	0.14	0.14
9	0.14	0.14	0.14	0.14
10	0.14	0.14	0.14	0.14
11	0.14	0.14	0.14	0.14
12	0.14	0.14	0.14	0.14
13	0.22	0.14	0.32	0.14
14	0.22	0.14	0.32	0.14
15	0.22	0.14	0.32	0.14
16	0.22	0.14	0.32	0.14
17	0.22	0.14	0.32	0.14
18	0.22	0.14	0.32	0.14
19	0.22	0.14	0.32	0.14
20	0.22	0.14	0.32	0.14
21	0.22	0.14	0.32	0.14
22	0.14	0.14	0.14	0.14
23	0.14	0.14	0.14	0.14
24	0.14	0.14	0.14	0.14

Meter Charge: $2.70/month