BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Programs, Tariffs, and Policies.	Rulemaking 13-11-007 (Filed November 14, 2013)

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

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December 29, 2017

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San Diego Gas & Electric Company, on behalf of itself, Southern California Edison Company, and Pacific Gas and 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 Commission's Energy Division with input from stakeholders pursuant to Ordering Paragraph 3 of D.13-06-014.

Respectfully submitted

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December 29, 2017

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

APPENDIX A

JOINT IOU ELECTRIC VEHICLE LOAD

RESEARCH REPORT

Joint IOU Electric Vehicle

Load Research Report

6th Report

Filed on December 29, 2017

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 1
Part 1: Introduction 2
Part 2: Scope of Load Research 3
Part 3: Cost Tracking Data, Findings, and Policy Recommendations 5
Introduction 5
Approach 5
Summary Data 8
PG&E Specific Details 9
SCE Specific Details 10
SDG&E Specific Details 11
Conclusions/Recommendations 12
Part 4: Load Research and Customer Behavior on Rates in Various Settings 12
Introduction 12
Pacific Gas and Electric Company 15
Southern California Edison 43
San Diego Gas and Electric 73
Conclusions and Observations 91

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 2017 report (6th Load Research Report) includes data through October 2017 for service line and distribution system upgrades, and for the period September 2016 through August 2017 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, 2017, the IOUs estimate there are over 277,365 PEVs within the three service territories. Of the 277,365 vehicles estimated to be currently on the road, only 460 or 0.16%, have required a service line or distribution system upgrade solely to support the PEV load at their residential charging location. In all but 69 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 evaluated the service and distribution system upgrades needed

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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

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.

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.

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.

At the time of this report, December 2017, Go Electric Drive lists on its EV showroom 42 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 277,365 PEVs are in their service territories, as of October 31, 2017. The number of PEVs forecasted to be operating in the IOUs service territories from 2018 through 2023 are:

Year	PG&E[9]	SCE[10]	SDG&E[11]
2018	150,000	148,446	27,589
2019	174,000	198,165	33,008
2020	201,000	256,531	40,610
2021	256,000	319,443	50,240
2022	296,000	388,308	64,918
2023	369,000	461,924	81,492

This report includes data through October 2017 for service line and distribution system upgrades and for the period September 2016 through August 2017 for load research data along with the conclusions reached analyzing the data. Data from prior Load Research Reports are also considered in drawing conclusions. It is important to note that the behavior of these PEV owners may not be representative of the typical PEV adopters. While the data collected is illustrative of the behaviors of customers on PEV rates, these behavior patterns may not hold as PEV technology matures, charging technology and charging behaviors evolve, and PEVs achieve greater market adoption.

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.[12] The CPUC determined that additional research is needed to inform

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

9 PG&E's 2017 EV adoption forecast (March 2017). Based on California DMV aggregated data reported by EPRI, actual EV adoption in PG&E's territory as of October 2017 is estimated at 142,732 PEVs, and may reach 150,000 by December 2017. This is higher than previously expected during development of the forecast. PG&E will be updating its forecast in 2018 to account for the increased adoption.

10 Transportation Energy Demand Forecast, 2018-2030. California Energy Commission. Publication Number: CEC-200-2017-010 (http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR 05/TN221893_20171204T085928_Transportation_Energy_Demand_Forecast_20182030.pdf)

11 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.

12 D.11-07-029, p. 3.

policies for the next stages of PEV market development.[13] 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.[14]

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.[15] 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.[16] The IOUs filed the 1st Load Research Report in December 2012. The First Extension Decision extended the research an additional three years[17] to begin in December 2013[18] and directed the Energy Division to work with stakeholders to revise the load research methodology.[19] The deadline for the December 2013 report was extended to January 31, 2014 by CPUC Executive Director Paul Clanon, to allow

[13] D.11-07-029, p. 60.

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

[15] *See* Advice Letters 2403-E for SDG&E, 2786-E for SCE, and 4115-E for PG&E.

[16] D.11-07-029, Ordering Paragraph 7.

[17] D.13-06-014, p. 15.

[18] D.13-06-014, Ordering Paragraph 4.

[19] D.13-06-014, Ordering Paragraph 3.

the IOUs more time to prepare the report under the revised methodology. Following the Second Extension Decision, this December 2017 report is the sixth report to be filed.

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."[20] 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."[21] 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."[22]

The Second Extension Decision extended the "common facility treatment" for costs in excess of the allowance to June 30, 2019,[23] and extended the cost tracking and research an additional three years[24] 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

[20] D.11-07-029, Ordering Paragraph 5.

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

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

[23] D.16-06-11, Ordering Paragraph 1.

[24] D. 16-06-11, Ordering Paragraph 2.

not attributed to the PEV because the PEV did not cause the need for the upgrade.[25] 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.[26] Once the evaluation is complete, a new project is opened for the upgrade and 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.

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[25] 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.

[26] The upgrade would be completed absent the PEV because other new load is being added.

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 2017.

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

	PG&E	SCE	SDG&E	Total
Residential Customers				
Estimated PEV customers through October 31, 2017	142,732	108,135	26,498	277,365
Residential Upgrades				
Number of PEV-related Infrastructure Checks Completed	8,328	Not tracked[27]	Not tracked[28]	N/A
Number PEV-related Service Line and/or Distribution System Upgrades[29]	228	197	35	460
Total Costs Incurred by Utility for Upgrades	$4,365,196	$314,137	$38,252	$4,717,585
Range of Costs for Upgrades	$148 - $275,817	$1 to $30,067	$80 to $10,958	N/A
Average Cost for Distribution System Upgrade[30]	$17,777	$4,847	$4,089	N/A
Average Cost for Service Line Upgrade	$1,422	$1,457	$653	N/A
Number of Service Line Upgrades Exceeding Residential Allowance	37	32	0	69
Current Residential Allowance	$2,431[31]	$3,084[32]	$3,241[33]	N/A
Amount of Foregone Billings to Customers for Service Line Upgrades Pursuant to "Common Facility Treatment" Policy Exemption for PEVs	$159,952	$29,767	$0	$189,719

[27] 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.

[28] 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.

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

[30] 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.

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

[32] SCE Electric Rule 15, Section C.3: https://www.sce.com/NR/sc3/tm2/pdf/Rule15.pdf

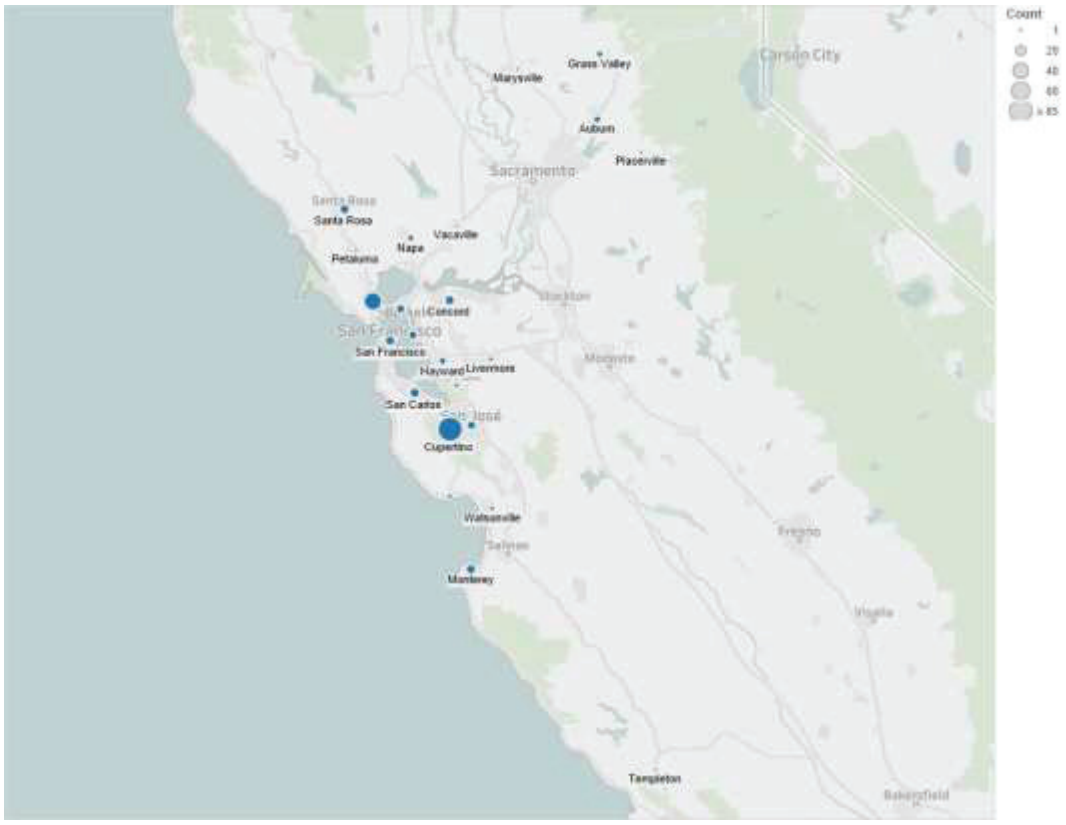
[33] SDG&E Electric Rule 15, Section C.3: http://regarchive.sdge.com/tm2/pdf/ELEC_ELECRULES_ERULE15.pdf

PG&E Specific Details

As of October 2017, PG&E's best estimate of the number of PEVs in the PG&E service territory is 142,732. This value reflects all PEVs registered in PG&E service territory according to data obtained via EPRI from external registration data.

While PG&E's total estimate of PEVs in the service territory is 142,732 PG&E is only able to perform service assessments for customers that notify the utility of their PEV status. As of October 31, 2017, PG&E had completed 8,328 such service assessments. Of the 8,328 service assessments completed to date, 228, or 2.7%, have required upgrades due solely to the addition of PEV load. In 37 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 37 customers combined was $159,952. The map below identifies the service center locations of all 228 upgrades.

Figure PG&E-1: Locations of Customers Requiring a Residential Upgrade Due to a PEV, by PG&E Service Center (as of October 2017)[34]



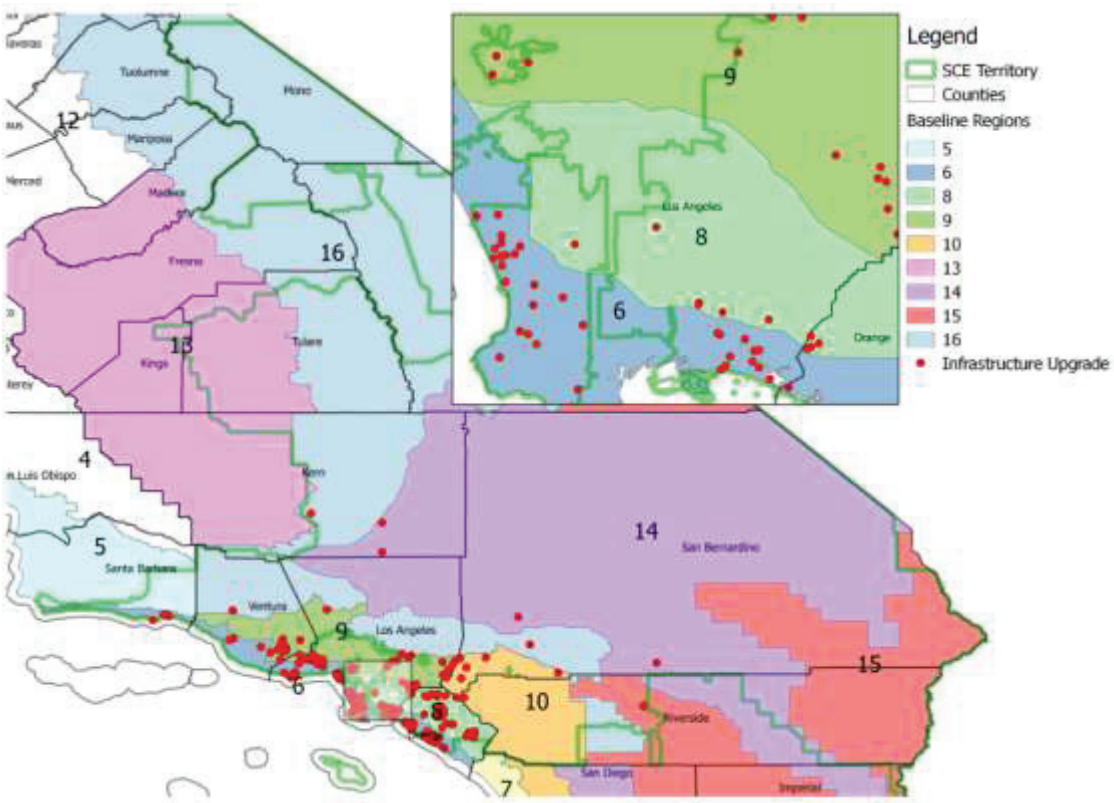
[34] Map has been updated and corrected from the 2016 PEV Load Research Report, which had a misplaced marker shown as Eden Valley that should have represented upgrades from PG&E's Edenvale service center in San Jose.

SCE Specific Details

As of October 2017, SCE's best estimate of the number of PEVs registered to residential customers in SCE's service territory is about 108,135. 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 108,135 residential PEVs in SCE's service territory, only 197 or 0.18% 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 32 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 32 customers combined was $29,767.

Figure SCE-1: PEVs in the SCE Service Territory Requiring a Residential Upgrade as of October 2017



From 2011 to 2017, SCE had 53 commercial upgrade products totaling $1,312,369.16. In last year's report, SCE incorrectly reported 59 upgrades relating to the commercial installation of PEV charging stations totaling approximately $1,022,413.67. The corrected figures are noted below:

Years	Commercial Upgrade Products	Total
2011-2016	**43**	$913,684.01
2016-2017	**10**	$398,685.15
2011-2017	**53**	$1,312,369.16

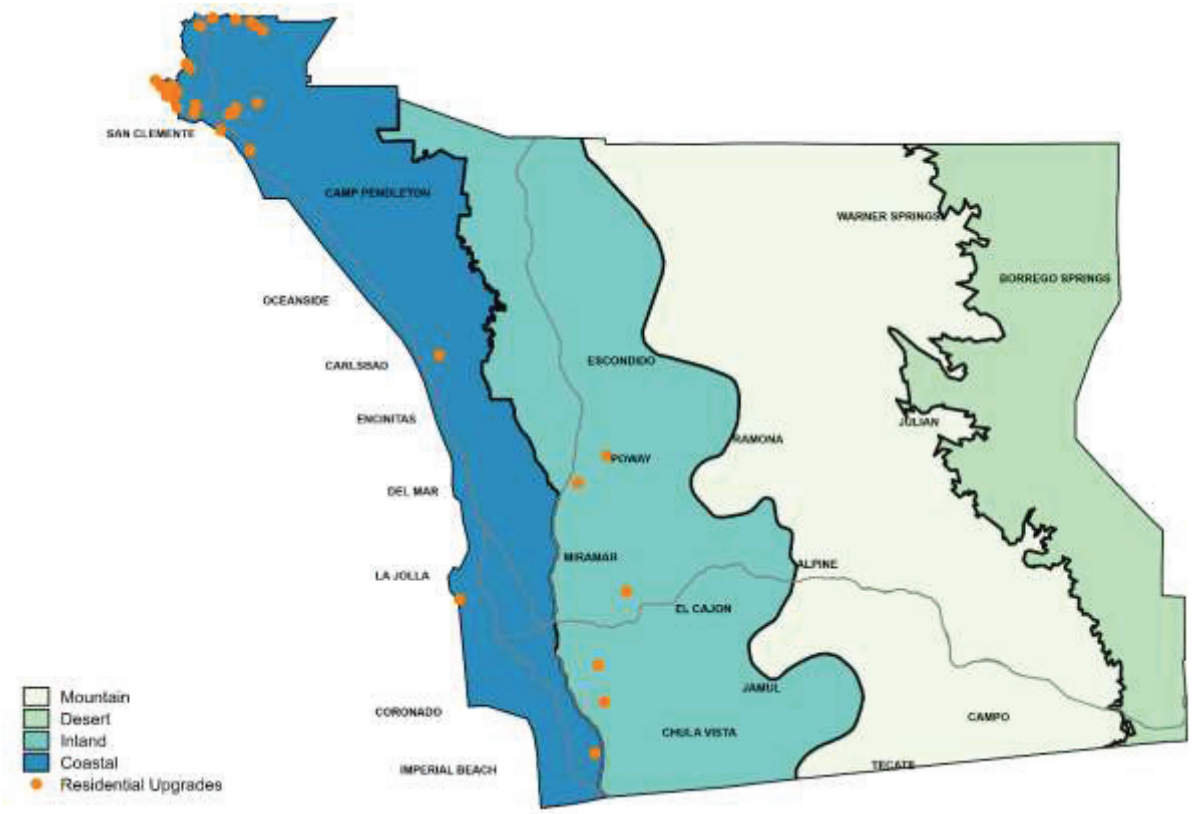
SCE is also reporting that this is the second year where it has implemented a new process to collect the data for this report. Previously, SCE gathered data through a mostly manual process. After querying its systems of record in preparation for this report, SCE identified a number of discrepancies in 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, 2017).

SDG&E Specific Details

As of October 2017, SDG&E's best estimate of the number of PEVs registered to residential customers in the SDG&E service territory is 26,498. 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 26,498 residential PEVs in SDG&E's service territory, 35, or less than 0.2%, 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 2017



Conclusions/Recommendations

As of October 31, 2017, the IOUs estimate there are approximately 277,365 PEVs within the three service territories. Of the 277,365 vehicles estimated to be currently on the road, only 460 or 0.16%, have required a service line and/or distribution system upgrade. In all but 69 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.[35]

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[36]
- 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:[37]

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

The data for this 6th Load Research Report covers the 12-month period of September 2016 to

August 2017. 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.

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

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

[36] 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).

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

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[38] 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.

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

Rate: EVA

Hour	Winter Weekday	Winter Weekend / Holidays	Summer Weekday	Summer Weekend / Holidays
12mn - 1am	0.12503	0.12503	0.12225	0.12225
1am - 2am	0.12503	0.12503	0.12225	0.12225
2am - 3am	0.12503	0.12503	0.12225	0.12225
3am - 4am	0.12503	0.12503	0.12225	0.12225
4am - 5am	0.12503	0.12503	0.12225	0.12225
5am - 6am	0.12503	0.12503	0.12225	0.12225
6am - 7am	0.12503	0.12503	0.12225	0.12225
7am - 8am	0.19794	0.12503	0.24986	0.12225
8am - 9am	0.19794	0.12503	0.24986	0.12225
9am - 10am	0.19794	0.12503	0.24986	0.12225
10am - 11am	0.19794	0.12503	0.24986	0.12225
11am - 12nn	0.19794	0.12503	0.24986	0.12225
12nn - 1pm	0.19794	0.12503	0.24986	0.12225
1pm - 2pm	0.19794	0.12503	0.24986	0.12225
2pm - 3pm	0.32018	0.12503	0.45389	0.12225
3pm - 4pm	0.32018	0.32018	0.45389	0.45389
4pm - 5pm	0.32018	0.32018	0.45389	0.45389
5pm - 6pm	0.32018	0.32018	0.45389	0.45389
6pm - 7pm	0.32018	0.32018	0.45389	0.45389
7pm - 8pm	0.32018	0.12503	0.45389	0.12225
8pm - 9pm	0.32018	0.12503	0.45389	0.12225
9pm - 10pm	0.19794	0.12503	0.24986	0.12225
10pm - 11pm	0.19794	0.12503	0.24986	0.12225
11pm - 12mn	0.12503	0.12503	0.12225	0.12225

Rate: EVB

Hour	Winter Weekday	Winter Weekend / Holidays	Summer Weekday	Summer Weekend / Holidays
12mn - 1am	0.12453	0.12453	0.12179	0.12179
1am - 2am	0.12453	0.12453	0.12179	0.12179
2am - 3am	0.12453	0.12453	0.12179	0.12179
3am - 4am	0.12453	0.12453	0.12179	0.12179
4am - 5am	0.12453	0.12453	0.12179	0.12179
5am - 6am	0.12453	0.12453	0.12179	0.12179
6am - 7am	0.12453	0.12453	0.12179	0.12179
7am - 8am	0.19447	0.12453	0.24660	0.12179
8am - 9am	0.19447	0.12453	0.24660	0.12179
9am - 10am	0.19447	0.12453	0.24660	0.12179
10am - 11am	0.19447	0.12453	0.24660	0.12179
11am - 12nn	0.19447	0.12453	0.24660	0.12179
12nn - 1pm	0.19447	0.12453	0.24660	0.12179
1pm - 2pm	0.19447	0.12453	0.24660	0.12179
2pm - 3pm	0.31325	0.12453	0.44738	0.12179
3pm - 4pm	0.31325	0.31325	0.44738	0.44738
4pm - 5pm	0.31325	0.31325	0.44738	0.44738
5pm - 6pm	0.31325	0.31325	0.44738	0.44738
6pm - 7pm	0.31325	0.31325	0.44738	0.44738
7pm - 8pm	0.31325	0.12453	0.44738	0.12179
8pm - 9pm	0.31325	0.12453	0.44738	0.12179
9pm - 10pm	0.19447	0.12453	0.24660	0.12179
10pm - 11pm	0.19447	0.12453	0.24660	0.12179
11pm - 12mn	0.12453	0.12453	0.12179	0.12179

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 March 1, 2017. 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.

[38] 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.

These rates change seasonally, generally 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		EV-B	
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	0.63	0.39	0.64	0.40
Summer	0.49	0.27	0.49	0.27

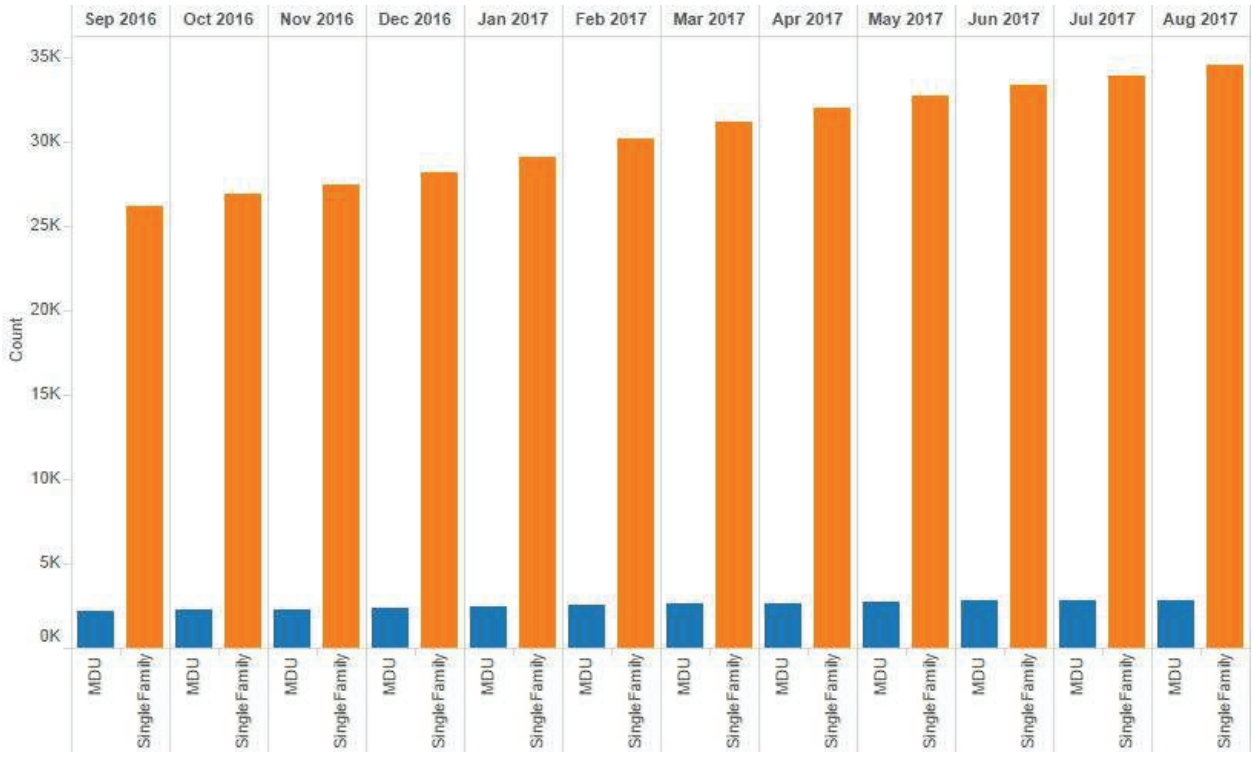
Single Metering (EV-A) Rate Growth

Participation in both EV-A and EV-B has increased during the study period. However, not all PEV customers have adopted PEV rates.[39] 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 2016 and August 2017, the number of accounts in the EV-A group as a whole increased by 32% at the last reported month compared to the base month.

[39] 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 (EV-A) Accounts by Customer Type



NEM EV-A Customers: Net Energy Metering (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 22% 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.[40]

[40] 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 (EV-A) NEM Program Enrollment by Customer Type

Year	Month	Number of Single Metering (EV-A) NEM Enrollments	NEM % of Single Metering	NEM % of SF Single Metering	NEM % of MDU Single Metering
2016	Sept	5,924	20%	21%	7%
2016	Oct	6,148	20%	21%	7%
2016	Nov	6,365	21%	22%	7%
2016	Dec	6,608	21%	22%	8%
2017	Jan	6,835	21%	22%	8%
2017	Feb	7,051	21%	22%	8%
2017	Mar	7,343	21%	22%	8%
2017	Apr	7,603	21%	22%	8%
2017	May	7,876	21%	23%	8%
2017	Jun	8,108	22%	23%	8%
2017	Jul	8,317	22%	23%	8%
2017	Aug	8,518	22%	23%	8%

DR EV-A Customers: Demand Response (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 5% 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.

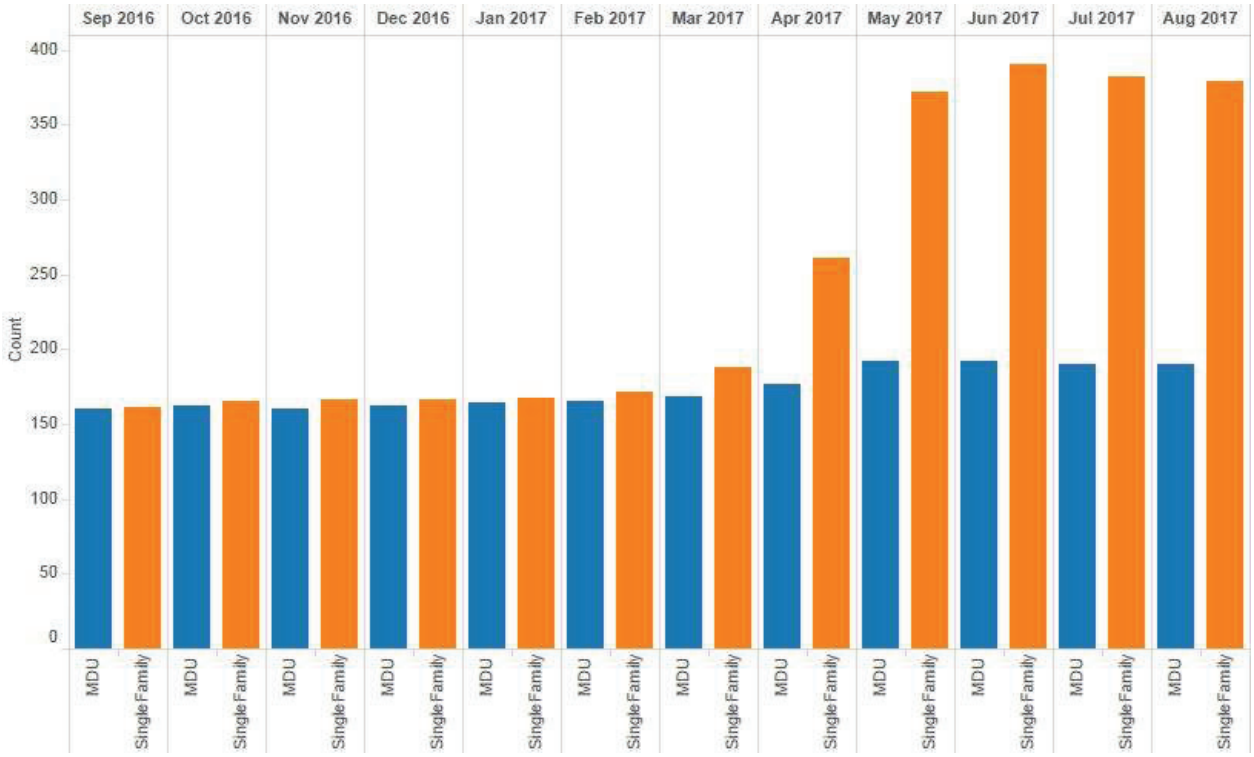
Table PG&E-3: Single Metering (EV-A) DR Program Enrollment by Customer Type

Year	Month	Number of Single Metering (EV-A) DR Enrollments	DR % of Single Metering	DR % of SF Single Metering	DR % of MDU Single Metering
2016	Sept	1,548	5%	5%	6%
2016	Oct	1,566	5%	5%	6%
2016	Nov	1,578	5%	5%	5%
2016	Dec	1,619	5%	5%	5%
2017	Jan	1,694	5%	5%	5%
2017	Feb	1,723	5%	5%	5%
2017	Mar	1,763	5%	5%	5%
2017	Apr	1,778	5%	5%	5%
2017	May	1,756	5%	5%	5%
2017	Jun	1,770	5%	5%	5%
2017	Jul	1,195	3%	3%	3%
2017	Aug	1,183	3%	3%	2%

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 an increase near the end of the period (see Chart PG&E-2). The increase in EV-B rate enrollment at the end of the period is likely due to enrollment in Phase 2 of PG&E's EV submetering pilot program. Customers' submetered EV charging usage is billed on the EV-B rate while participating in the submetering pilot. After the conclusion of the pilot, these customers are returned to their previous rate. Despite this growth from submetering pilot participants, separate metering remains a much less popular option for PEV rate customers than single metering.

Chart PG&E-2: Separate Metering (EV-B) 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. 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 (EV-B) NEM Program Enrollment by Customer Type

Year	Month	Number of Separate Metering (EV-B) NEM Enrollments	NEM % of Separate Metering	NEM % of SF Separate Metering	NEM % of MDU Separate Metering
2016	Sept	15	5%	4%	5%
2016	Oct	16	5%	5%	5%
2016	Nov	16	5%	5%	5%
2016	Dec	16	5%	5%	5%
2017	Jan	16	5%	5%	5%
2017	Feb	16	5%	5%	5%
2017	Mar	16	4%	4%	5%
2017	Apr	16	3%	3%	4%
2017	May	16	3%	2%	4%
2017	Jun	16	3%	2%	4%
2017	Jul	16	3%	2%	4%
2017	Aug	16	3%	2%	4%

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

Table PG&E-5: Separate Metering (EV-B) DR Program Enrollment by Customer Type

Year	Month	Number of Separate Metering (EV-B) DR Enrollments	DR % of Separate Metering	DR % of SF Separate Metering	DR % of MDU Separate Metering
2016	Sept	1	0%	1%	0%
2016	Oct	1	0%	1%	0%
2016	Nov	1	0%	1%	0%
2016	Dec	1	0%	1%	0%
2017	Jan	1	0%	1%	0%
2017	Feb	1	0%	1%	0%
2017	Mar	1	0%	0%	0%
2017	Apr	1	0%	0%	0%
2017	May	1	0%	0%	0%
2017	Jun	1	0%	0%	0%
2017	Jul	1	0%	0%	0%
2017	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 confirmed they own an EV, and 69% 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 end-use 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 EV-A customers with NEM, 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 without NEM. 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 (EV-A) Average Monthly Usage (kWh) by Customer Type With NEM

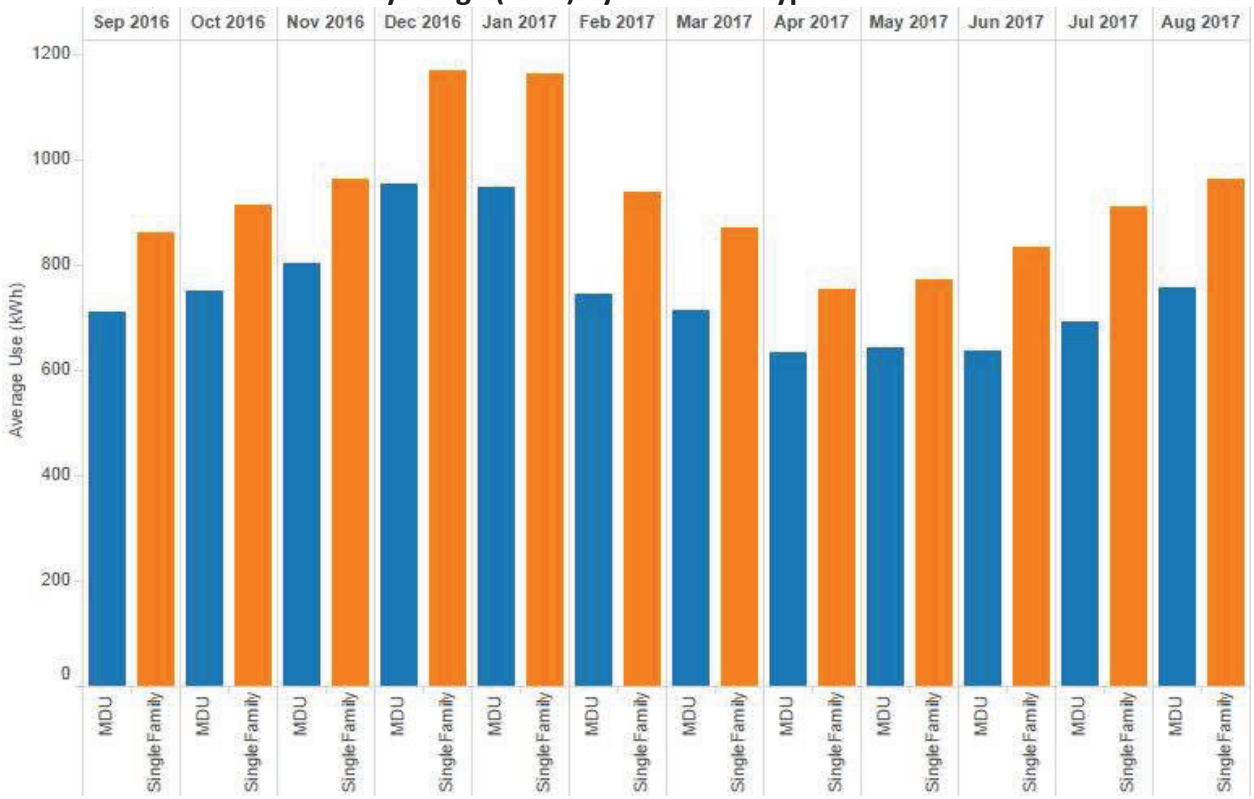
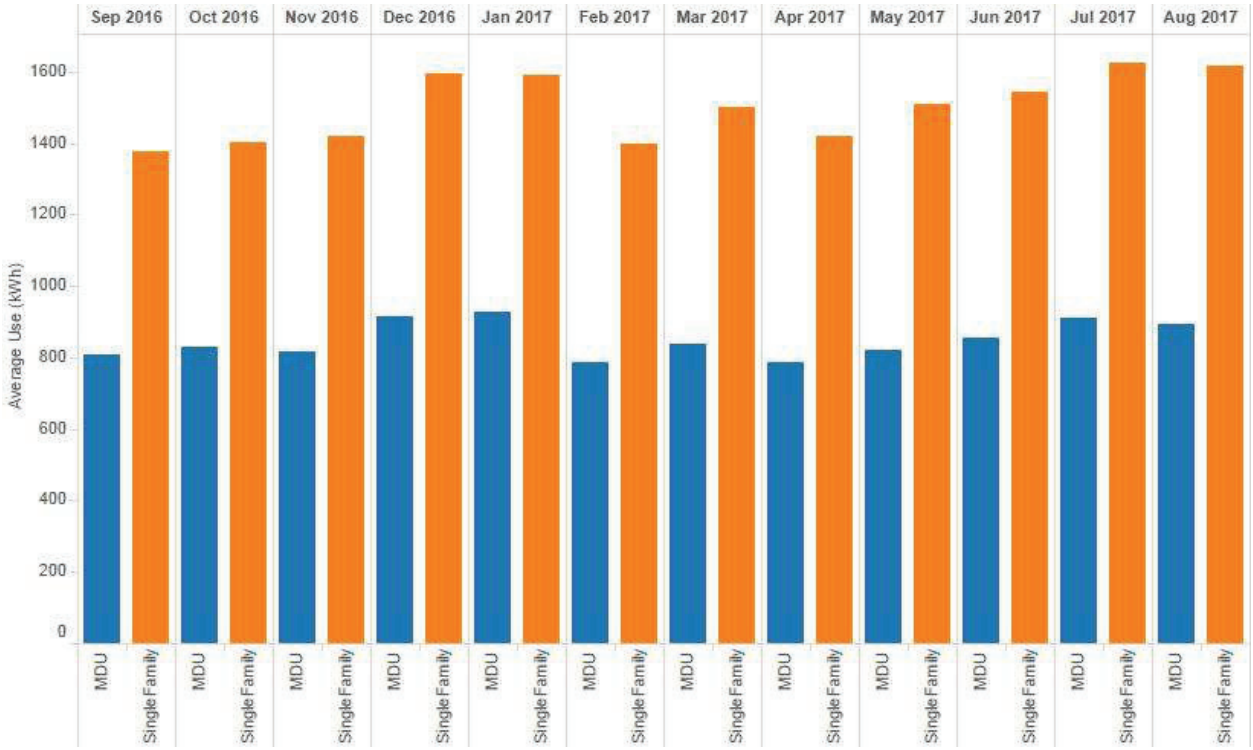


Chart PG&E-4: Single Metering (EV-A) Average Monthly Usage (kWh) by Customer Type Without NEM



A comparison of Charts PG&E 3 and 4 reveals an unsurprising result for both sectors: absent the NEM accounts, usage is flatter for 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 (EV-B) Average Monthly Usage (kWh) by Customer Type

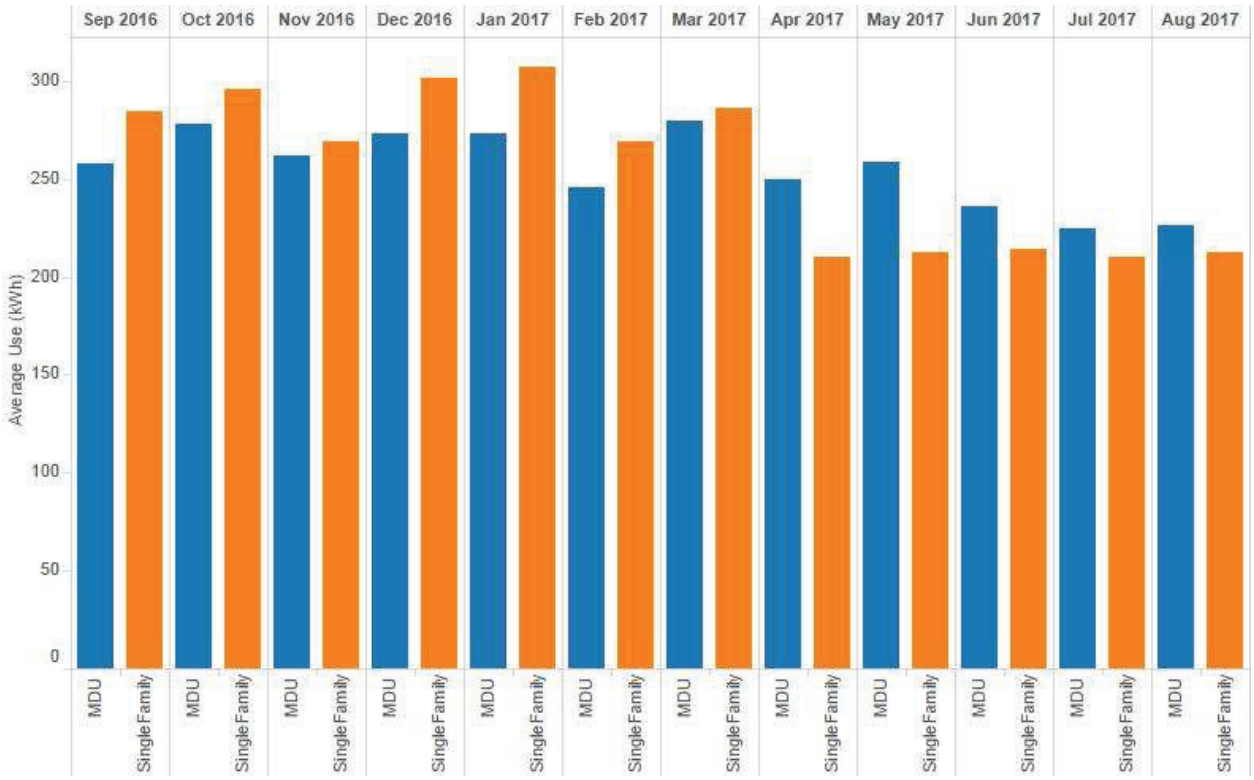


Chart PG&E-5 shows that, absent other loads on the meter, researchers can better observe that PEV rate customers' total charging amount remains relatively consistent over time. The results in Chart PG&E-5 are even flatter near the end of the study period, perhaps due to the increased enrollment in EV-B which could have reduced the effect of any outliers to create a smoother monthly average.

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 7% less energy during the peak period than the average PG&E residential customer and NEM

customers on EV-A used 11% less energy than the residential population. Likewise non-NEM customers on EV-B used an average of 21% less energy during the peak period, and NEM customers on EV-B used 12% 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 EV TOU rates are achieving this goal among this group of early PEV adopters.

- 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 14% more energy than the average PG&E residential customer and NEM customers on EV-A used 31% 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 37% 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 6% less energy than the average PG&E residential customer during partial peak periods, and NEM customers on EV-A used 20% less energy than the residential population. Non-NEM customers on EV-B used an average of 22% less energy during partial peak periods, and NEM customers on EV-B used 25% 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 in 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 85% of their charging in the off-peak period on average and only 8% 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 (EV-A), excluding NEM	SF Single Metering (EV-A), excluding NEM	MDU Single Metering (EV-A), excluding NEM	Single Metering (EV-A) NEM	All Separate Metering (EV-B), excluding NEM	SF Separate Metering (EV-B), excluding NEM	MDU Separate Metering (EV-B), excluding NEM	Separate Metering (EV-B) NEM
2016	Sep	31%	22%	22%	22%	15%	8%	7%	9%	25%
2016	Oct	28%	21%	21%	22%	18%	8%	8%	9%	14%
2016	Nov	27%	21%	21%	22%	25%	8%	8%	9%	18%
2016	Dec	27%	22%	22%	22%	26%	9%	9%	9%	22%
2017	Jan	27%	22%	22%	22%	25%	9%	9%	9%	18%
2017	Feb	26%	21%	21%	21%	22%	9%	9%	9%	16%
2017	Mar	29%	21%	21%	22%	17%	8%	7%	10%	9%
2017	Apr	30%	20%	20%	21%	10%	7%	7%	8%	5%
2017	May	30%	20%	20%	21%	9%	7%	6%	7%	9%
2017	Jun	33%	22%	22%	22%	14%	6%	6%	6%	19%
2017	Jul	31%	23%	23%	24%	18%	5%	5%	5%	26%
2017	Aug	33%	23%	23%	23%	18%	6%	6%	6%	21%
Max		33%	23%	23%	24%	26%	9%	9%	10%	26%
Average		29%	22%	22%	22%	18%	8%	7%	8%	17%

* Load data used for the analysis are from January 2016 to December 2016.

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

Year	Month	Total Residential Population*	All Single Metering (EV-A), excluding NEM	SF Single Metering (EV-A), excluding NEM	MDU Single Metering (EV-A), excluding NEM	Single Metering (EV-A) NEM	All Separate Metering (EV-B), excluding NEM	SF Separate Metering (EV-B), excluding NEM	MDU Separate Metering (EV-B), excluding NEM	Separate Metering (EV-B) NEM
2016	Sep	40%	56%	56%	56%	76%	85%	87%	83%	72%
2016	Oct	43%	56%	56%	56%	72%	84%	85%	83%	81%
2016	Nov	44%	57%	57%	57%	66%	83%	85%	82%	75%
2016	Dec	46%	56%	56%	56%	61%	84%	84%	83%	70%
2017	Jan	47%	56%	56%	55%	62%	84%	84%	83%	74%
2017	Feb	43%	57%	57%	57%	68%	84%	85%	83%	80%
2017	Mar	38%	56%	56%	56%	75%	82%	85%	78%	89%
2017	Apr	40%	56%	56%	56%	81%	85%	86%	83%	93%
2017	May	40%	57%	57%	57%	83%	87%	88%	85%	90%
2017	Jun	37%	55%	55%	56%	79%	88%	88%	88%	78%
2017	Jul	42%	54%	54%	55%	75%	89%	89%	89%	69%
2017	Aug	38%	54%	54%	55%	73%	88%	88%	88%	75%
Max		47%	57%	57%	57%	83%	89%	89%	89%	93%
Average		42%	56%	56%	56%	73%	85%	86%	84%	79%

* Load data used for the analysis are from January 2016 to December 2016.

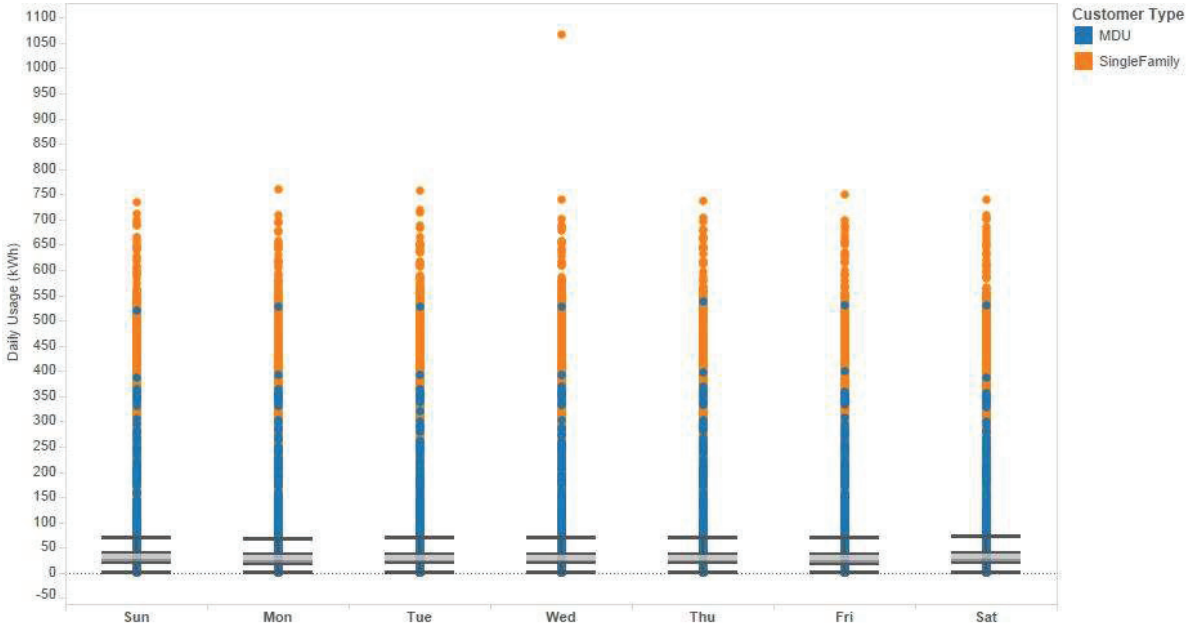
Table PG&E-8: Share of Partial-Peak Usage by Tariff and Customer Type

Year	Month	Total Residential Population*	All Single Metering (EV-A), excluding NEM	SF Single Metering (EV-A), excluding NEM	MDU Single Metering (EV-A), excluding NEM	Single Metering (EV-A) NEM	All Separate Metering (EV-B), excluding NEM	SF Separate Metering (EV-B), excluding NEM	MDU Separate Metering (EV-B), excluding NEM	Separate Metering (EV-B) NEM
2016	Sep	29%	23%	23%	22%	9%	7%	6%	8%	3%
2016	Oct	29%	23%	23%	22%	10%	7%	7%	8%	5%
2016	Nov	29%	22%	22%	21%	9%	8%	7%	10%	8%
2016	Dec	27%	22%	22%	21%	12%	7%	7%	8%	8%
2017	Jan	25%	23%	23%	22%	13%	8%	7%	8%	8%
2017	Feb	30%	23%	23%	22%	11%	7%	6%	8%	4%
2017	Mar	32%	23%	24%	23%	8%	10%	9%	11%	2%
2017	Apr	31%	24%	24%	23%	9%	8%	7%	9%	2%
2017	May	29%	23%	23%	22%	8%	6%	6%	8%	1%
2017	Jun	30%	23%	23%	22%	8%	6%	6%	6%	3%
2017	Jul	27%	23%	23%	21%	8%	6%	6%	6%	5%
2017	Aug	29%	23%	23%	22%	8%	6%	6%	6%	4%
Max		32%	24%	24%	23%	13%	10%	9%	11%	8%
Average		29%	23%	23%	22%	9%	7%	7%	8%	4%

* Load data used for the analysis are from January 2016 to December 2016.

Chart PG&E-6 displays a box and whisker plot for PEV rate energy consumption (kilowatt-hours (kWh)) by customer type and day of the week. Looking past the outliers with usage greater than 68 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 PEV Rate 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 p.m. to 7:00 a.m. with a bulk of the load occurring from 11:00 p.m. to 4:00 a.m.). This responsiveness is more clearly depicted in the data from the EV-B customers (Chart PG&E-8a and Chart PG&E-8b) where the vast majority of the usage occurs during off-peak hours.

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

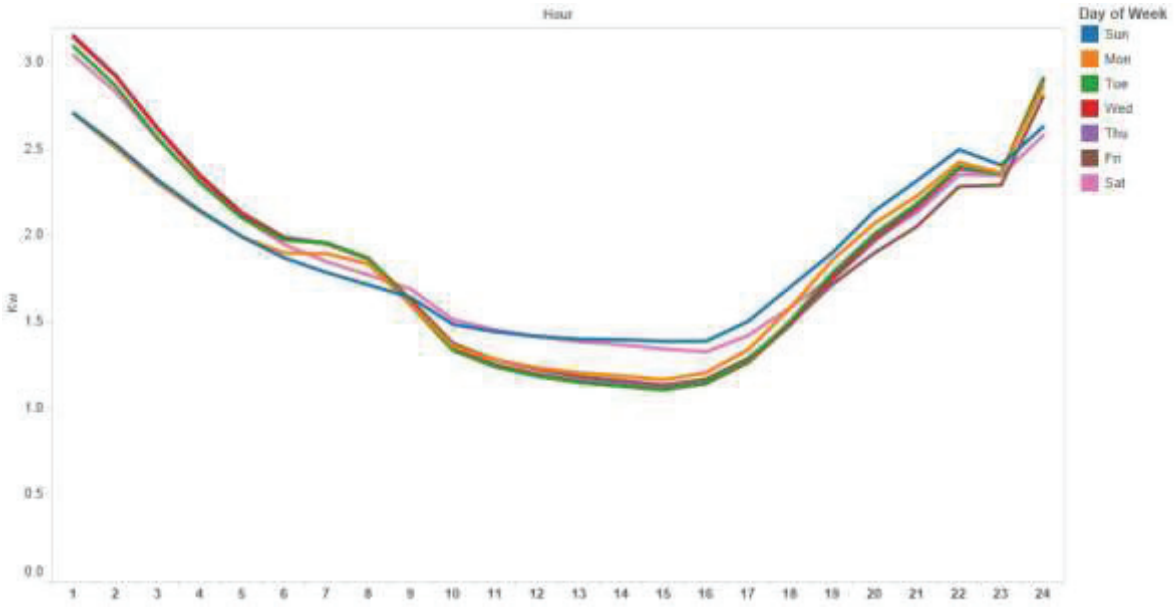


Chart PG&E-7b: Average Load Profile for MDU Single Metering (EV-A) by Day of the Week

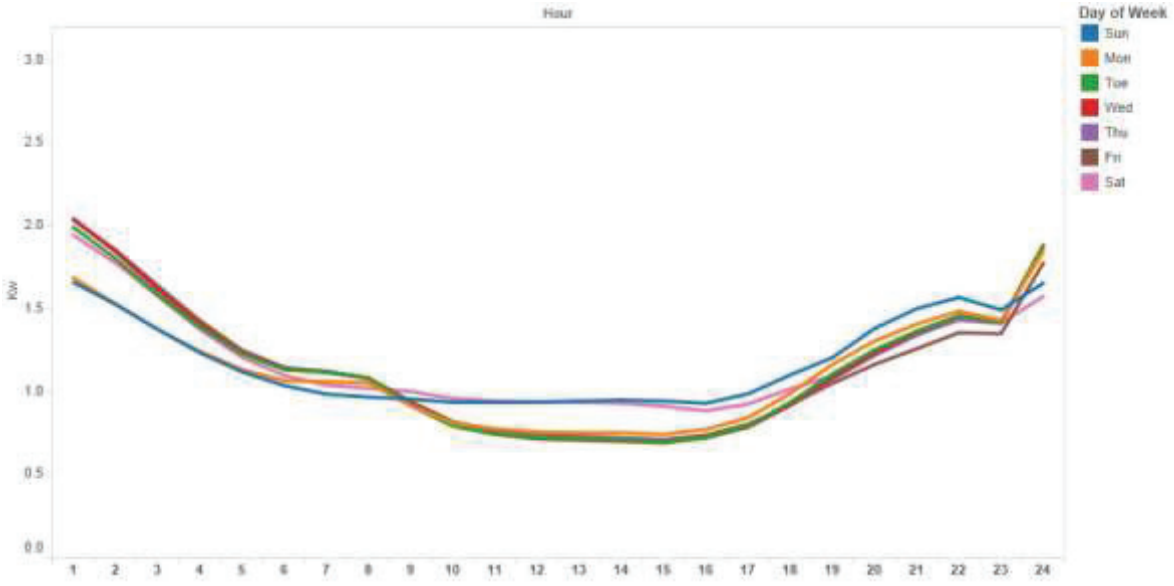


Chart PG&E-8a: Average Load Profile for SF Separate Metering (EV-B) by Day of the Week

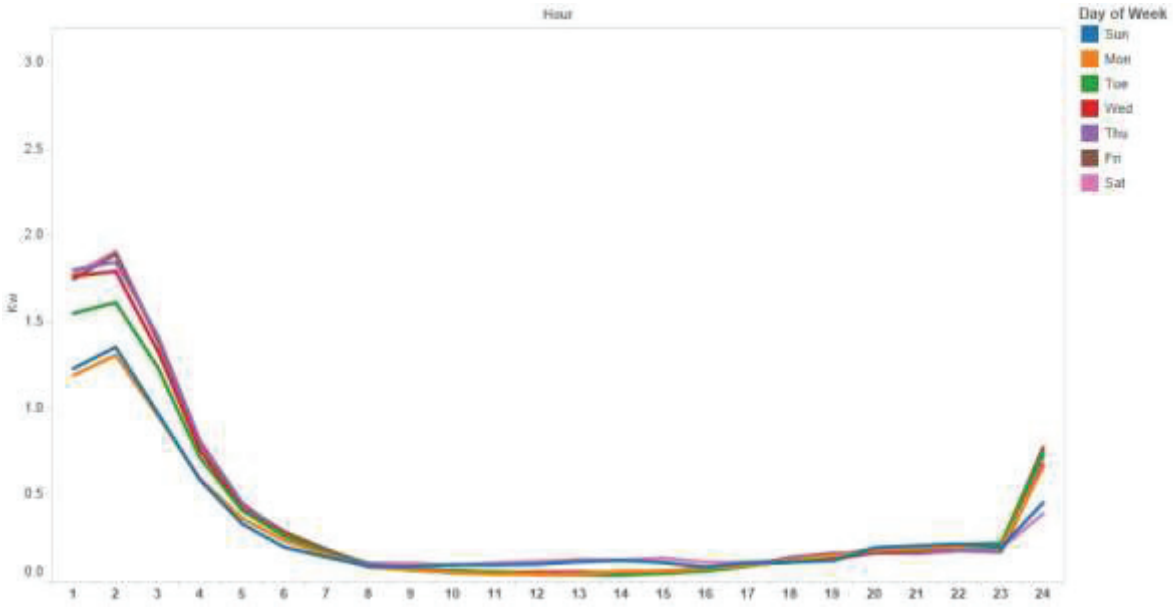
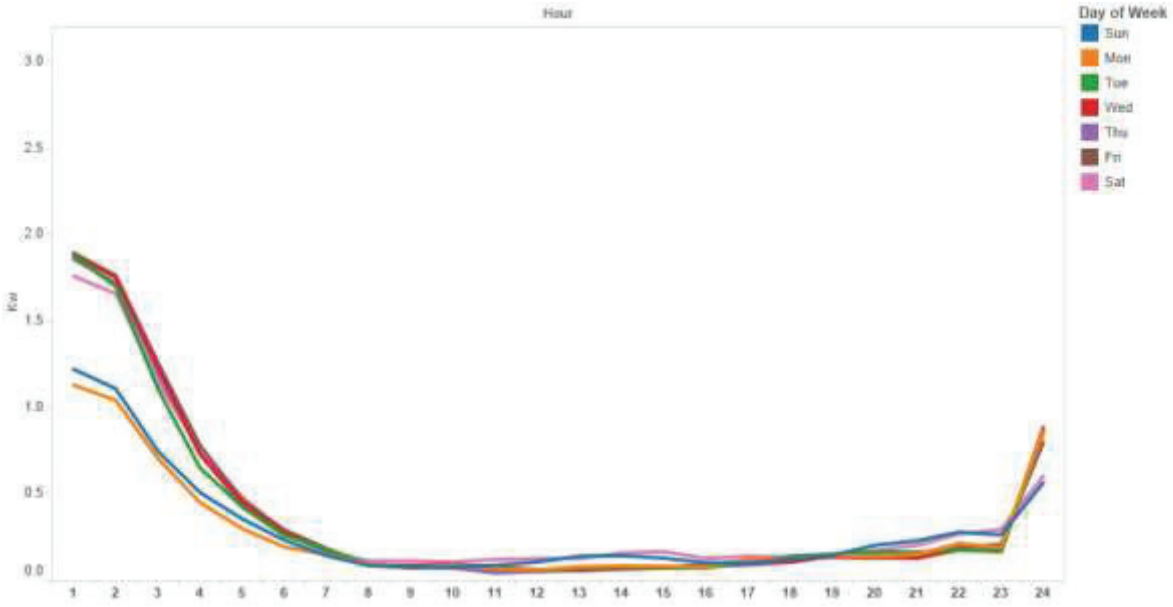


Chart PG&E-8b: Average Load Profile for MDU Separate Metering (EV-B) by Day of the Week



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 3.54 kW higher for the EV-A group category compared to the average residential peak.[41] This was 2.94 kW higher for single family customers and 3.58 kW higher for multi-family customers. The average non-coincident peak was 2.57 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.

[41] 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 (EV-A)	Single Family Single Metering (EV-A)	MDU Single Metering (EV-A)	All Separate Metering (EV-B)	Single Family Separate Metering (EV-B)	MDU Separate Metering (EV-B)
2016	Sep	4.15	4.77	2.65	7.98	8.13	6.21	7.42	8.05	6.79
2016	Oct	3.81	4.34	2.50	7.65	7.78	6.01	7.36	8.27	6.42
2016	Nov	3.96	4.48	2.67	7.83	7.97	6.11	7.20	7.89	6.48
2016	Dec	4.36	4.90	3.02	8.22	8.37	6.39	7.17	7.99	6.33
2017	Jan	4.28	4.85	2.91	8.13	8.28	6.39	7.24	8.20	6.26
2017	Feb	3.80	4.31	2.56	7.88	8.02	6.13	7.30	8.16	6.39
2017	Mar	3.84	4.38	2.54	7.83	7.98	6.04	7.08	7.67	6.41
2017	Apr	3.58	4.08	2.36	7.65	7.79	5.96	6.71	7.14	6.08
2017	May	3.93	4.51	2.50	8.03	8.18	6.16	6.80	*7.25*	5.93
2017	Jun	4.46	5.18	2.70	8.45	8.62	6.46	6.82	*7.12*	6.22
2017	Jul	7.30	9.15	2.78	8.45	8.61	6.52	7.02	7.38	6.31
2017	Aug	6.52	8.08	2.72	8.44	8.60	6.44	6.76	7.07	6.16
Average		4.50	5.25	2.66	8.04	8.19	6.24	7.07	7.68	6.32

* Load data used for the analysis are from January 2016 to December 2016.

** 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 (EV-A) by Customer Type by Month

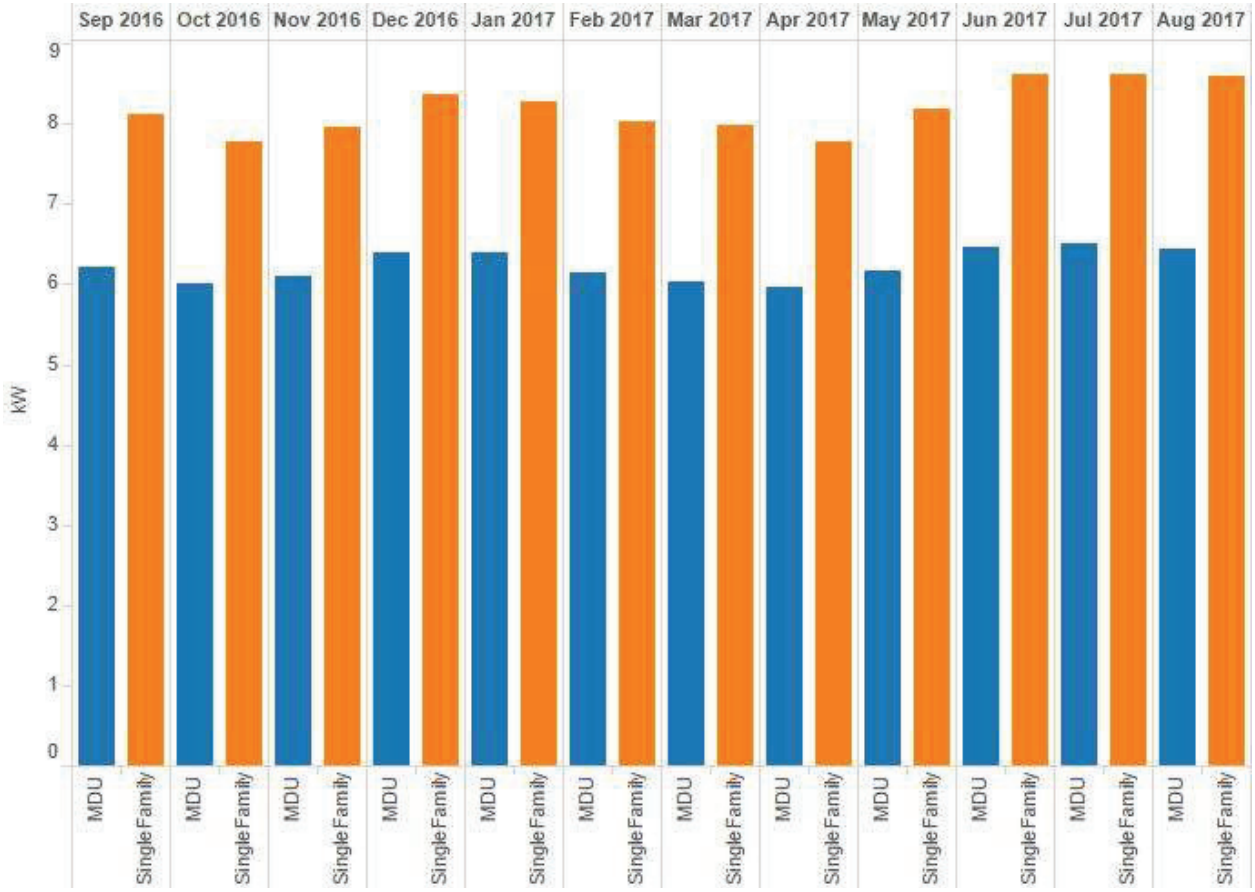


Chart PG&E-9b: Average Non-Coincident Peak Load (kW) for Separate Metering (EV-B) by Customer Type by Month

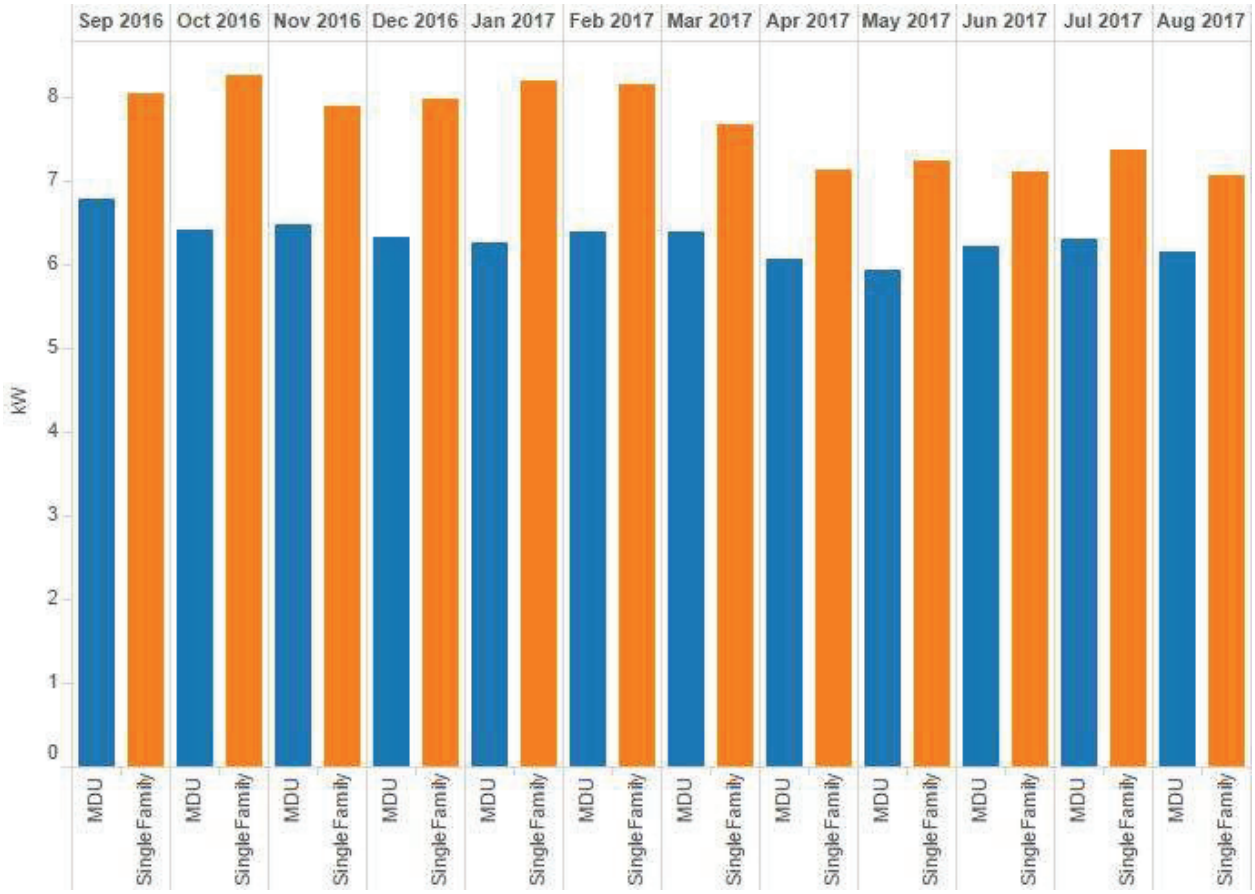


Chart PG&E-10a: Histogram of the Hour at Which the Non-Coincident Peak Load Occurred for Single Metering (EV-A) by Customer Type

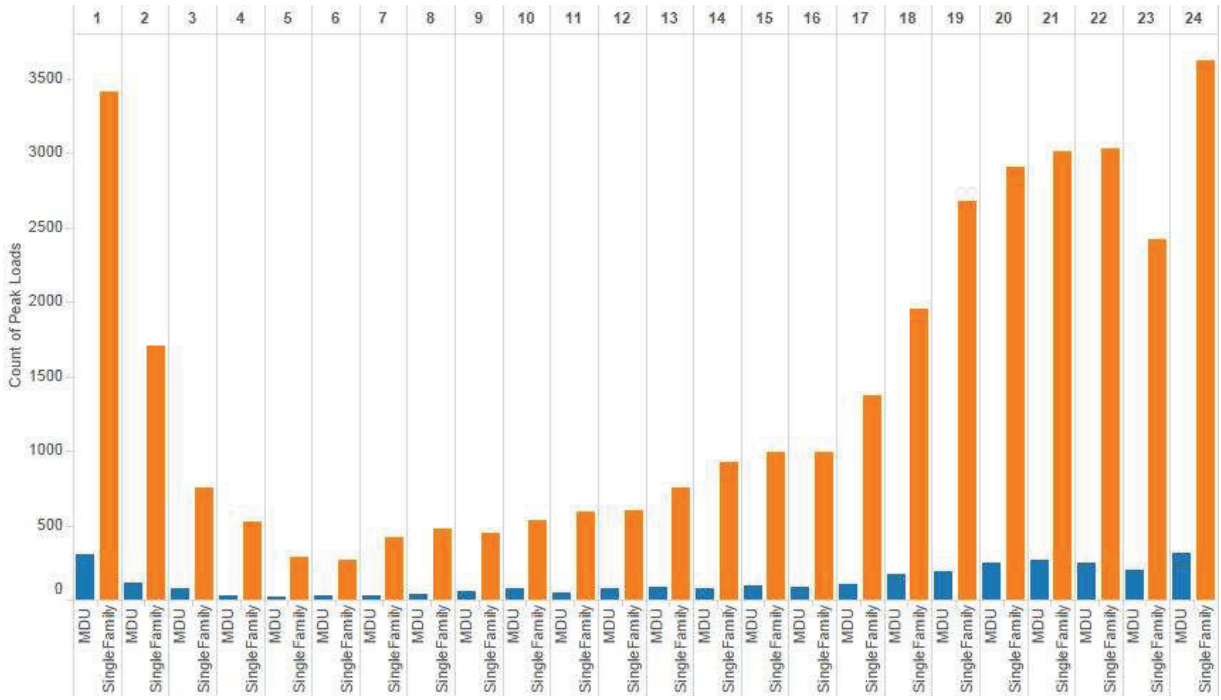
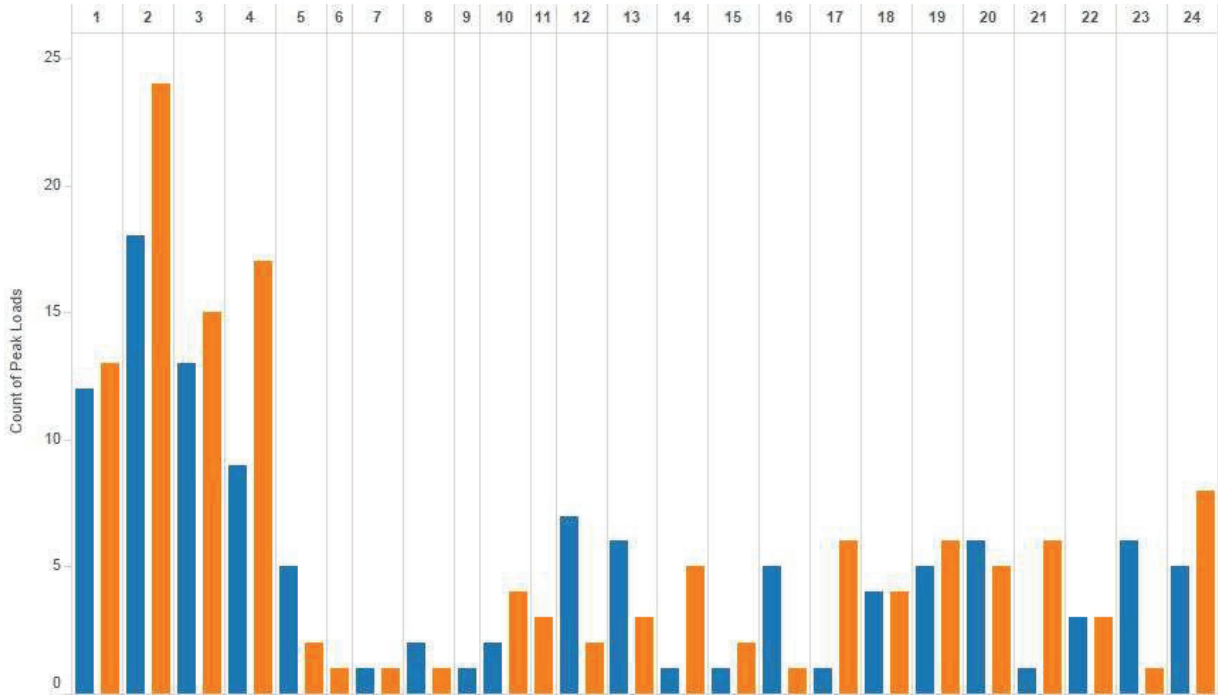


Chart PG&E-10b: Histogram of the Hour at Which the Non-Coincident Peak Load Occurred for Separate Metering (EV-B) by Customer Type



Data Accompanying Charts PG&E 10a and 10b

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

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 1 a.m. to 2 a.m. 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*
2016	Sep	1.19	14	1.42	14	0.68	14
2016	Oct	1.12	13	1.34	14	0.61	13
2016	Nov	1.08	13	1.30	13	0.65	19
2016	Dec	1.13	19	1.30	13	0.77	21
2017	Jan	1.08	19	1.24	19	0.73	19
2017	Feb	1.12	13	1.34	13	0.65	20
2017	Mar	1.21	14	1.47	14	0.62	14
2017	Apr	1.20	14	1.46	14	0.61	13
2017	May	1.22	14	1.46	14	0.67	14
2017	Jun	1.31	14	1.57	14	0.78	15
2017	Jul	3.59	15	4.77	8	0.80	15
2017	Aug	3.36	13	4.48	13	0.78	14

Table PG&E-10, cont'd: Time and Associated Demand of Diversified Peak Load - Single Metering (EV-A)

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
2016	Sep	3.11	1	3.20	1	2.18	1
2016	Oct	3.00	1	3.08	1	2.09	1
2016	Nov	3.23	1	3.32	1	2.13	1
2016	Dec	3.31	1	3.40	1	2.27	1
2017	Jan	3.33	1	3.43	1	2.27	1
2017	Feb	3.24	1	3.34	1	2.16	1
2017	Mar	3.33	1	3.43	1	2.25	1
2017	Apr	3.00	1	3.08	1	1.99	1
2017	May	3.26	1	3.35	1	2.19	1
2017	Jun	3.43	1	3.52	1	2.32	1
2017	Jul	3.22	1	3.32	1	2.11	1
2017	Aug	3.41	1	3.51	1	2.27	1

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

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
2016	Sep	2.21	2	2.70	2	*2.21*	1
2016	Oct	2.46	2	2.65	2	*2.35*	1
2016	Nov	2.44	1	2.62	2	*2.63*	1
2016	Dec	2.54	1	2.68	2	2.75	1
2017	Jan	2.28	1	*2.59*	1	*2.37*	1
2017	Feb	2.17	2	*2.55*	2	2.60	2
2017	Mar	2.54	2	*2.82*	2	*2.38*	2
2017	Apr	2.08	2	*1.88*	2	2.39	2
2017	May	*1.95*	1	*2.11*	1	*2.22*	2
2017	Jun	*1.94*	2	*1.92*	2	*2.39*	1
2017	Jul	*1.89*	2	*2.02*	1	*2.04*	1
2017	Aug	*1.67*	2	*1.68*	2	*1.96*	1

* Load data used for the analysis are from January 2016 to December 2016.

** 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 some of 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 lower than that of each EV-A category, and much higher than that of each EV-B category (See Table PG&E-11). The EV-B data suggests that, for this particular group of early adopters, customers on a separate meter PEV rate are not doing a substantial amount of PEV charging during the system 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 (EV-A)	Single Family Single Metering (EV-A)	MDU Single Metering (EV-A)	All Separate Metering (EV-B)	Single Family Separate Metering (EV-B)	MDU Separate Metering (EV-B)
2016	Sep	1.05	1.24	0.59	1.99	2.05	1.31	*0.17*	*0.20*	*0.14*
2016	Oct	0.76	0.86	0.52	1.87	1.92	1.24	*0.18*	*0.25*	*0.11*
2016	Nov	0.90	1.02	0.60	2.02	2.08	1.27	*0.10*	*0.13*	*0.08*
2016	Dec	1.08	1.23	0.71	2.18	2.25	1.42	*0.17*	*0.14*	*0.21*
2017	Jan	0.96	1.10	0.65	1.86	1.91	1.21	*0.20*	*0.22*	*0.19*
2017	Feb	0.84	0.95	0.59	1.97	2.02	1.28	*0.23*	*0.15*	*0.33*
2017	Mar	0.69	0.78	0.48	2.20	2.26	1.46	*0.17*	*0.14*	*0.20*
2017	Apr	0.68	0.77	0.47	1.93	1.99	1.26	*0.15*	*0.21*	*0.06*
2017	May	0.97	1.14	0.58	2.01	2.08	1.27	*0.16*	*0.12*	*0.24*
2017	Jun	1.19	1.41	0.65	2.38	2.45	1.60	*0.07*	*0.09*	*0.03*
2017	Jul	1.27	1.49	0.71	2.39	2.47	1.46	*0.10*	*0.13*	*0.05*
2017	Aug	0.96	1.10	0.61	2.41	2.48	1.48	*0.13*	*0.13*	*0.12*
Average		0.95	1.09	0.60	2.10	2.16	1.36	0.15	0.16	0.15

* Load data used for the analysis are from January 2016 to December 2016.

** 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 customers on PEV rates in PG&E's service territory (as of September 2017). Tables PG&E-12a and 12b as well as Figure PG&E-2 demonstrate that PEV rate customers are predominantly located in the San Francisco Bay Area and Central Coast (California Energy Commission Climate Zones 3 and 4[42]). 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 (EV-A)	% Separate Metering (EV-B)	% Residential Population
Z01	3%	1%	1%
Z02	10%	4%	8%
Z03	37%	42%	31%
Z04	27%	39%	14%
Z05	1%	1%	3%
Z06	0%	0%	0%
Z09	0%	0%	0%
Z11	2%	0%	7%
Z12	18%	11%	22%
Z13	2%	1%	13%
Z16	0%	0%	1%
Total	100%	100%	100%

[42] 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.

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

Rate	Zip Code	Customers	% Total
Single Meter (EV-A)	94539	866	2.48%
	95120	673	1.93%
	95070	642	1.84%
	94582	610	1.75%
	95014	553	1.58%
Separate Meter (EV-B)	95120	80	2.63%
	95035	77	2.53%
	95014	73	2.40%
	95138	71	2.33%
	94568	64	2.10%

Figure PG&E-2: Customer on EV Rates by Rate Schedule as of August 2017

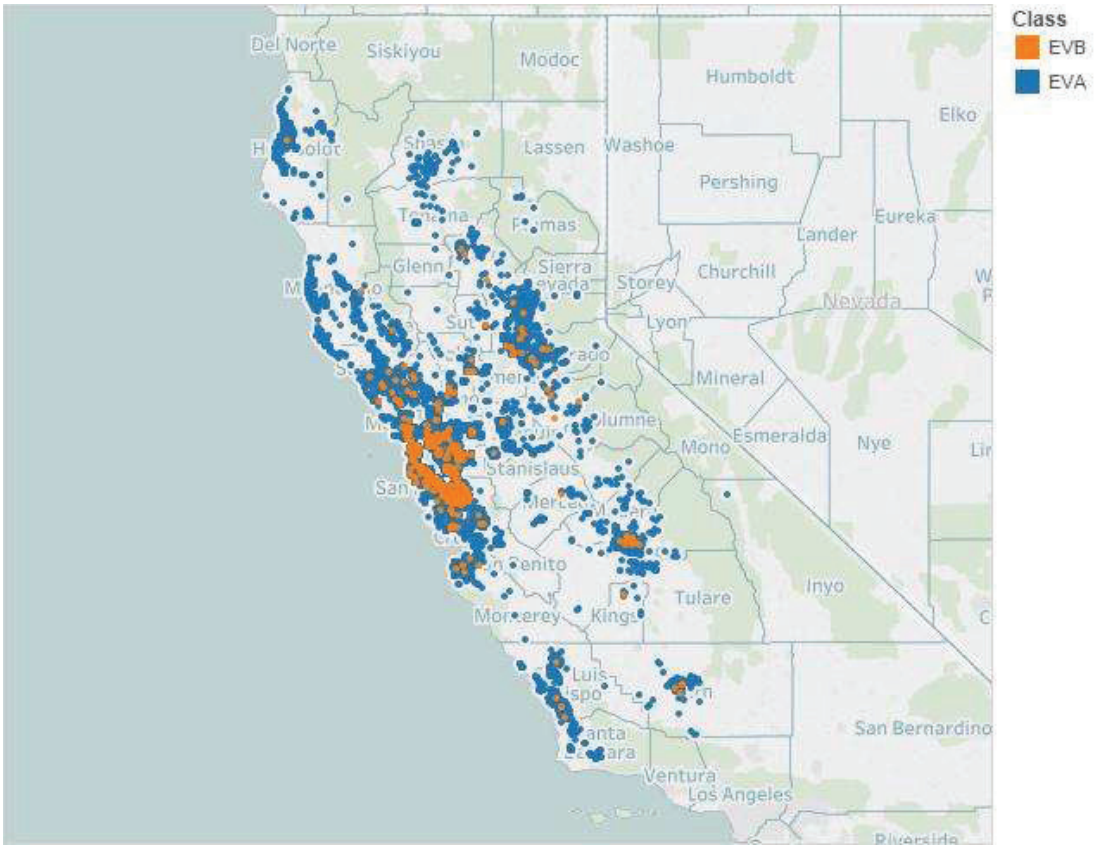
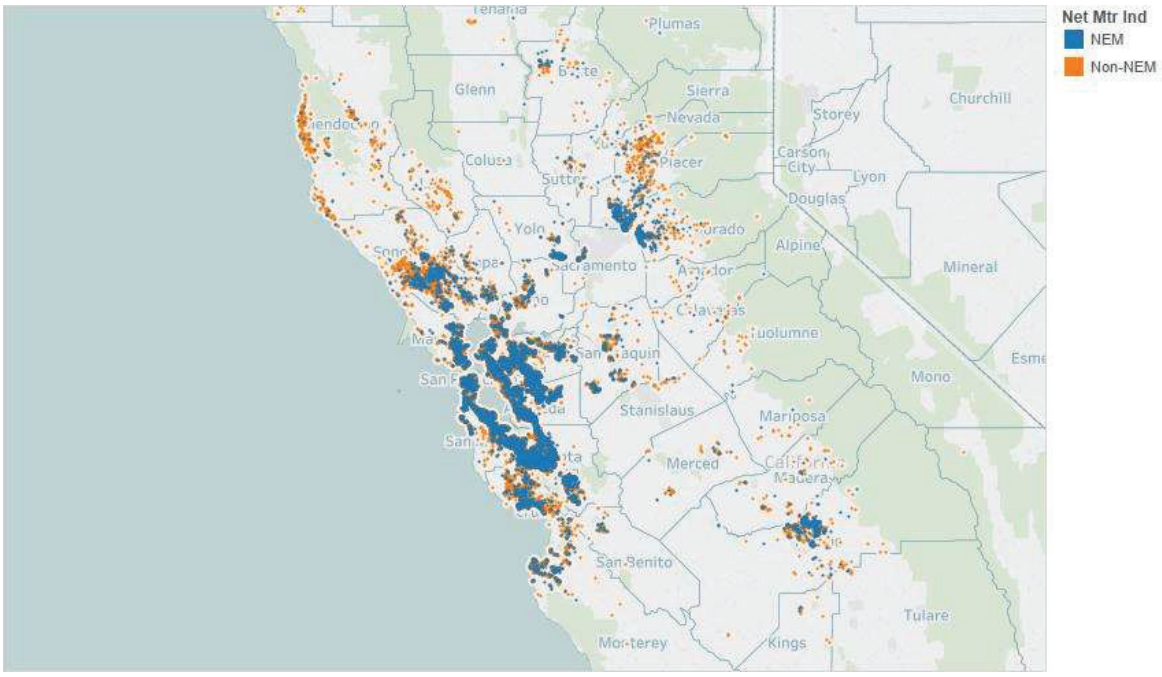


Figure PG&E-3: Customers on EV Rates by NEM/Non-NEM in the PG&E Service Territory as of August 2017



Southern California Edison

SCE currently offers residential customers two rate schedules [43] designed to facilitate the charging of PEVs. Both of these rates employ price-differentiated time-of-use periods. The following section will report the monthly usage characteristics from September 2016 through August 2017 for the identified PEV owners on these tariffs. The TOU-D tariff with Option A or B (TOU-D-A/B) applies to both regular household loads and PEV charging loads recorded with a single meter. The time-of-use periods are designed to accommodate PEV charging requirements but apply to all household loads. 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 by the PEV. Additionally, customers may remain under their existing tariff, likely Schedule D (domestic rate schedule). Based on the number of PEVs SCE estimates are within its service territory, the majority of PEV owners choose to remain on the domestic rate plan.

The TOU-D-A/B tariff was designed to provide attractive charging options to PEV owners and replaced the TOU-D-TEV tariff, which was only available 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 it is presumed that they still possess an electric vehicle. Additionally, any customers who self-identified as PEV owners with SCE and take service under TOU-D Option A or Option B were included in this analysis as of the first full month following their purchase of the PEV. Previously, customers self-identified either by notifying SCE as a result of applying for a cash incentive at the California Center for Sustainable Energy's (CCSE) or providing their information through contact with SCE's call center. There is a significant new source of PEV identification reflected in this year's report. In May 2017, SCE began accepting applications for its Clean Fuel Rebate Program. This program provides rebates to PEV owners even if they are not the first owner of that PEV. Consequently, as of November 2017 SCE has identified a large portion of PEV owners who were previously unknown to SCE.

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. This tariff notably has an extended off-peak TOU window of ten hours. Additionally, the customer can choose between, 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 $0.53/meter/day but significantly lower mid-peak and on-peak rates as compared to Option A. Option A also

[43] SCE also offers three PEV TOU rates for commercial customers: TOU-EV-3, TOU-EV-4 and TOU-EV-6. As of the beginning of August 2017, there were 42 TOU-EV-3 accounts, 125 TOU-EV-4 accounts and 4 TOU-EV-6 accounts.

includes a $0.09/kWh/meter/day Baseline Credit. Both options have pricing which varies seasonally.

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.

In SCE's 2016 Rate Design Window application, SCE proposed new time-of-use periods that would include an on-peak period occurring later in the day during summer only and an off-peak period occurring during the middle of the day during winter. A decision on the final structure of the new TOU periods is expected in the first quarter of 2018. SCE expects to implement the new TOU tariffs replacing the existing tariffs in the first quarter of 2019.

Table SCE – 1a presents the rates that were effective for the largest portion of the reporting period. Rates were in place between January 1, 2017, and June 1, 2017.

Table SCE – 1a: Single Meter (TOU-D-A/B) Tariff[44] ($/kWh) – Effective 1/1/2017

	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	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
10	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
11	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
12	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
13	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
14	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
15	0.34	0.27	0.45	0.28	0.23	0.16	0.34	0.17
16	0.34	0.27	0.45	0.28	0.23	0.16	0.34	0.17
17	0.34	0.27	0.45	0.28	0.23	0.16	0.34	0.17
18	0.34	0.27	0.45	0.28	0.23	0.16	0.34	0.17
19	0.34	0.27	0.45	0.28	0.23	0.16	0.34	0.17
20	0.34	0.27	0.45	0.28	0.23	0.16	0.34	0.17
21	0.27	0.27	0.28	0.28	0.16	0.16	0.17	0.17
22	0.27	0.27	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: $0.09/kWh/meter/day Baseline Credit

Option B: $0.53 meter/day Basic Charge

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

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	3.5 : 2.2 : 1.0	2.4 : 1.9 : 1.0
	Weekend	2.2 : 2.2 : 1.0	1.9 : 1.9 : 1.0
Option B	Weekday	2.6 : 1.3 : 1.0	1.6 : 1.1: 1.0
	Weekend	1.3 : 1.3 : 1.0	1.1 : 1.1: 1.0

Separately-Metered PEV Rate

The TOU-EV-1 rate is designed for residential customers who have a separate meter solely for PEV charging. Therefore, the TOU-EV-1 rate only applies to the customer's PEV charging load. The second meter is provided and installed at no additional cost to the customer, 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 relevant rate factors are reported in the following table, Table SCE – 1b.

Table SCE – 1b: Separate Meter (TOU-EV-1) Tariff ($/kWh) – Effective 1/1/2017

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	0.34	0.14
14	0.22	0.14	0.34	0.14
15	0.22	0.14	0.34	0.14
16	0.22	0.14	0.34	0.14
17	0.22	0.14	0.34	0.14
18	0.22	0.14	0.34	0.14
19	0.22	0.14	0.34	0.14
20	0.22	0.14	0.34	0.14
21	0.22	0.14	0.34	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: $2.66/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 was slightly lower than in previous reports. In Table SCE – 3a the portion of PEV owners on NEM was consistently at 22%. The change from previous reports appears to be a level drop rather than a trend and may be attributed to the inclusion of a large portion of previously unidentified PEV owners. The percent of single-metered accounts on DR, shown in Table SCE – 4, went from 15% to 14%. The first month in the previous report had 18% participation in a DR program.

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. 2016	2,699	22%	25%	8%
Oct. 2016	2,740	22%	25%	8%
Nov. 2016	2,803	22%	25%	8%
Dec. 2016	2,850	22%	25%	8%
Jan. 2017	2,960	22%	25%	8%
Feb. 2017	3,059	22%	25%	8%
Mar. 2017	3,158	22%	24%	8%
Apr. 2017	3,211	22%	24%	8%
May 2017	3,280	22%	24%	8%
Jun. 2017	3,363	22%	24%	8%
Jul. 2017	3,431	22%	25%	8%
Aug. 2017	3,495	22%	25%	8%

Table SCE – 3b: NEM Program Enrollment for Separate Metering

Month	NEM Customers with Separate Metering	NEM as % Separate Metering
Sep. 2016	2	0%
Oct. 2016	2	0%
Nov. 2016	2	0%
Dec. 2016	2	0%
Jan. 2017	2	0%
Feb. 2017	2	0%
Mar. 2017	2	0%
Apr. 2017	2	0%
May 2017	2	0%
Jun. 2017	2	0%
Jul. 2017	2	0%
Aug. 2017	2	0%

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. 2016	1,835	15%	16%	12%
Oct. 2016	1,850	15%	16%	12%
Nov. 2016	1,857	15%	15%	12%
Dec. 2016	1,859	15%	15%	12%
Jan. 2017	1,938	14%	15%	11%
Feb. 2017	1,987	14%	15%	11%
Mar. 2017	2,039	14%	15%	11%
Apr. 2017	2,076	14%	14%	11%
May 2017	2,116	14%	15%	11%
Jun. 2017	2,142	14%	14%	11%
Jul. 2017	2,162	14%	14%	11%
Aug. 2017	2,177	14%	14%	11%

DR is associated with the air conditioning energy use and is therefore attached to the meter recording the house usage. SCE identified no separately-metered (TOU-EV-1) DR customers (i.e., Table 5: DR Program Enrollment by Separate Metering is not applicable for SCE). There are two separately-metered accounts on NEM, as shown in Table SCE-3b.

Number of PEV Time-of-Use Accounts

SCE's single-metered rate option is open to all residential customers and therefore it is necessary to find an additional means of PEV identification. The distribution of Low Carbon Fuel Standard credits to PEV owners through the Clean Fuel Rewards Program has significantly impacted the number of PEVs identified. The date of acquisition, however, is still unknown so this report includes any owers of vehicles where the model year of their vehicle is older than the current year. As such, statisistics for September through December only include PEV owners with vehicles of model year 2015 or older and January through August statistics include any accounts with PEVs from model year 2016 or older.

It is still the case however that the vast majority of PEV owners remain on the default Schedule D. Nevertheless, a small but consistent increase in the number of accounts with PEVs for both single-family and multi-family units can be seen in Chart SCE – 1. It is not known if this trend reflects growth in the overall market as other factors might influence the rates of self-identification (e.g. tarriff changes, propensities to contact the Call Center, utility or industry marketing efforts, new vehicle models with different specifications, etc.). As of August 2017, SCE identified 15,855 single-metered PEV owners, of which 84% were single-family units.

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

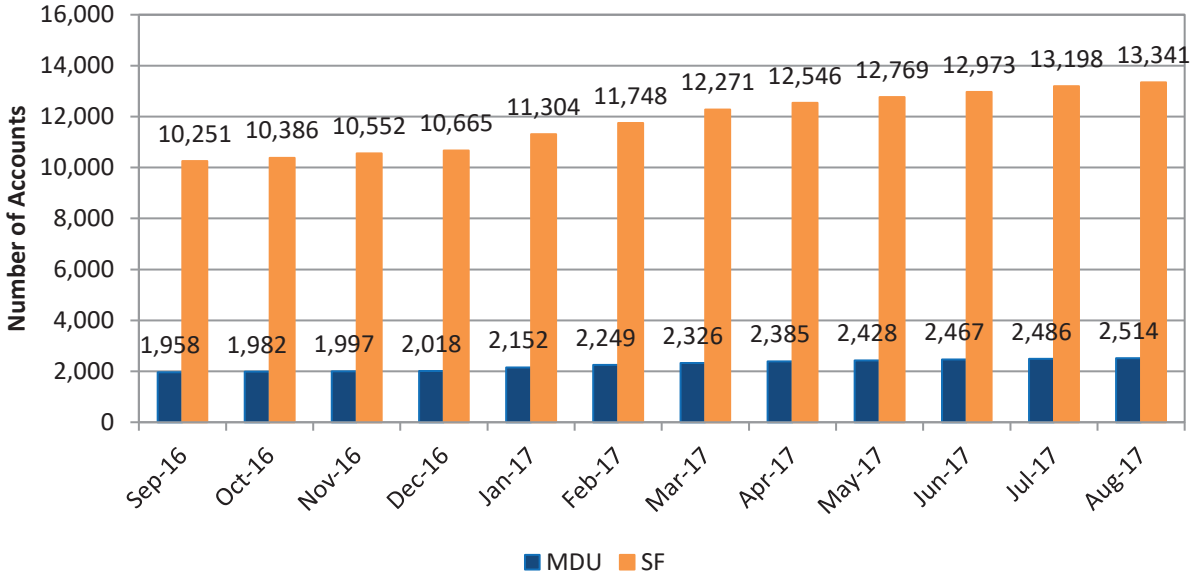
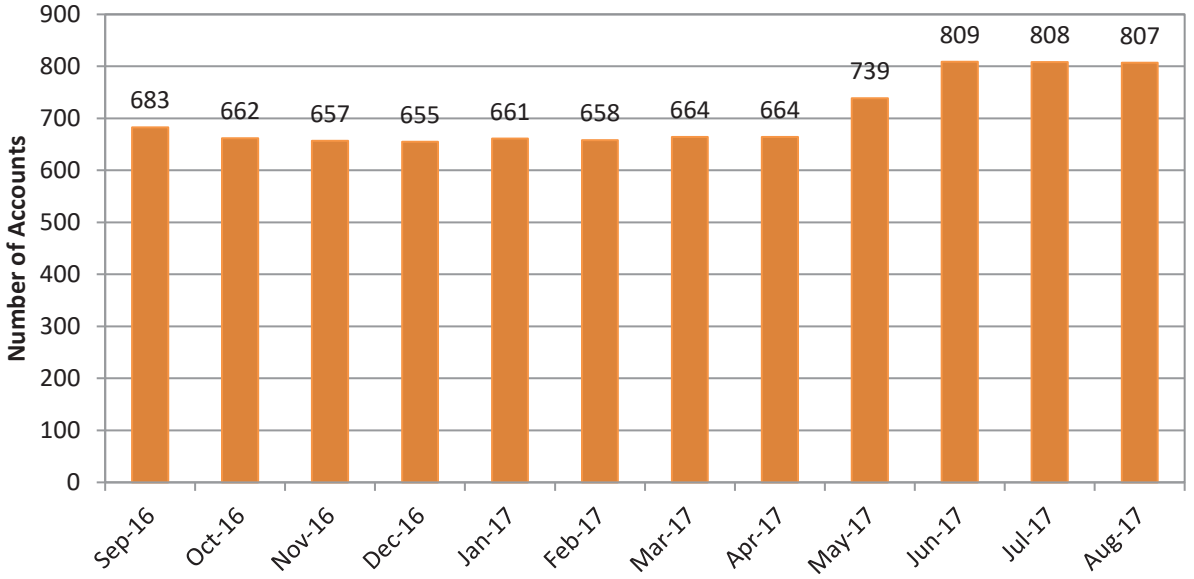


Chart SCE – 2 shows more active separately-metered accounts during this reporting period than in previous reports. It shows 807 separately-metered accounts in August 2017. This 18% increase, however, is mostly accounted for by strong growth in May and June. During the months from September 2016 to December 2016, more accounts closed than opened, so the number of accounts declined during that period.

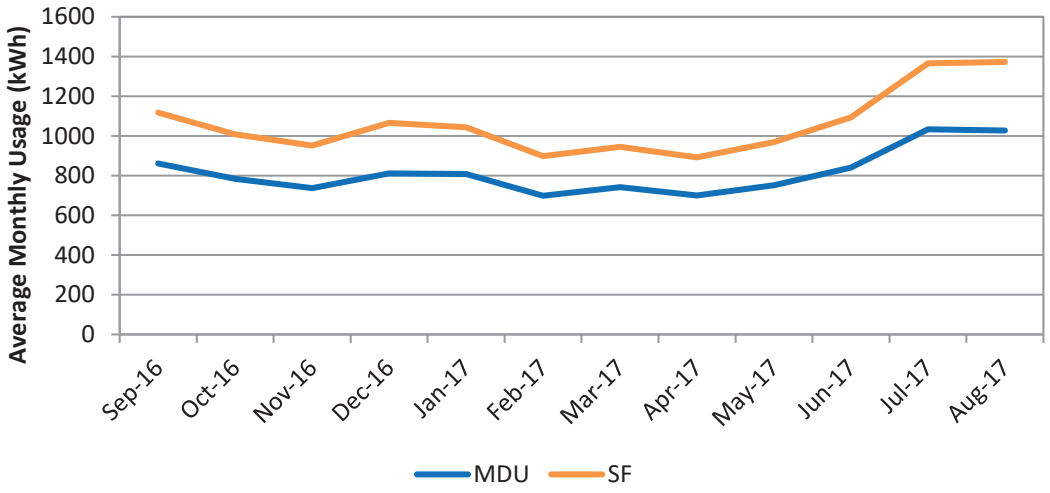
Chart SCE – 2: Separate Meter (TOU-EV-1) – Number of Accounts at the Beginning of Each Month



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 the same seasonal pattern as in previous years as well as very similar usage levels. Single-family dwellings have 30% more usage than multi-family units but the same pattern over the course of the year with the lowest usage occuring February through May, and again in November. July and August have the highest usage for single-metered households. This is the typical seasonal behavior of residential households, which is primarily driven by cooling. The greatest average usage durring these twelve months occurred in August, with 1,372 kWh, for SF and in July for MDU, with 1,033 kWh.

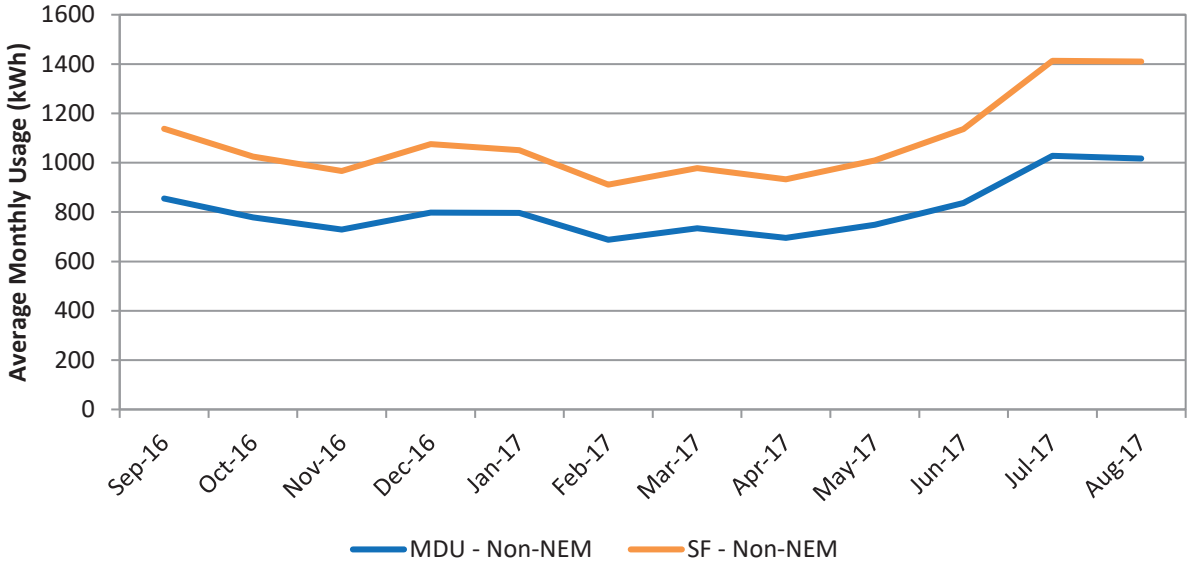
Chart SCE – 3: Single Meter (TOU-D-A/B) –
Average Monthly Usage (kWh) by Customer Type Including NEM



Excluding NEM accounts has 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 higher when NEM accounts are excluded, indicating that the NEM housholds with PEVs take less electricity from the grid than the non-NEM PEV owners. The small impact is in part the result of the relatively small percentage of NEM accounts. Also, the average monthly usage for NEM households is only the energy that is delivered by SCE, not the total consumption. If NEM households have higher consumption than non-NEM households, then the balance of their consumption served by SCE might be similar between the two groups. This would also explain why the average monthly usage when NEM households are excluded changes very little.

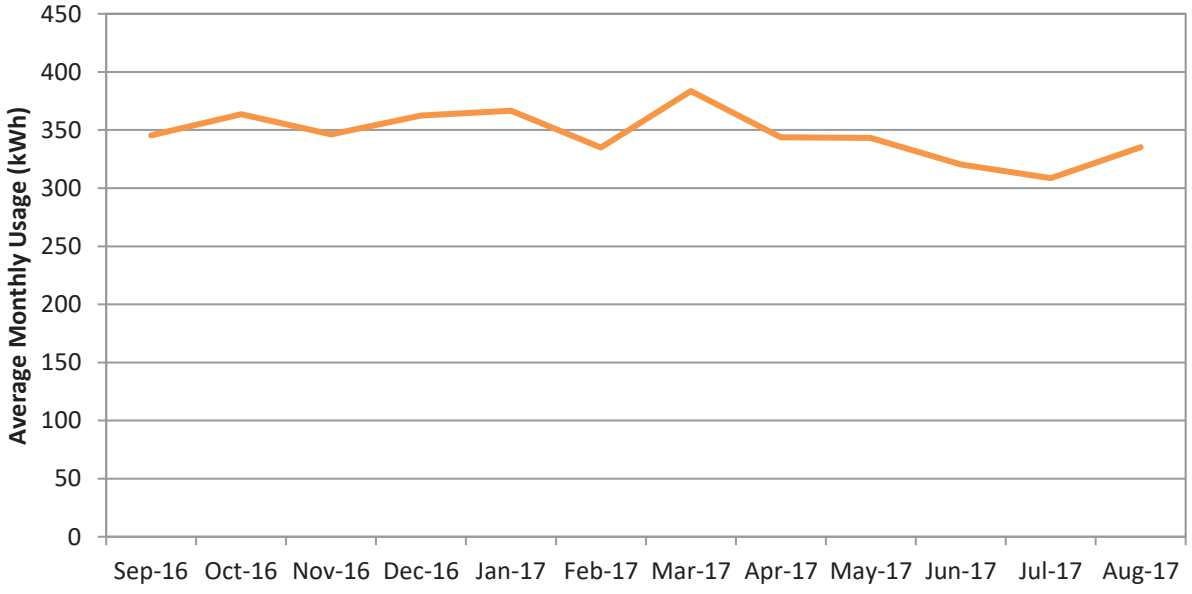
If using non-coincident demand as a proxy for consumption, the non-coincident demands for NEM households with PEVs are higher than the average household. Non-coincident demands for all single-meter PEV owners are presented in Table SCE – 9a and discussed in greater detail below. However, the monthly average non-coincident demands for NEM households range from 7.7 kW to 9.9 kW, indicating that demands for the NEM households with a PEV are about 1 kW larger than the average household with a PEV.

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 fairly consistent month-to-month, averaging 346 kWh. Usage ranged from 309 to 384 kWh each month, with the months of June and July having the lowest average usage. These are the same months that experienced the greatest growth in new accounts. 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 the result of 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 usage characteristics will also include the average residential customer as a benchmark for the single-metered PEV customers. This data is derived from SCE's 2016 Domestic Rate Group Load Study, which is based on the 2016 calendar year. As such, the statistics for the residential population are not presented in chronological order. The data for January 2017 through August 2017 is from the corresponding months in 2016.

Tables SCE – 6a, – 7, and – 8 each show the monthly proportion of usage by time-of-use period for the single-metered households. 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-seven 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, 45% on average, 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.

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. 2016	24.4%	17.6%	18.0%	17.6%	16.4%
Oct. 2016	20.7%	16.8%	15.2%	14.8%	13.6%
Nov. 2016	20.2%	14.0%	15.5%	15.0%	16.0%
Dec. 2016	19.2%	16.2%	15.7%	15.2%	16.6%
Jan. 2017	18.0%	14.0%	15.1%	14.8%	15.4%
Feb. 2017	20.2%	14.9%	14.7%	14.5%	14.5%
Mar. 2017	21.0%	15.0%	15.4%	15.0%	12.2%
Apr. 2017	20.5%	14.3%	13.6%	13.5%	9.4%
May 2017	20.1%	13.6%	15.5%	15.4%	11.1%
Jun. 2017	25.6%	17.9%	18.6%	18.2%	14.4%
Jul. 2017	23.8%	17.7%	18.5%	17.9%	15.9%
Aug. 2017	27.7%	20.3%	21.1%	20.6%	18.6%

* 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. 2016	44.6%	37.1%	37.2%	36.4%	26.7%
Oct. 2016	45.7%	37.3%	37.5%	36.5%	27.0%
Nov. 2016	45.2%	37.2%	37.4%	36.4%	26.4%
Dec. 2016	44.1%	37.4%	37.5%	36.6%	28.0%
Jan. 2017	45.3%	36.7%	36.8%	36.0%	27.5%
Feb. 2017	43.9%	36.4%	36.5%	35.6%	26.6%
Mar. 2017	43.1%	34.4%	34.5%	33.5%	22.2%
Apr. 2017	44.3%	37.0%	37.1%	36.3%	23.4%
May 2017	44.9%	35.9%	36.0%	35.5%	24.0%
Jun. 2017	44.1%	36.6%	36.8%	35.9%	25.7%
Jul. 2017	46.6%	40.7%	40.8%	40.0%	30.2%
Aug. 2017	42.8%	37.0%	37.1%	36.4%	27.2%
* 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. 2016	31.0%	45.0%	44.8%	46.0%	57.0%
Oct. 2016	33.6%	47.6%	47.4%	48.7%	59.5%
Nov. 2016	34.6%	47.3%	47.1%	48.6%	57.6%
Dec. 2016	36.7%	47.0%	46.8%	48.2%	55.4%
Jan. 2017	36.7%	48.2%	48.0%	49.3%	57.1%
Feb. 2017	36.0%	49.0%	48.8%	49.9%	59.0%
Mar. 2017	36.0%	50.3%	50.1%	51.5%	65.6%
Apr. 2017	35.2%	49.4%	49.2%	50.2%	67.3%
May 2017	34.9%	48.6%	48.5%	49.1%	64.9%
Jun. 2017	30.3%	44.8%	44.6%	45.9%	59.9%
Jul. 2017	29.6%	40.8%	40.6%	42.1%	53.9%
Aug. 2017	29.5%	41.9%	41.8%	43.0%	54.2%
* 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 88% of their usage during the off-peak period as shown in Table SCE – 6c. Very similar results were present 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. 2016	11.6%	88.4%
Oct. 2016	12.0%	88.0%
Nov. 2016	12.5%	87.5%
Dec. 2016	12.8%	87.2%
Jan. 2017	12.9%	87.1%
Feb. 2017	13.0%	87.0%
Mar. 2017	12.2%	87.8%
Apr. 2017	12.0%	88.0%
May 2017	11.8%	88.2%
Jun. 2017	11.6%	88.4%
Jul. 2017	12.4%	87.6%
Aug. 2017	11.7%	88.3%

The following three charts, Charts SCE – 6a-6c, examine the dispersion of individual account usage for each day of the week. The average consumption for each account was calculated for each day of the week and then the distribution of all accounts is displayed in a box-and-whisker[45] plot for each day. Chart SCE—6a and SCE—6b show the distribution for single-metered households by SF and MDU respectively. Chart—6c displays the daily distributions for the separately metered accounts.

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 Saturday and Sunday. Most noteworthy for both rates 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 300 kWh for any day of the week, whereas the SF customers have a handful of accounts with average consumption greater than 300 kWh and up to about 520 kWh per day.

[45] 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.

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

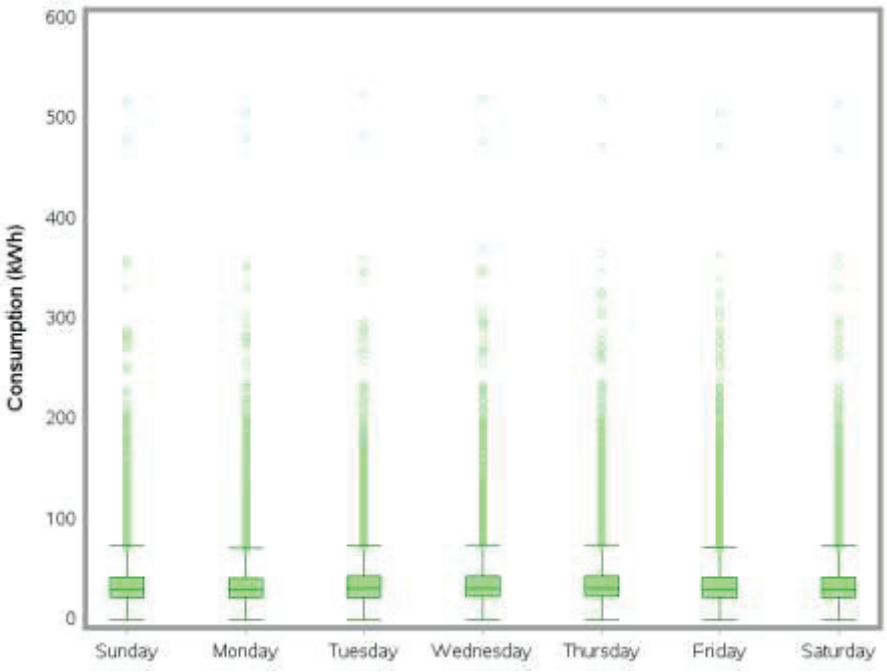


Chart SCE – 6b: Single Meter (TOU-D-A/B), MDU –
Box-and-Whisker Plot of Individual Average Daily Consumption(kWh) by Day of the Week

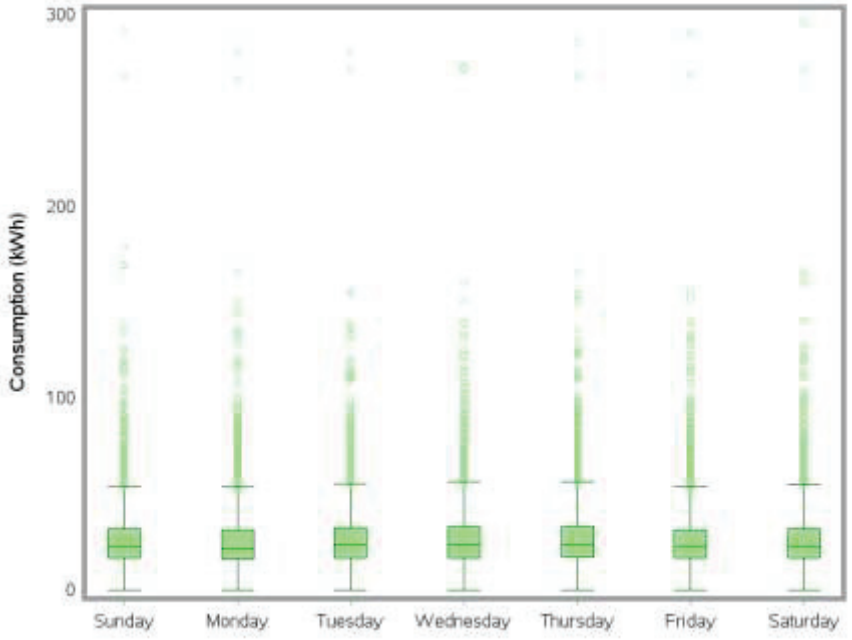
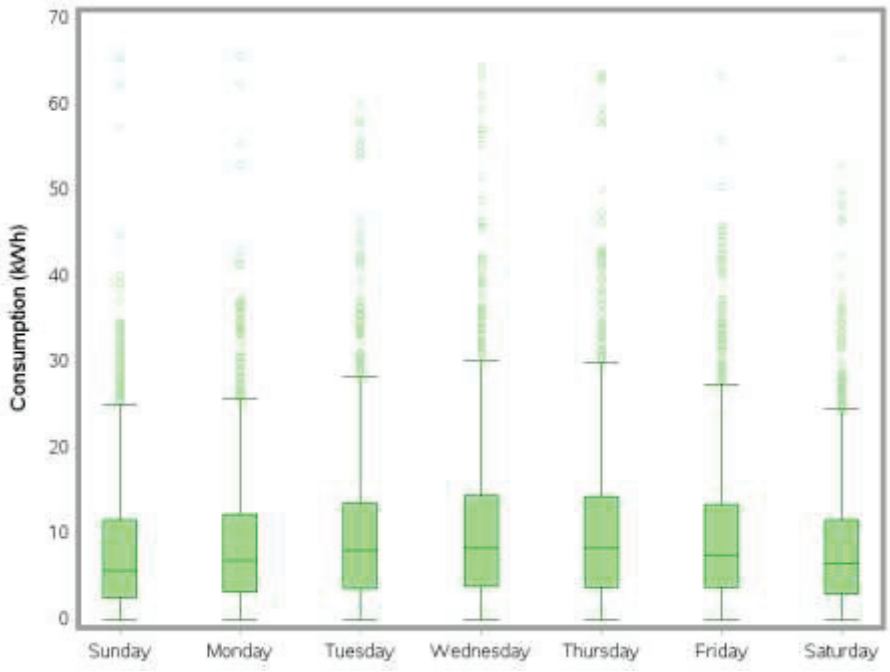


Chart SCE – 6c: Separate Meter (TOU-EV-1), SF –
Box-and-Whisker Plot of Individual Average Daily Consumption(kWh) by Day of the Week



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-metetered 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 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 every day, but not quite as low on weekend days as weekdays. Rather than declining into the morning hours, however, these profiles exhibt a large spike begining at 10 p.m. and peaking at midnight before tapering until 6:00 a.m. The peak of the spike averages 2.4 kW, 26% greater than the 1.9 kW average usage at 8:00 p.m. The beginning of the spike at 10 p.m. corresponds directly with the off-peak time period of the TOU-D-A/B tariff and is abnormal for typical residential customers. The peak is likely attributable to PEV charging, however, the observed usage includes all household loads during these hours. Nearly identical behavior is observed with MDU customers in Chart SCE – 7b, with the exception that the avergage hourly usage is lower, peaking around 1.8 kW on average. 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.

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

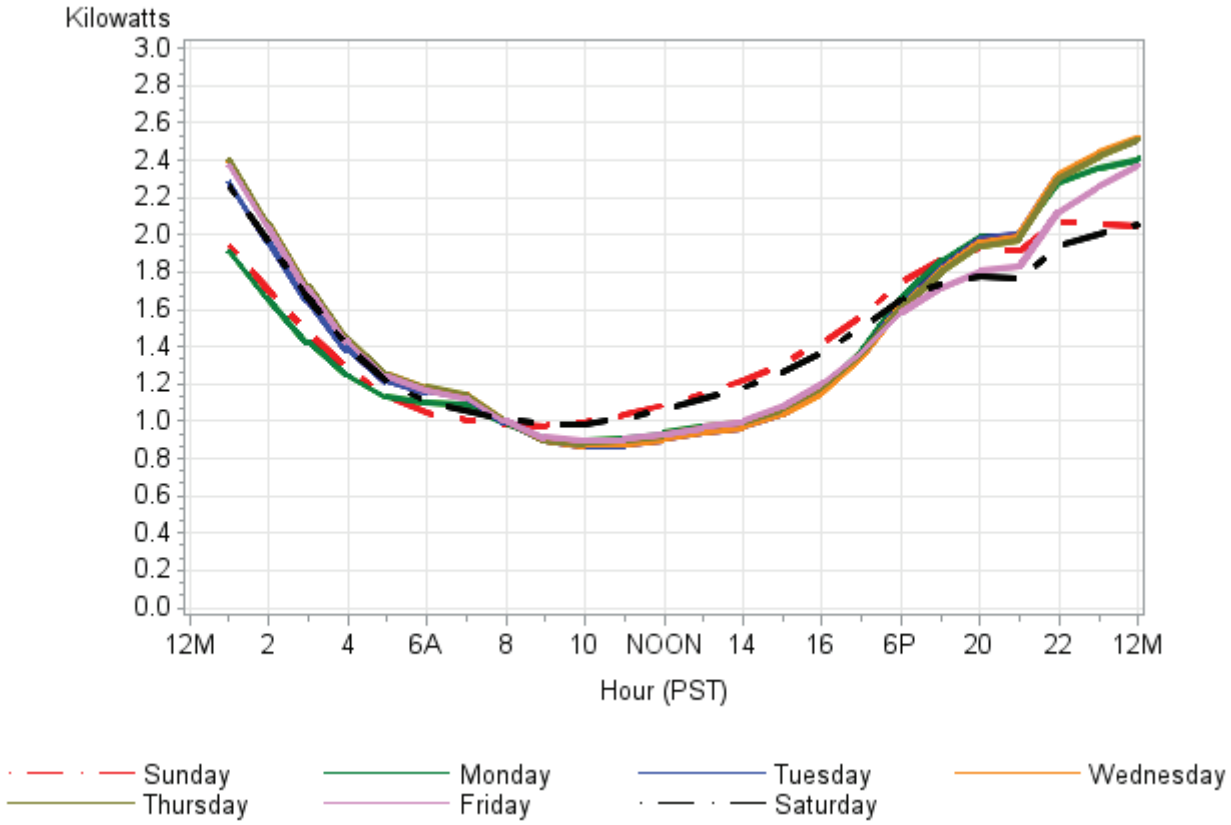
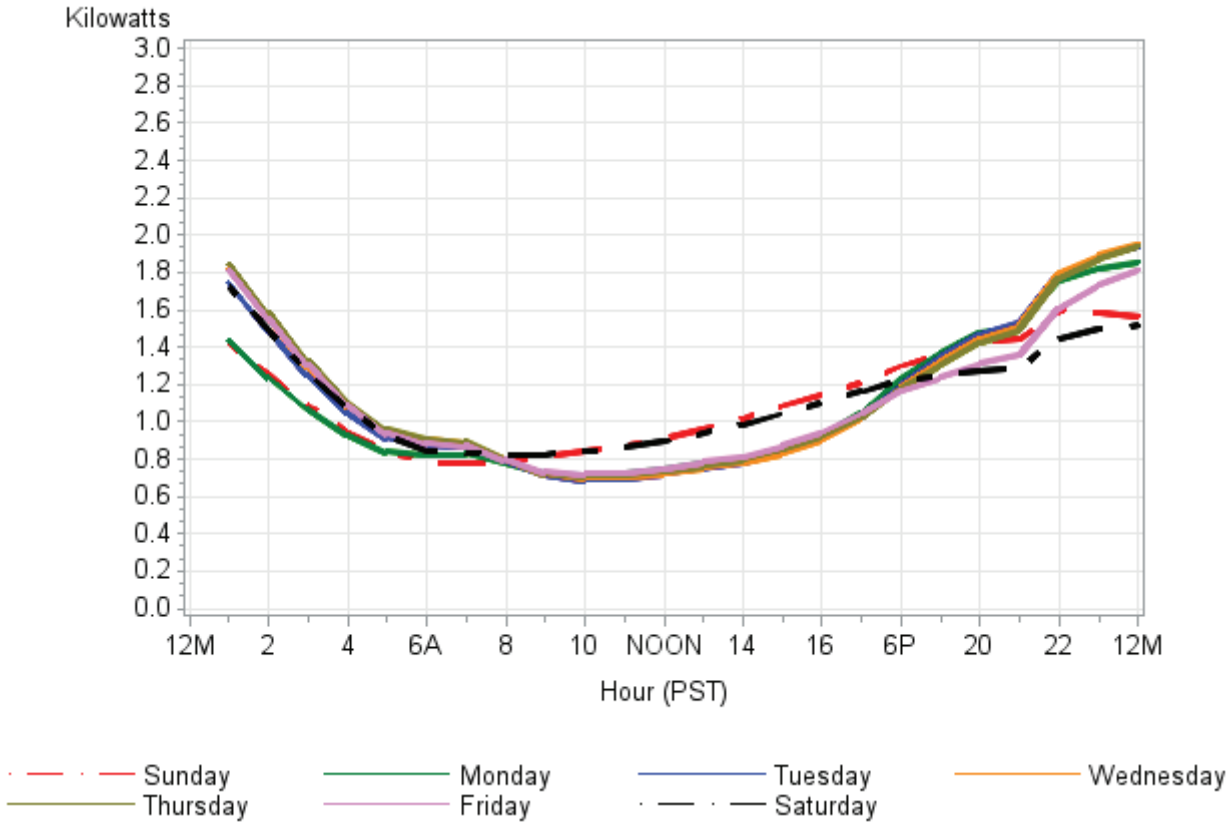


Chart SCE – 7b: Single Meter (TOU-D-A/B), MDU –
Average Hourly Load Profile for Each Day of the Week



Separately-meterered PEVs commence charging promptly at the beginning 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 Tuesday through Thursday and has an average hourly demand of 1.7 kW. Weekend peak demand is around 1.1 kW. Charging during the day between 6:00 a.m. and 8:00 p.m. is very low, especially on weekdays.

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

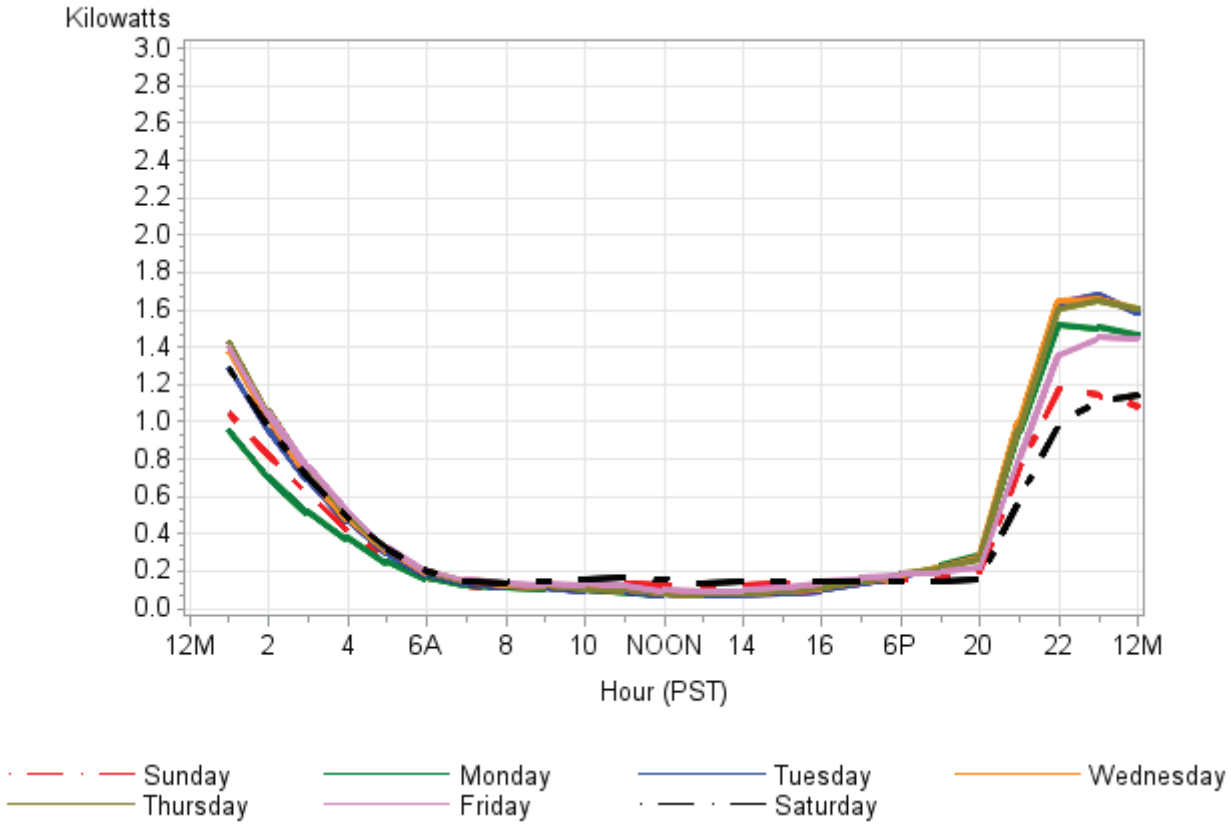
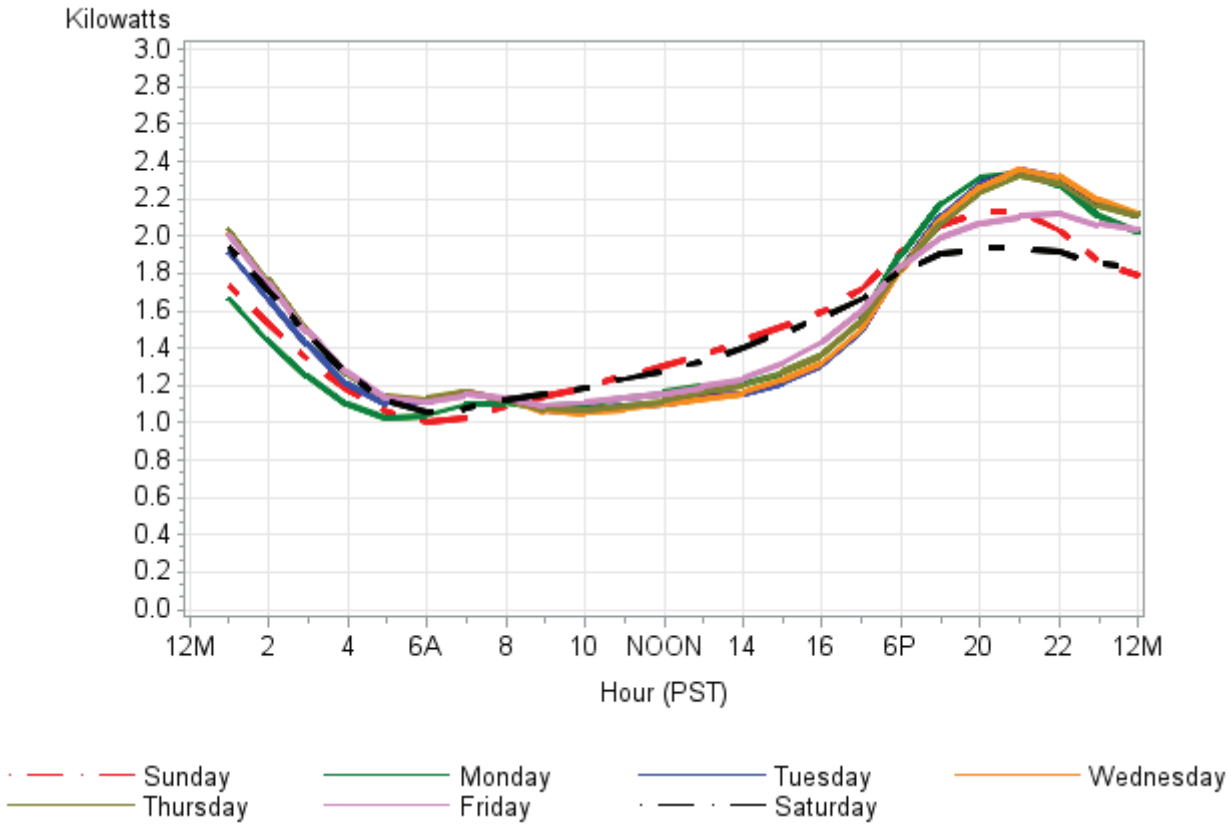


Chart SCE – 9 shows the load profile for a portion of the SF customers who are believed by SCE to own a PEV but choose to remain on the regular, tiered domestic rate. Their daytime demand begins to rise around 10:00 a.m. at 1.1 kW on weekdays and increases gradually until it peaks in the evening at 9:00 p.m. at about 2.3 kW on average. Weekend loads are slightly higher during the middle of the day but notably have lower evening peak loads. Late evening loads are also lower presumably due to less PEV charging.

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 and a higher evening peak, which may be a factor in their decision to remain on the regular residential rate as opposed to the TOU rate. It is not clear if these customers simply have higher non-PEV consumption or if the greater usage is due to PEV charging.

Chart SCE – 9: Single Meter, SF PEV Owners[46] on a Non-TOU Rate – Average Hourly Load Profile for Each Day of the Week



Average Non-Coincident Peak Load

The size and timing of demands 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.

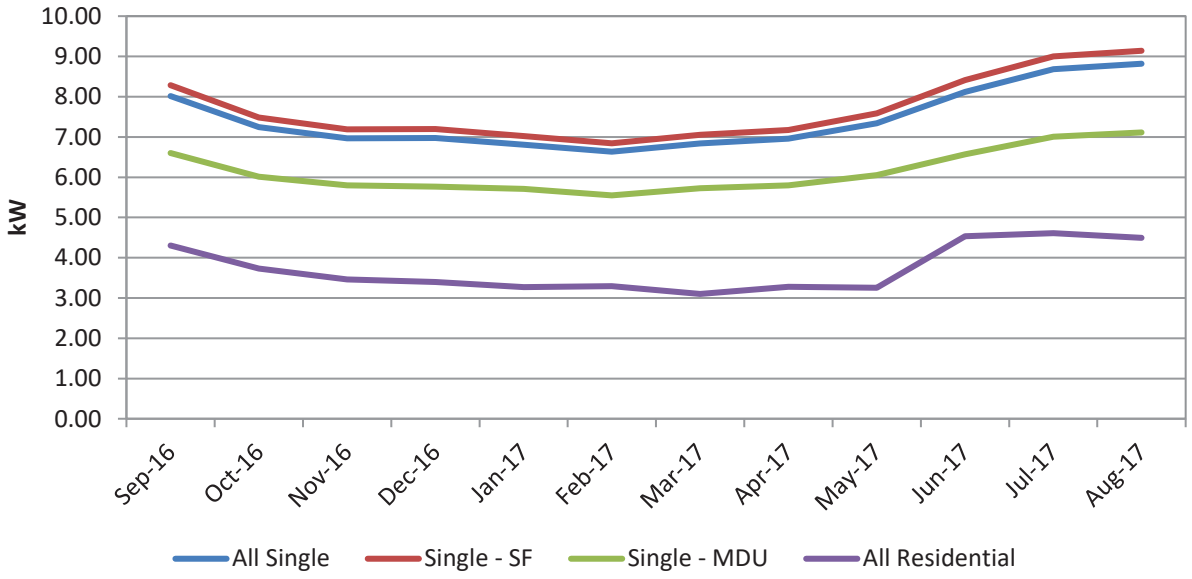
The average monthly non-coincident peak for all single-metered PEV households of 7.5 kW in Table SCE – 9a is on average 3.8 kW higher than the residential population as a whole and unchanged from the previous report. Chart SCE – 10a shows a seasonal fluctuation in non-coincident demands ranging from a high of 8.8 kW in August to a low of 6.6 kW in February. The non-coincident demands for single-metered households are about twice as large as the non-coincident demands for general residential population. The general residential population, however, displays a similar seasonal variation in non-coincident demand levels.

[46] 4,628 accounts on the regular Domestic rate schedule (including NEM customers) with load data between September 1, 2016, and August 31, 2017, and known to own a 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. 2016	4.30	5.01	3.25	8.02	8.29	6.60
Oct. 2016	3.73	4.24	2.96	7.25	7.48	6.01
Nov. 2016	3.46	3.79	2.97	6.96	7.19	5.80
Dec. 2016	3.40	3.67	2.99	6.97	7.20	5.77
Jan. 2017	3.27	3.48	2.94	6.81	7.02	5.71
Feb. 2017	3.29	3.54	2.92	6.63	6.84	5.55
Mar. 2017	3.10	3.35	2.73	6.84	7.05	5.72
Apr. 2017	3.28	3.60	2.80	6.96	7.18	5.80
May 2017	3.25	3.60	2.72	7.34	7.58	6.05
Jun. 2017	4.53	5.31	3.38	8.12	8.41	6.57
Jul. 2017	4.61	5.41	3.41	8.68	9.00	7.00
Aug. 2017	4.49	5.25	3.35	8.82	9.14	7.11

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 7.7 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. 2016	7.69
Oct. 2016	7.81
Nov. 2016	7.95
Dec. 2016	7.83
Jan. 2017	7.85
Feb. 2017	7.88
Mar. 2017	8.03
Apr. 2017	7.80
May 2017	7.66
Jun. 2017	7.48
Jul. 2017	7.38
Aug. 2017	7.40

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

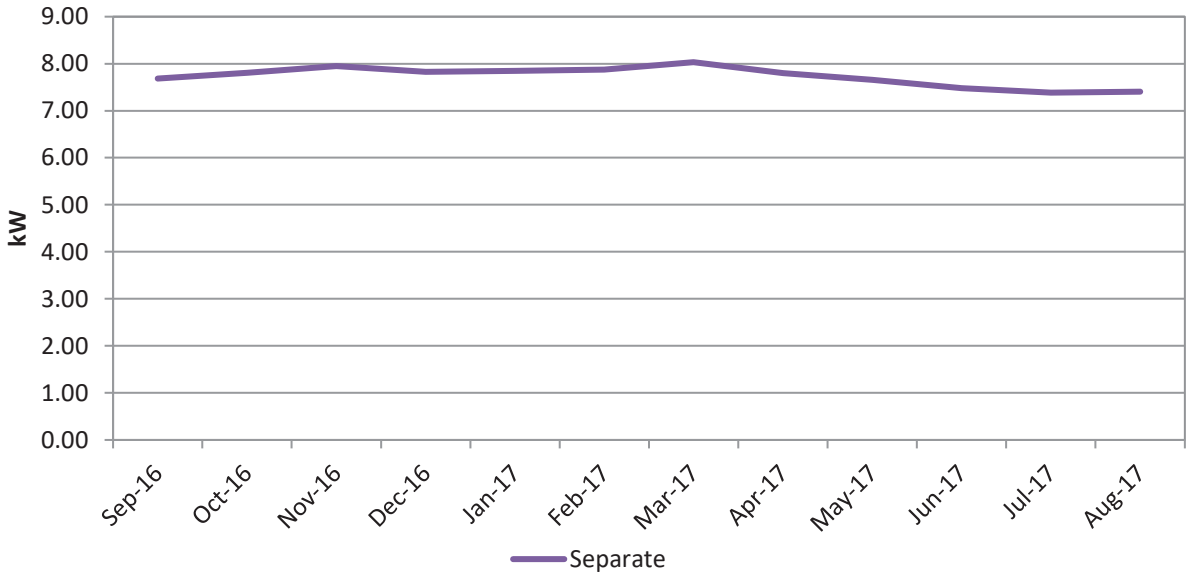
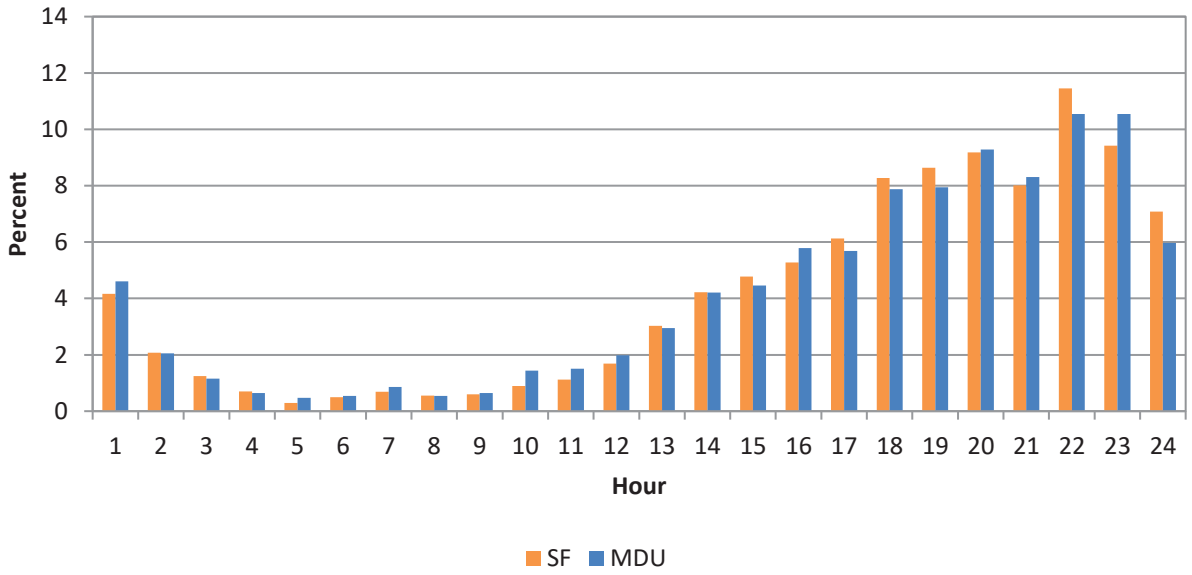


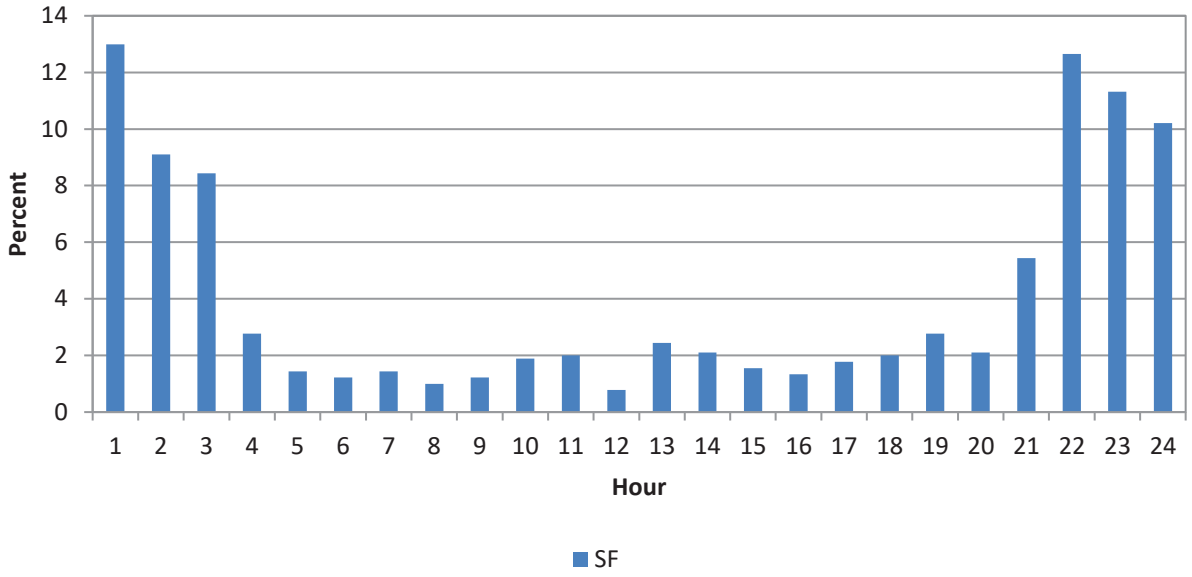
Chart SCE – 11a provides a contrast to the average hourly demands seen in the load profiles previously. For single-metered households, while the average demand is highest during the off-peak hours in the early morning, the hour of the annual non-coincident peak most frequently occurs in the evening. MDUs peak at 10:00 and 11:00 p.m. SF households have the most annual hourly peaks at 10 p.m., but slightly earlier peaks than the MDU customers. Both groups have a second peak in non-coincident demand frequency occurring in the early evening from 6 p.m. to 8 p.m. This second, earlier peak in frequency overlaps with the general residential population as can be seen in the table titled Data Accompanying Chart SCE – 11a. The general residential population has the most accounts peaking within a longer window from 3:00 to 8:00 p.m.

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



Unlike the single-metered households, there are no other loads that coincide with PEV charging causing the peak to shift for separately-metered PEVs. Chart SCE – 11b shows that separately-metered PEVs have annual non-coincident peaks that occur overwhelmingly more frequently during their off-peak period. Only 16% of customers peak in the tariff's on-peak window of 12:00 – 9:00 p.m. Daytime non-coincident peaks are uncommon in general. Even though the hours from 5 a.m. to noon are off-peak, there are very few customers which have a non-coincident peaks during these morning hours.

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%	4%	4%	5%	13%
2	0%	0%	1%	2%	2%	2%	9%
3	0%	0%	0%	1%	1%	1%	8%
4	0%	0%	0%	1%	1%	1%	3%
5	0%	0%	0%	0%	0%	0%	1%
6	1%	0%	1%	1%	0%	1%	1%
7	1%	1%	1%	1%	1%	1%	1%
8	1%	1%	2%	1%	1%	1%	1%
9	2%	1%	2%	1%	1%	1%	1%
10	2%	2%	3%	1%	1%	1%	2%
11	3%	3%	3%	1%	1%	2%	2%
12	4%	4%	4%	2%	2%	2%	1%
13	6%	6%	6%	3%	3%	3%	2%
14	7%	8%	7%	4%	4%	4%	2%
15	9%	10%	8%	5%	5%	4%	2%
16	10%	11%	8%	5%	5%	6%	1%
17	9%	10%	8%	6%	6%	6%	2%
18	10%	11%	9%	8%	8%	8%	2%
19	9%	9%	10%	9%	9%	8%	3%
20	8%	8%	8%	9%	9%	9%	2%
21	7%	7%	7%	8%	8%	8%	5%
22	4%	3%	5%	11%	11%	11%	13%
23	2%	2%	3%	10%	9%	11%	11%
24	1%	1%	2%	7%	7%	6%	10%

Average Diversified Peak Load and Timing

The hour of residential class peak loads varies throughout the year ranging from roughly 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. By comparison, the peak load for the single-metered PEV owners is much more consistent month-to-month, averaging 2.3 kW and occuring mostly at 1:00 a.m. (or midnight during daylight savings time). The presummed addition of PEV charging loads in the late night hours augments household loads enough to surpass the 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. 2016	1.86	17	2.26	17	1.17	17
Oct. 2016	1.38	16	1.66	16	0.90	16
Nov. 2016	1.08	19	1.26	19	0.77	20
Dec. 2016	1.14	20	1.35	19	0.81	21
Jan. 2017	1.15	20	1.31	19	0.87	20
Feb. 2017	1.10	20	1.25	20	0.83	21
Mar. 2017	0.98	20	1.12	20	0.72	20
Apr. 2017	1.05	20	1.21	20	0.77	20
May 2017	1.03	20	1.22	20	0.71	20
Jun. 2017	2.30	18	2.77	18	1.50	18
Jul. 2017	2.20	17	2.68	17	1.38	18
Aug. 2017	2.15	17	2.62	17	1.33	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. 2016	2.43	24	2.52	24	1.93	24
Oct. 2016	2.23	24	2.32	24	1.78	24
Nov. 2016	2.10	1	2.18	1	1.69	1
Dec. 2016	2.21	1	2.30	1	1.76	1
Jan. 2017	2.20	1	2.28	1	1.77	1
Feb. 2017	2.18	1	2.27	1	1.76	1
Mar. 2017	2.14	24	2.21	24	1.73	24
Apr. 2017	2.15	24	2.23	24	1.71	24
May 2017	2.23	24	2.33	24	1.75	24
Jun. 2017	2.41	24	2.50	24	1.89	24
Jul. 2017	2.72	22	2.83	22	2.12	22
Aug. 2017	2.79	22	2.90	22	2.17	22

Average monthly diversified peak loads for separately-metered PEVs is 1.6 kW with the peaks occuring between 10:00 and 11:00 p.m. This indicates a significant amount of diversity in charging as the non-coincident peak loads were 7.7 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. 2016	1.64	22
Oct. 2016	1.63	22
Nov. 2016	1.63	23
Dec. 2016	1.57	23
Jan. 2017	1.68	23
Feb. 2017	1.68	23
Mar. 2017	1.66	23
Apr. 2017	1.63	22
May 2017	1.55	22
Jun. 2017	1.53	22
Jul. 2017	1.41	22
Aug. 2017	1.54	22

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 system peak represents all the load on the system in contrast to the net system peak, which represents only the load on the system not provided by renewable generation. The net system peak often occurs later in the day than the system peak for SCE. The net system loads generally better reflect marginal costs. The monthly system peaks for the months in this report occur at 7 p.m. or 8 p.m. from December to April. During the other months, the system peak occurs at 3 p.m. or 4 p.m.

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 1.9 kW compared to the 2.3 kW diversified peak. Comparing the coincident loads of the residential population with the PEV owners is not very meaningful as the underlying residential data for January through August is from 2016 and thus the peak loads and hours differ from those in 2017.

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. 2016	1.79	2.17	1.14	2.19	2.29	1.68
Oct. 2016	1.14	1.35	0.77	1.51	1.57	1.19
Nov. 2016	0.94	1.08	0.67	1.27	1.32	1.00
Dec. 2016	1.11	1.31	0.75	1.79	1.88	1.34
Jan. 2017	1.07	1.23	0.77	1.78	1.86	1.34
Feb. 2017	0.96	1.11	0.70	1.62	1.70	1.24
Mar. 2017	0.89	1.03	0.64	1.59	1.65	1.25
Apr. 2017	0.92	1.06	0.67	1.71	1.79	1.28
May 2017	0.92	1.09	0.62	1.31	1.35	1.10
Jun. 2017	2.22	2.70	1.39	2.14	2.23	1.66
Jul. 2017	2.09	2.58	1.27	2.52	2.64	1.91
Aug. 2017	2.07	2.52	1.28	2.89	3.02	2.17

Table SCE – 11a cont'd shows the average load coincident with sytem peak for accounts that have a PEV and are NEM or DR. In comparison to all sinlgle-meter accounts with a PEV, these customers have lower coincident demands in summer and fall months but higher system peak coincident demands December through April.

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

Month	NEM	DR
Sep. 2016	1.81	2.04
Oct. 2016	1.23	1.27
Nov. 2016	1.11	1.07
Dec. 2016	2.04	1.59
Jan. 2017	2.08	1.59
Feb. 2017	1.92	1.46
Mar. 2017	1.88	1.41
Apr. 2017	1.99	1.57
May 2017	0.70	1.25
Jun. 2017	1.43	2.17
Jul. 2017	1.93	2.54
Aug. 2017	2.39	2.97

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	0.11
Oct. 2015	0.16
Nov. 2015	0.07
Dec. 2015	0.16
Jan. 2016	0.21
Feb. 2016	0.28
Mar. 2016	0.25
Apr. 2016	0.15
May-16	0.12
Jun. 2016	0.07
Jul. 2016	0.09
Aug. 2016	0.13

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, 61% of single-metered and 55% or separately-metered, are in the mild climate. By contrast only 45% of residential accounts are in these zones.

Table SCE –12a: Percentage of PEV Customers on
TOU Rates by Zone[47] as Compared to Residential Population

Climate	Zone(s)	Residential Population*	Single Meter	Separate Meter
mild	5, 6, 8, 16	45%	61%	55%
moderate/hot	9, 10, 13, 14, 15	55%	39%	44%

*Percentages are based on residential customers at the end of October 2017.

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.

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

- 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.

Nearly the same zip codes maintain the greatest prevelance of PEVs as in the previous report. Table SCE 12 – b shows Manhattan Beach again tops the list and Irvine is again second in the top five zip codes by single-metered households. The only change from last year's report is Newport Beach replacing Huntington Beach as the fifth highest number of PEVs by zip code. These two beach cities, however, are neighbors. For separately-metered PEVs, only four zip codes have greater than the 15 necessary accounts to report publicly. Santa Monica zip code 90402 remains the zip code with the most seperartely-metered PEVs, with 30 accounts. Calabasas remains in the top five, having increased by 3 accounts, but Santa Monica zip code 90401, Altadena, Laguna Beach and Los Alamitos are all new in the top five ranking.

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	324
	92620	Irvine	291
	90274	Palos Verdes Peninsula	261
	90275	Rancho Palos Verdes	250
	92660	Newport Beach	234
Separate Meter	90402	Santa Monica	30
	91302	Calabasas	18
	90401, 91001, 92651	Santa Monica, Altadena, Laguna Beach	16
	90720	Los Alamitos	15
	Undisclosed	Undisclosed	<15

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

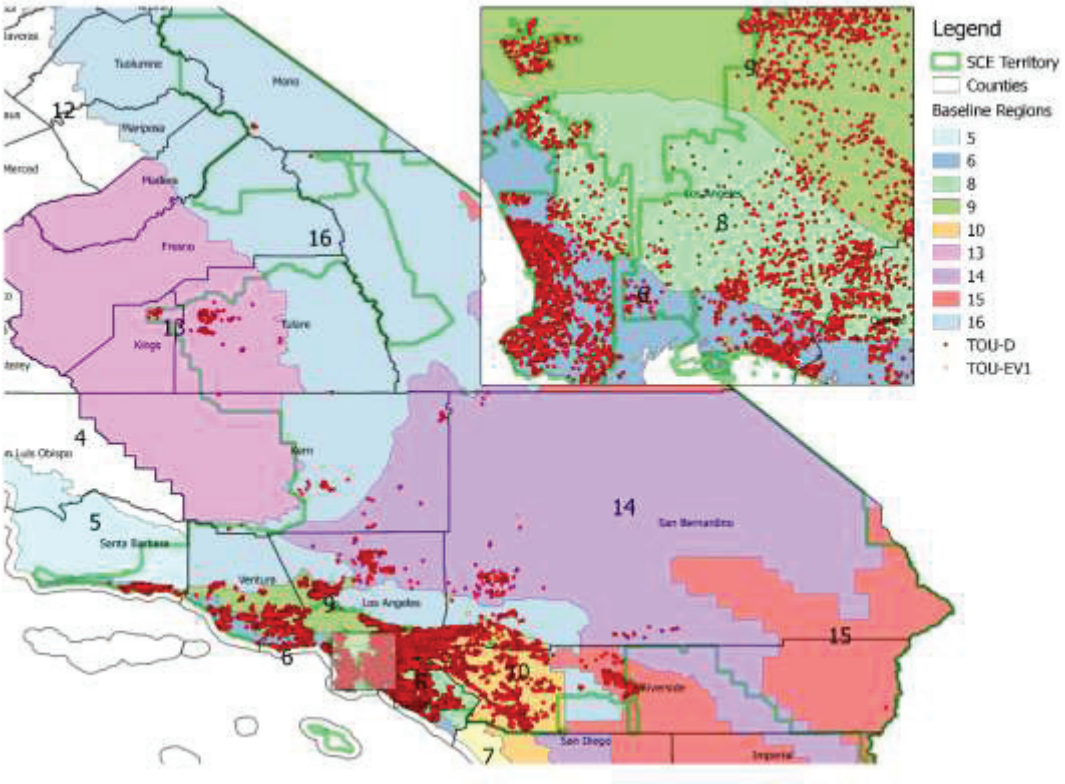
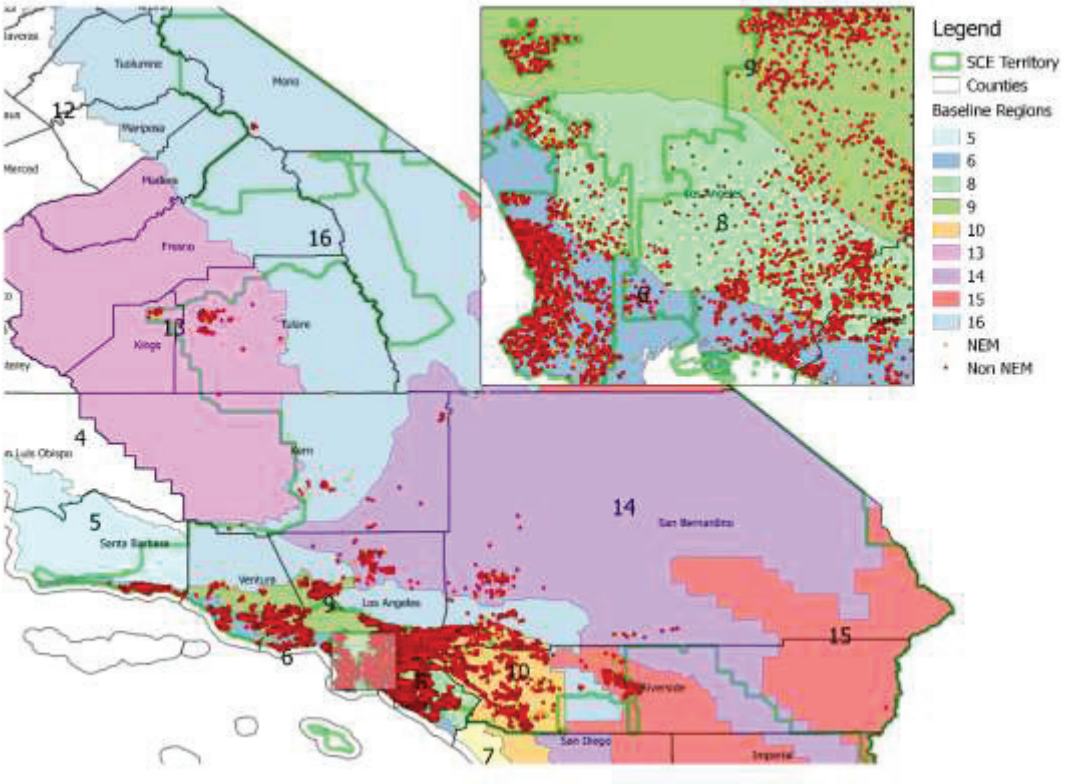


Figure SCE – 4: Geographic Location PEV TOU Accounts by NEM Designation



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 March 1, 2017 through August 31, 2017. 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	Time Period	Summer	Winter
EVTOU	Super Off-Peak	Midnight to 5am	0.19	0.21
	On-Peak	Noon to 8pm	0.50	0.24
	Off-Peak	All other hours	0.24	0.23
EVTOU2	Super Off-Peak	Midnight to 5am	0.19	0.21
	On-Peak	Noon to 6pm	0.50	0.23
	Off-Peak	All other hours	0.24	0.23

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

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 2016, the number of customers taking service under EVTOU-2 has grown 25%.

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
Sep2016	7814	2542	32.53%	1720	22.01%
Oct2016	7971	2602	32.64%	1758	22.05%
Nov2016	8126	2667	32.82%	1797	22.11%
Dec2016	8275	2749	33.22%	1821	22.01%
Jan2017	8454	2826	33.43%	1866	22.07%
Feb2017	8708	2950	33.88%	1918	22.03%
Mar2017	8921	3040	34.08%	1972	22.11%
Apr2017	9204	3136	34.07%	1971	21.41%
May2017	9334	3203	34.32%	2002	21.45%
Jun2017	9489	3283	34.60%	2056	21.67%
Jul2017	9627	3342	34.71%	2109	21.91%
Aug2017	9761	3407	34.90%	2165	22.18%

The research presented herein analyzes usage patterns of customers on EV rates, 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. NEM penetration for the residential population in SDG&E's service territory is between 8% and 9%, while NEM customers represent 32%-35% 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):

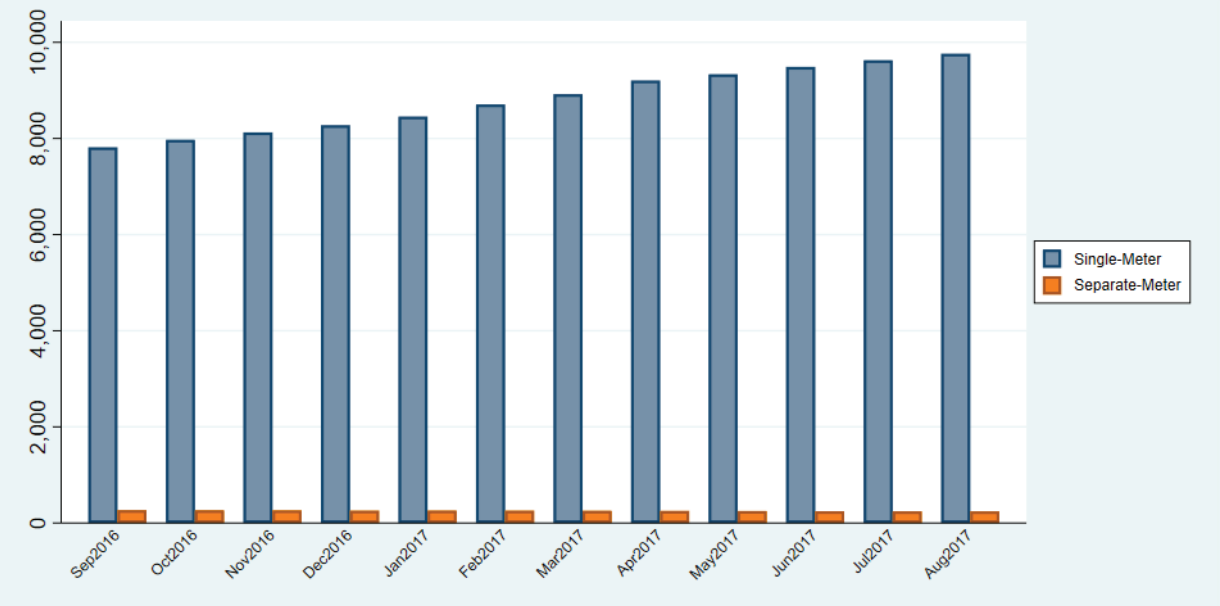
EVTOU:

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
Sep2016	266	102	38.35%	40	15.04%
Oct2016	264	101	38.26%	40	15.15%
Nov2016	262	100	38.17%	39	14.89%
Dec2016	256	98	38.28%	38	14.84%
Jan2017	258	99	38.37%	38	14.73%
Feb2017	256	99	38.67%	40	15.63%
Mar2017	254	98	38.58%	39	15.35%
Apr2017	251	97	38.65%	36	14.34%
May2017	249	97	38.96%	36	14.46%
Jun2017	244	94	38.52%	35	14.34%
Jul2017	243	93	38.27%	35	14.40%
Aug2017	242	93	38.43%	36	14.88%

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

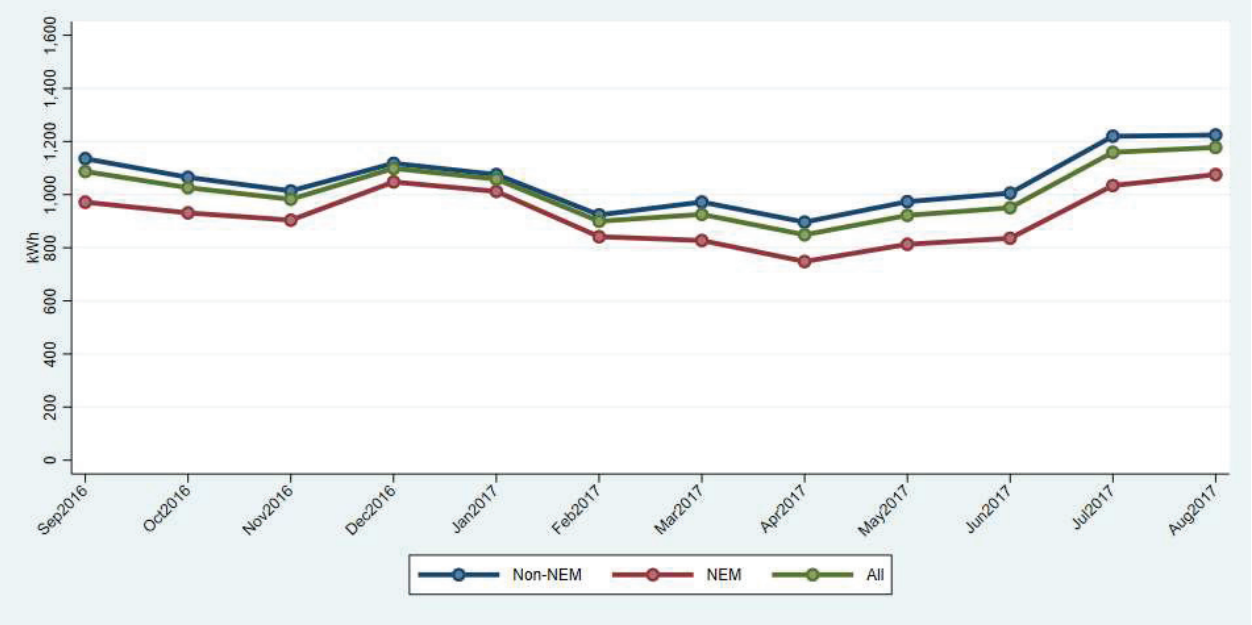


Looking at Table 3 and Chart 1, we can see that the number of customers taking service under these separate-metered rates have decreased constant over the past 12 months. The disparity in growth rates between single- and separate-meter customers can be attributed to three factors: (1) only customers 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.

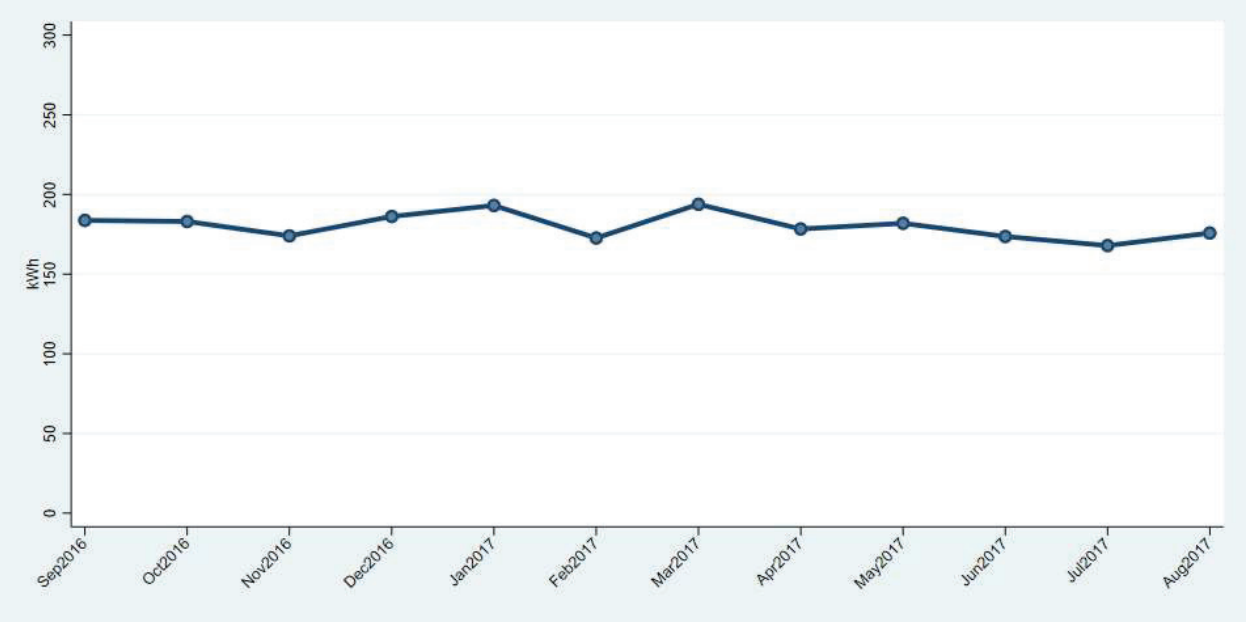
NEM penetration is higher in the separately-metered rates compared to single-meter customers.

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
2016	9	22.76%	10.85%	19.31%	11.34%
2016	10	21.36%	10.27%	18.07%	11.24%
2016	11	19.96%	14.01%	18.15%	11.50%
2016	12	20.34%	15.26%	18.73%	12.42%
2017	1	19.08%	13.23%	17.19%	14.01%
2017	2	20.00%	12.42%	17.59%	13.09%
2017	3	20.23%	6.63%	16.10%	11.57%
2017	4	21.02%	4.92%	16.17%	9.73%
2017	5	20.50%	6.35%	16.20%	8.96%
2017	6	22.91%	7.22%	18.15%	8.79%
2017	7	24.99%	11.10%	20.69%	9.48%
2017	8	25.23%	11.69%	20.91%	8.75%

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 slightly over 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 on average about 75% 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 NEM	Single-Metering	Separate-Metering
2016	9	52.69%	53.72%	52.99%	14.35%
2016	10	53.31%	53.36%	53.33%	14.25%
2016	11	55.52%	51.59%	54.33%	14.92%
2016	12	55.93%	53.10%	55.03%	14.70%
2017	1	56.49%	53.90%	55.65%	17.54%
2017	2	54.79%	52.70%	54.13%	16.04%
2017	3	53.44%	53.71%	53.52%	15.32%
2017	4	52.67%	53.51%	52.92%	12.95%
2017	5	53.20%	53.09%	53.17%	12.37%
2017	6	51.63%	53.65%	52.24%	12.32%
2017	7	51.85%	54.61%	52.71%	12.97%
2017	8	51.17%	54.32%	52.18%	12.79%

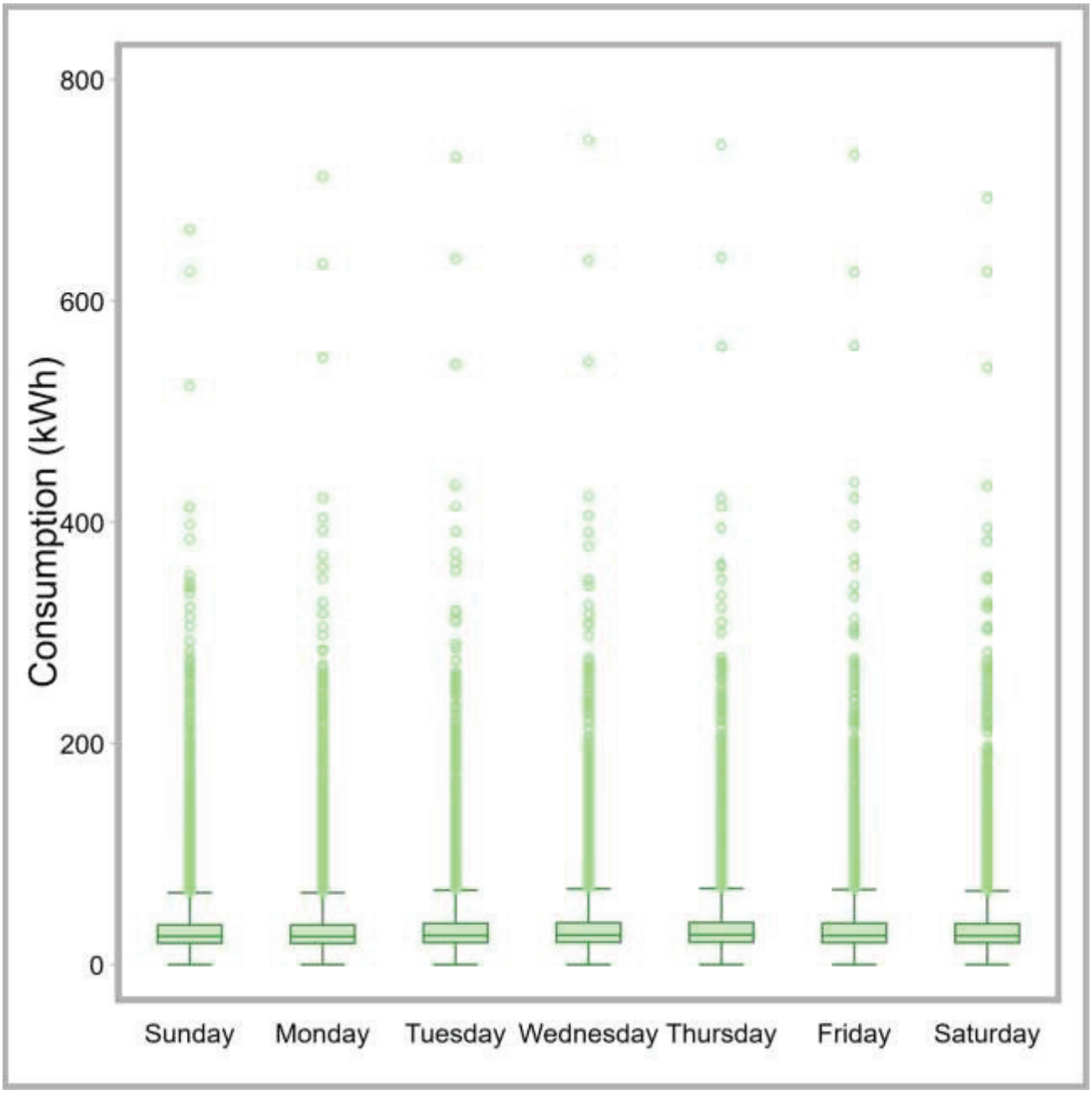
SDG&E Table 8: Percentage of Super Off-Peak Usage by Meter Configuration

Year	Month	Single-Metering Non-NEM	Single-Metering NEM	Single-Metering	Separate-Metering
2016	9	24.54%	35.43%	27.70%	74.32%
2016	10	25.33%	36.37%	28.61%	74.51%
2016	11	24.52%	34.40%	27.52%	73.57%
2016	12	23.73%	31.64%	26.24%	72.87%
2017	1	24.43%	32.87%	27.16%	68.45%
2017	2	25.21%	34.88%	28.29%	70.87%
2017	3	26.33%	39.66%	30.38%	73.11%
2017	4	26.31%	41.57%	30.91%	77.33%
2017	5	26.30%	40.56%	30.63%	78.67%
2017	6	25.47%	39.13%	29.61%	78.88%
2017	7	23.16%	34.29%	26.60%	77.54%
2017	8	23.60%	33.98%	26.92%	78.46%

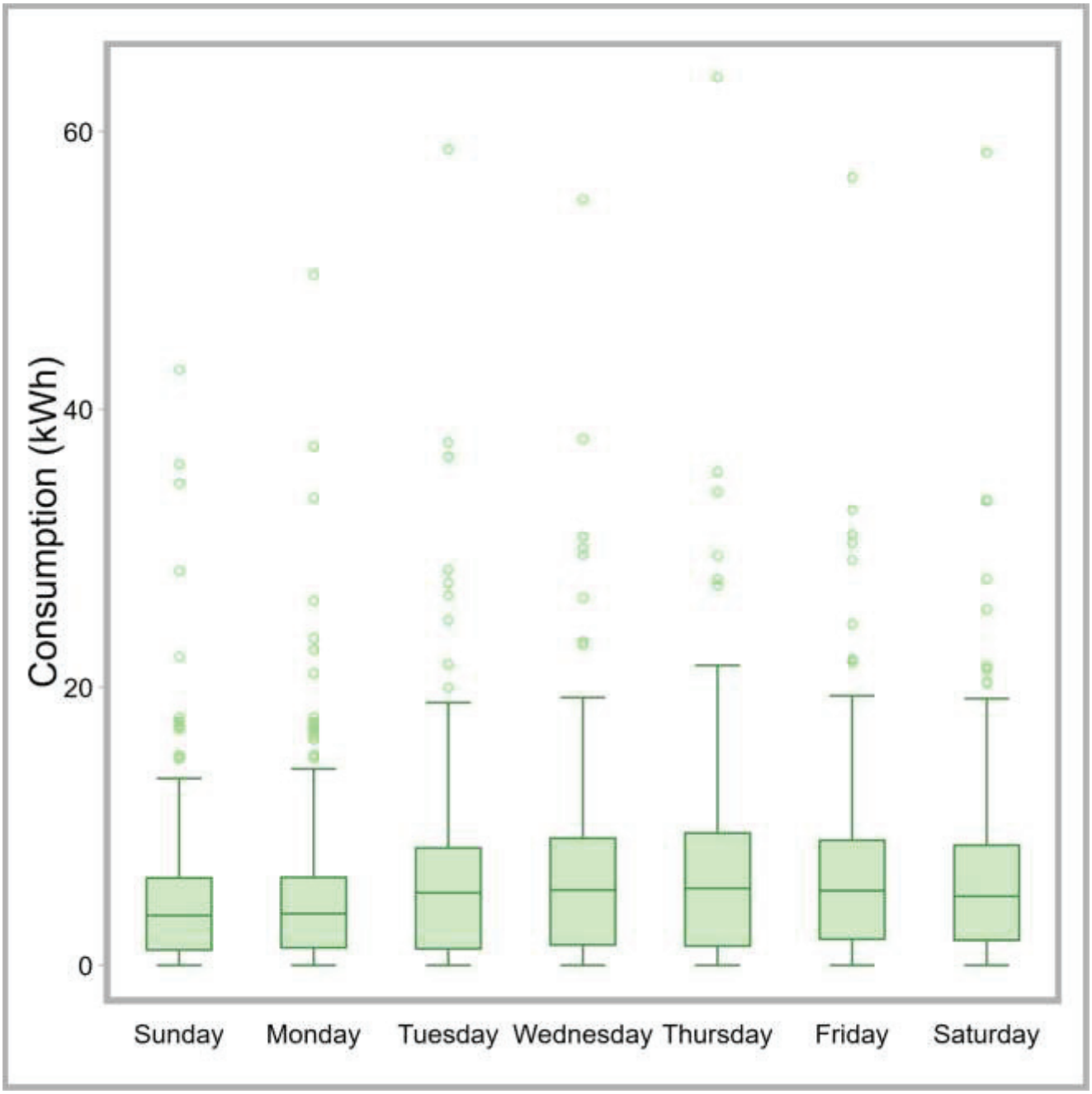
The box and whisker plots in Charts 6a and 6b show the distribution of customers' average daily usage by day of the week. As you can see, there is a lot of variation in the single-meter rate but not in the separate-meter rates. We would expect this since there are fewer factors that can affect consumption on a meter solely designated for PEV charging compared to consumption for a whole house. It is clear from 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. Noticeably, 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

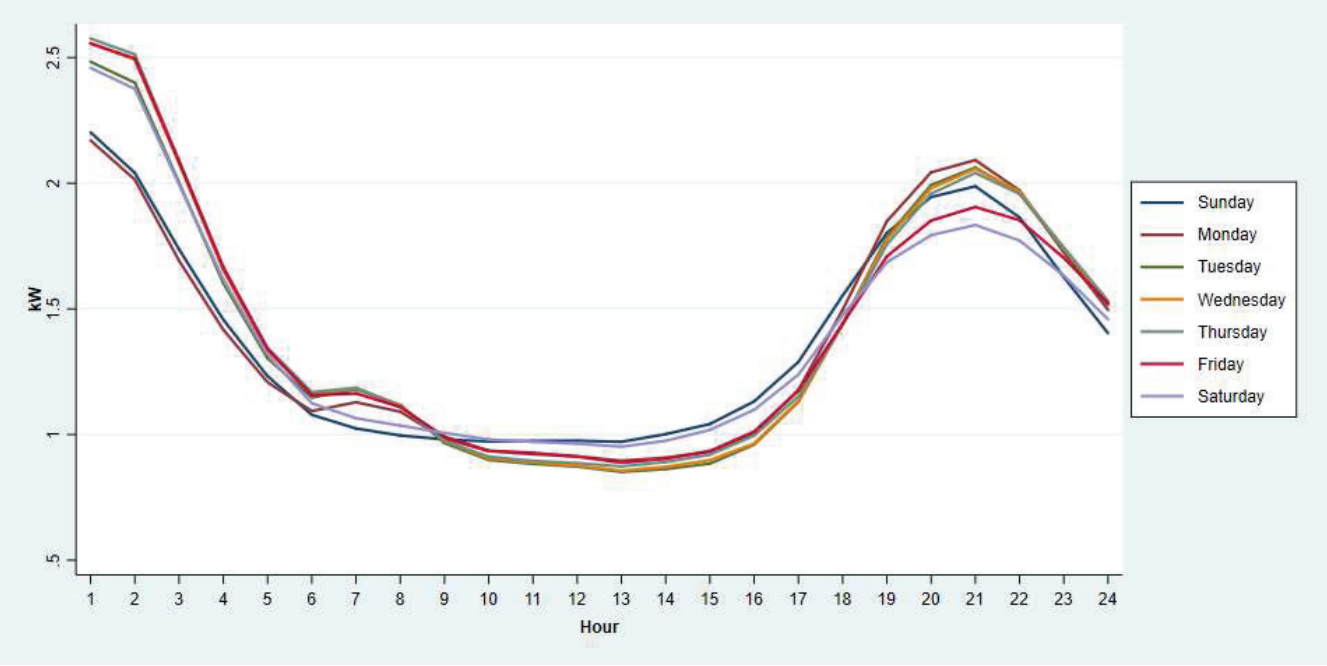
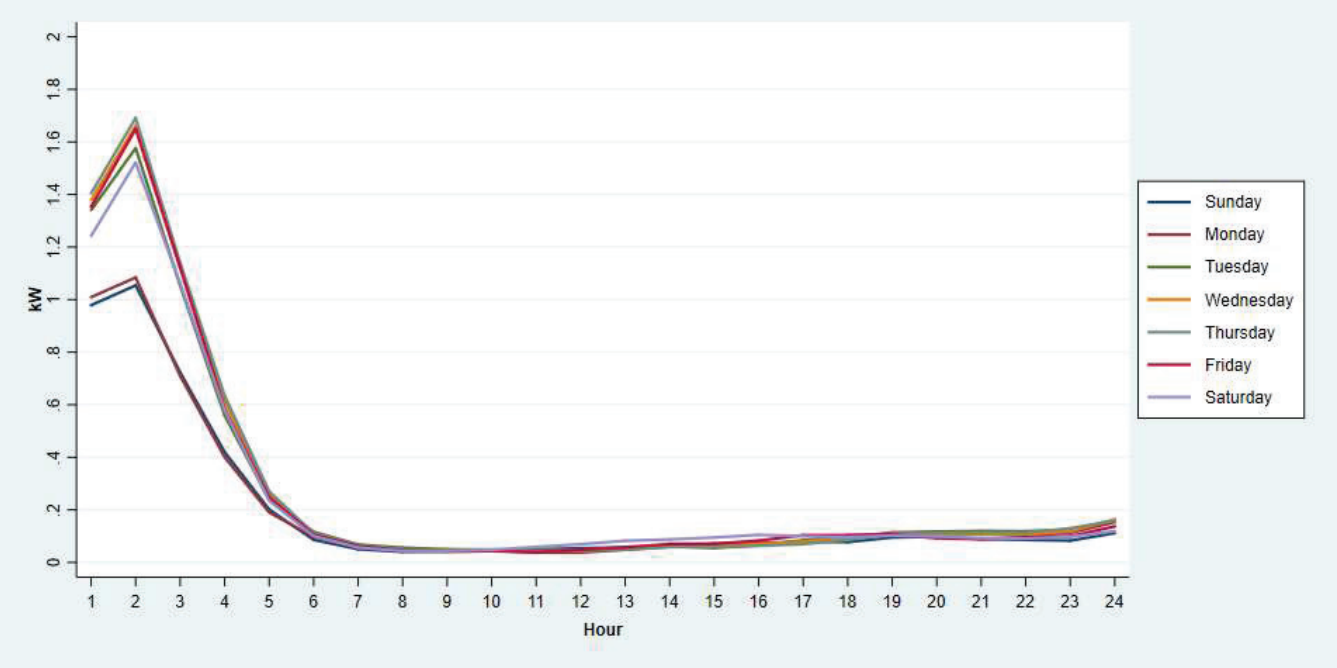


Chart 8 displays similar day of week patterns for separate-meter PEV customers. These accounts peak in the 01:00 – 02:00 hours and have virtually zero consumption during the rest of the day. This would indicate that the rates and enabling technology are extremely successful in encouraging charging during 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

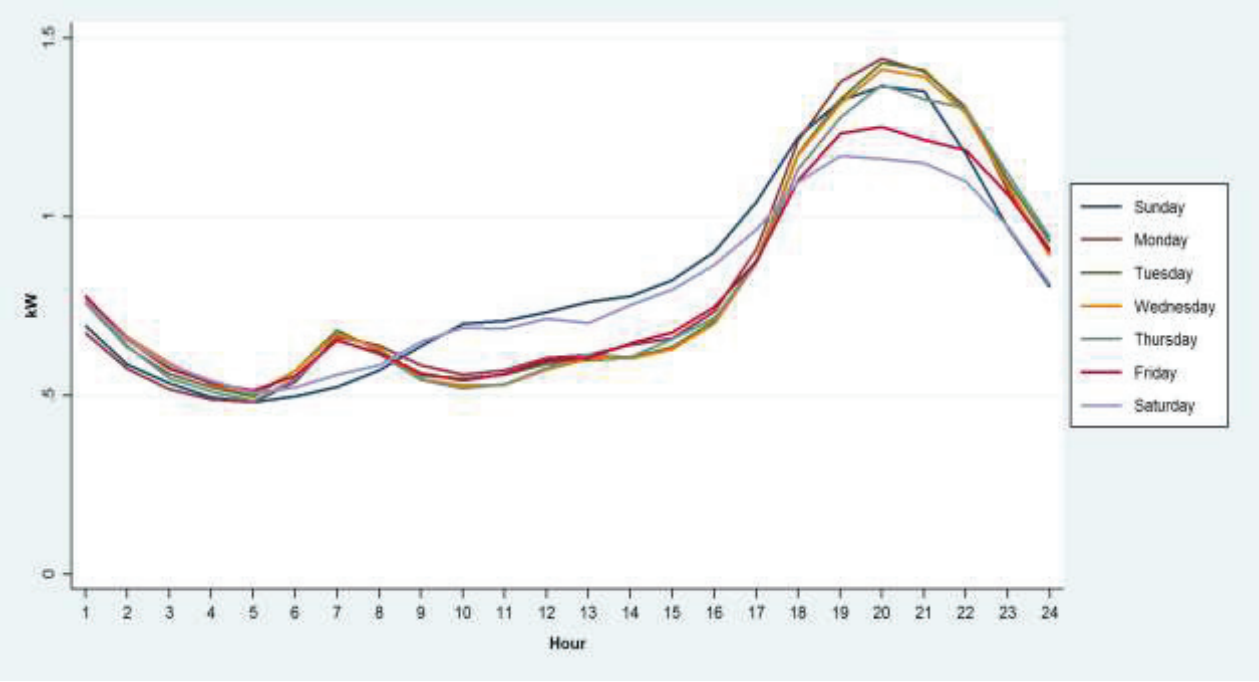


Chart 9 shows the same daily load profiles for customers who we believe own a PEV, but are not currently taking service under one of the previously mentioned PEV rates. These are either company employees who own EVs, or customers who had previously taken service under one of the EV experimental rates no longer being offered, and opted for a Non-EV Rate, mainly SDG&E tiered DR Rate Schedule. It should be noted that this is a subset that is not

representative of the general EV population and any characteristics should not suggest behavior for the general EV population. A couple observation worth noting, however, are 1) that because these customers are not incentivized to charge at any particular time, charging occurs at various times during the day, and therefore is not apparent in these average shapes, and 2) these customer peak in the evening, similarly to the general residential population.

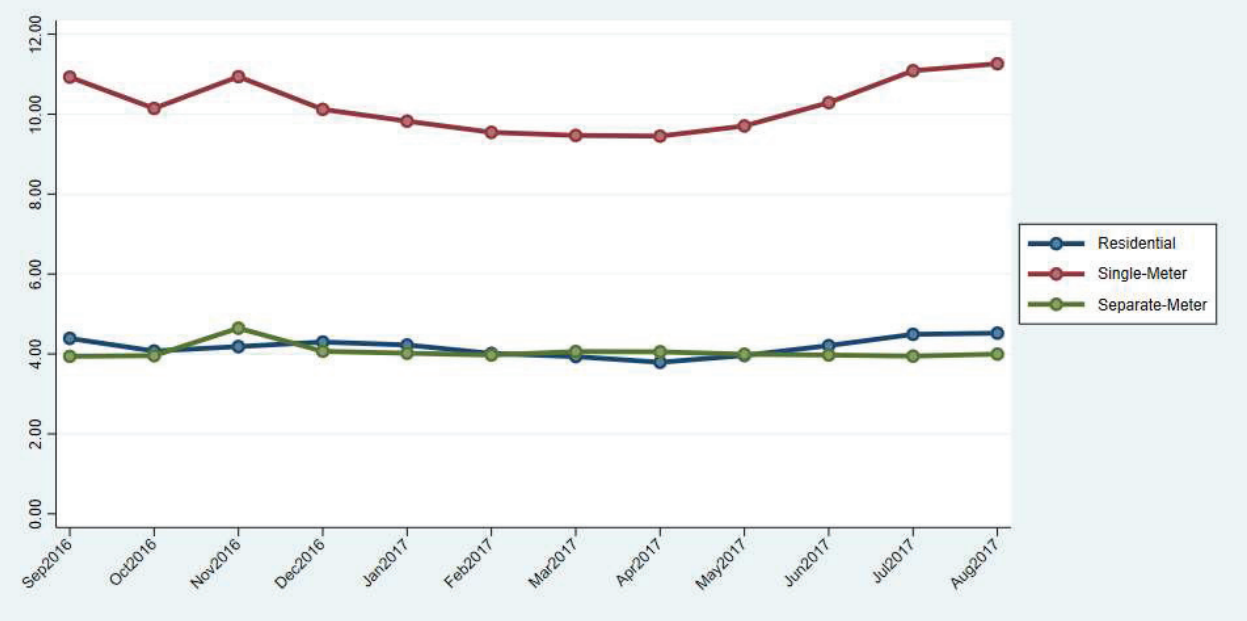
Average Non-Coincident Peak Load

Table 9 shows that the average non-coincident peak load for separate-meter customers is slightly over 4 kW – for reference, 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)

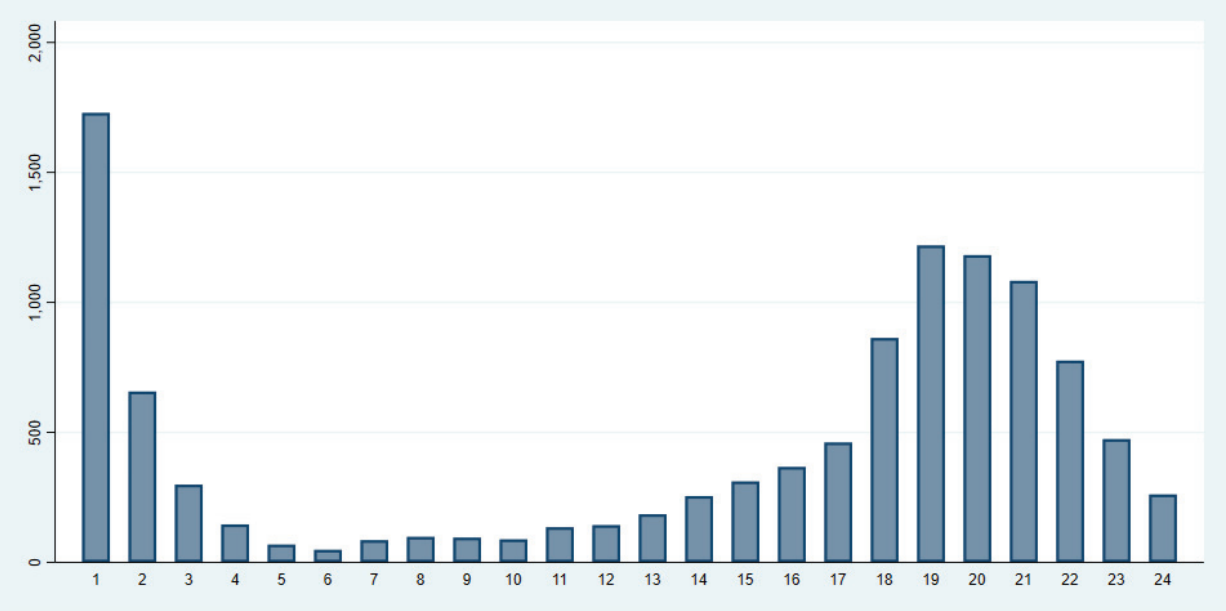
Month	Residential Pop.	Single-Meter	Separate-Meter
Sep2016	4.39	10.93	3.94
Oct2016	4.07	10.14	3.96
Nov2016	4.18	10.94	4.65
Dec2016	4.30	10.12	4.07
Jan2017	4.22	9.82	4.02
Feb2017	4.01	9.54	3.97
Mar2017	3.93	9.47	4.06
Apr2017	3.79	9.45	4.05
May2017	3.96	9.70	3.99
Jun2017	4.21	10.29	3.97
Jul2017	4.49	11.09	3.94
Aug2017	4.52	11.26	4.00

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. Of eleven-thousand customers, the majority of single-meter customers' peaks occur in the super off-peak TOU period, but 32% of the peaks still occur between hour-ending 19 and hour-ending 21.

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	Residential		Single-Meter		Separate-Meter	
	Time	kW	Time	kW	Time	kW
Sep2016	7:15PM	1.51	7:30PM	4.34	1:30AM	2.10
Oct2016	7:15PM	1.00	12:30AM	3.37	1:30AM	2.17
Nov2016	6:00PM	1.00	1:15AM	3.30	1:30AM	1.99
Dec2016	7:00PM	1.08	1:15AM	3.25	1:30AM	2.17
Jan2017	7:00PM	1.10	1:15AM	3.30	1:30AM	2.10
Feb2017	7:00PM	1.04	1:15AM	3.16	1:30AM	1.93
Mar2017	7:30PM	0.93	1:15AM	3.18	1:30AM	1.95
Apr2017	8:30PM	0.86	1:15AM	3.07	1:30AM	2.00
May2017	8:30PM	0.92	1:15AM	3.26	1:30AM	2.04
Jun2017	7:15PM	1.25	12:30AM	3.37	1:30AM	1.94
Jul2017	6:30PM	1.22	12:30AM	3.52	1:30AM	1.81
Aug2017	6:30PM	1.47	12:45AM	3.90	1:30AM	1.89

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	1729	16%
2	657	6%
3	299	3%
4	146	1%
5	68	1%
6	48	0%
7	85	1%
8	98	1%
9	95	1%
10	88	1%
11	135	1%
12	143	1%
13	185	2%
14	255	2%
15	311	3%
16	367	3%
17	461	4%
18	863	8%
19	1219	11%
20	1182	11%
21	1083	10%
22	776	7%
23	474	4%
24	261	2%

Average Load Coincident With System Peak

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

Month	Residential	Single-Meter	Separate-Meter
Sep2016	1.43	3.66	0.13
Oct2016	0.79	1.70	0.07
Nov2016	0.95	2.58	0.11
Dec2016	1.02	2.51	0.12
Jan2017	1.05	2.51	0.13
Feb2017	1.03	2.47	0.15
Mar2017	0.90	2.33	0.18
Apr2017	0.79	2.19	0.09
May2017	0.77	1.38	0.05
Jun2017	1.22	2.36	0.04
Jul2017	1.17	2.25	0.04
Aug2017	1.38	2.70	0.06

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, though one thing to consider is that single meter customers are mainly single-family homes, which tend to have higher usage than the general residential population.

Geographic Concentration of PEV Owners

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

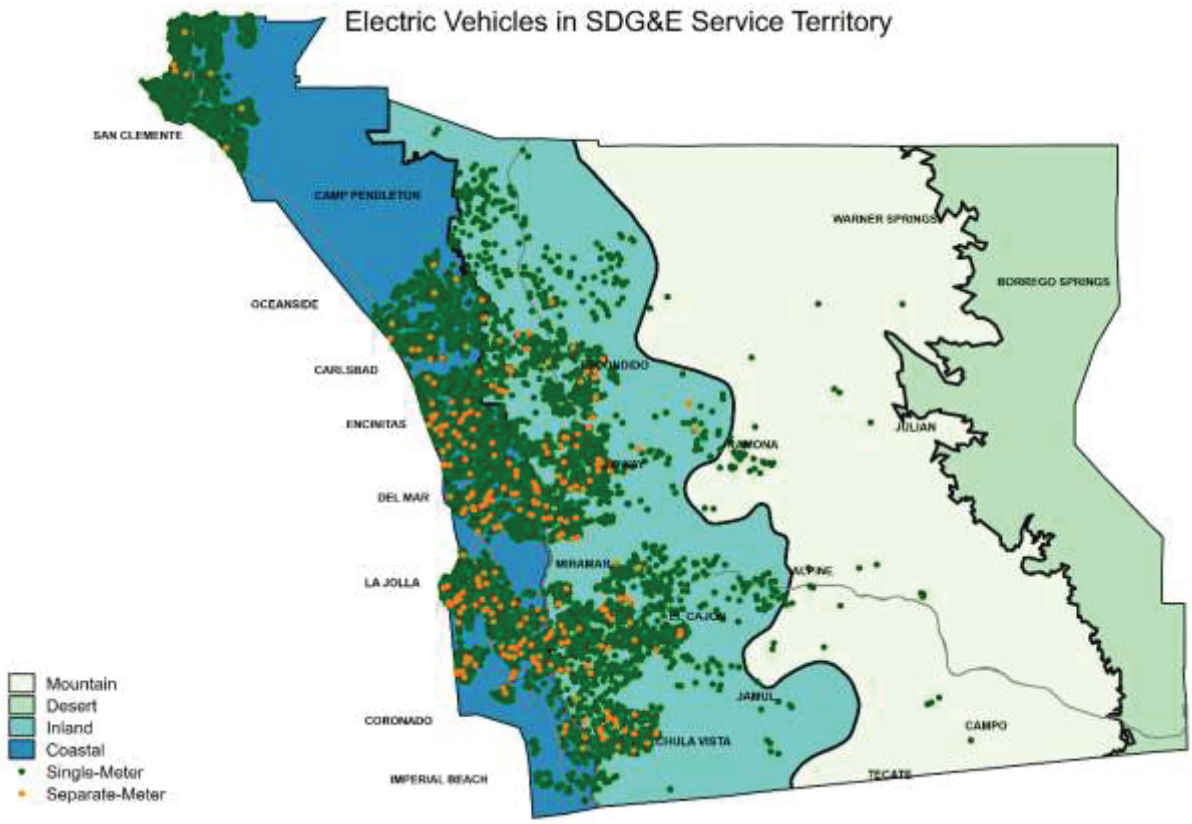
Rate	Zip Code	Area	Number of Customers	Percent of Total
Single-Meter	92130	Carmel Valley	581	5%
	92037	La Jolla	487	4%
	92127	Rancho Bernardo	430	4%
	92024	Encinitas	430	4%
	92067	Rancho Santa Fe	418	4%
Separate-Meter	92130	Carmel Valley	18	6%
	92024	Encinitas	17	6%
	92129	Rancho Peñasquitos	13	4%
	92037	La Jolla	12	4%
	92117	Clairemont	10	3%

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

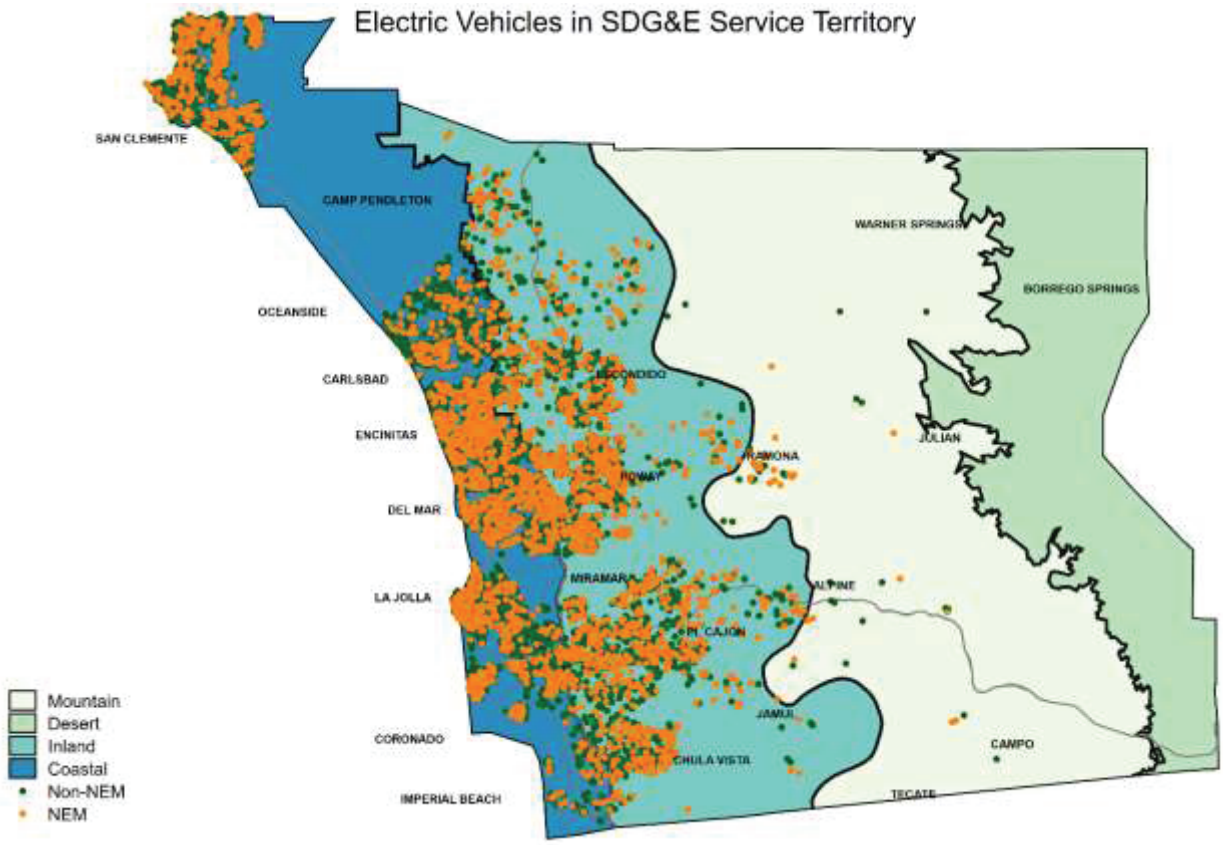
Climate Zone	Single-Meter	Separate-Meter	Total	Percent of Total
Coastal	7,695	181	7,876	69.39%
Mountain/Desert	67	0	67	0.59%
Inland	3,299	109	3,408	30.02%

Almost 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 selection bias. Furthermore, present ownership of a PEV is not verifiable, thus the extent to which PEV charging load is a component of the metered household load cannot be determined. The reliability of this information therefore cannot be guaranteed.
- Due to the allocation of Low Carbon Fuel standard credits through the Clean Fuels Rebate Program SCE has identified a significant number of additional PEV accounts for this year and this report therefore shows a dramatic increase in the number of accounts reported.
- The statistics and metrics found in this report are based on a 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.
- A total of 15,855 accounts with a PEV charging under the single-meter TOU-D-A/B tariff have been identified as of the beginning of August 2017. 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 346 kWh which is slightly larger from the 339 kWh/month reported during the previous report.
- Non-coincident peak demand for the separately metered PEVs was 7.7 kW on average. Average non-coincident demand was 7.2 kW in the 2014 report and 7.5 kW in the 2015 and 2016 reports. Sixty-five 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.
- PEV owners identified for this report reside disproportionately to the SCE's general residential population 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, Manhattan Beach with 324 accounts remains the zip code with the highest number of PEVs under the single-metered tariff. For separately metered PEVs, Santa Monica remains at the top with 30 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.
- Customers on EV-TOU-2 (SDG&E's whole-house TOU rate) have a very high NEM penetration, over 30%, compared to general residential population, offsetting some of their consumption.
- 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 25% from September 2016 to August 2017, which may cause instability in current Load Research results.