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**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)

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

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Dated: April 2, 2019

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OF D.16-06-011**

Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company hereby file their load research report as required by Ordering Paragraph 2 of D.16-06-011.¹ The load research report is attached to this pleading.

Respectfully Submitted,

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Dated: April 2, 2019

¹ Southern California Edison Company and San Diego Gas & Electric Company have authorized PG&E to file this compliance report on their behalf.

Joint IOU Electric Vehicle

Load Research Report

7th Report

Filed on April 2, 2019

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



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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 years¹ 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 April 2019⁵ report (7th Load Research Report) includes data through December 2018 for service line and distribution system upgrades, and for the period September 2017 through December 2018 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 December 31, 2018, the IOUs estimate there are over 415,272 PEVs within the three service territories. Of the 415,272 vehicles estimated to be currently on the road, only 618 or 0.15%, have required a service line or distribution system upgrade solely to support the PEV load at their residential charging location. In all but 72 instances, the standard allowance for

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 The report was originally due December 31, 2018, however an extension was granted by the CPUC Executive Director to file the report on March 31, 2019. As March 31st is a Sunday and April 1st is a State holiday, the report is to be filed on Tuesday, April 2, 2019.

residential service upgrades was sufficient to cover the portion of the service upgrade cost that is assigned to the utility.⁶ 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.

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 16 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 represented about 1% of global carbon dioxide emissions in 2016.⁷ California's transportation sector is the largest contributor, consisting of more than 41% of the State's total greenhouse gas emissions. Passenger vehicles alone are responsible for over 27% of California's greenhouse gas emissions.⁸ 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.⁹

⁶ For a service line upgrade, the utility is responsible for the cost of the service conductor, connectors, support poles, and metering. These costs are covered by the residential allowance and any amount in excess of the allowance (absent the CPUC's current policy for the excess to be paid by all customers for upgrades related to PEVs) is billed to the customer. The customer is responsible for any trenching, conduit, substructures, or protective structures required for the upgrade. These costs are not covered by the residential allowance, or the CPUC policy currently in place that directs costs in excess of the allowance to be paid by all customers.

⁷

https://www.energy.ca.gov/renewables/tracking_progress/documents/Greenhouse_Gas_Emissions_Reductions.pdf (p. 2)

⁸ California Greenhouse Gas Emissions for 2000 to 2016. California Air Resources Board. July 2018. https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf

⁹ D.11-07-029, p 3-4.

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

At the time of this report, April 2019, Go Electric Drive lists on its EV showroom 43 PEV models.¹⁰ 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 415,272 PEVs are in their service territories, as of December 31, 2018. The number of PEVs forecasted to be operating in the IOUs service territories from 2019 through 2024 are:

Year	PG&E ¹¹	SCE ¹²	SDG&E ¹³
2019	253,000	259,248	42,000
2020	321,000	332,784	49,000
2021	399,000	416,670	56,000
2022	491,000	502,484	64,000
2023	599,000	591,002	73,000
2024	725,000	664,472	82,000

This report includes data through December 2018 for service line and distribution system upgrades and for the period September 2017 through December 2018 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.¹⁴ The CPUC determined that additional research is needed to inform

¹⁰ www.goelectricdrive.org/you-buy/ev-showroom

¹¹ PG&E’s 2019 EV adoption forecast (Dec 2018).

¹² 2018 IEPR update Light Duty PEV Forecast (Mid case), California Energy Commission, slide15 <http://dawg.energy.ca.gov/sites/default/files/meetings/04%20-%20Aniss%20%28CEC%29%20-%20Electric%20Vehicles.pdf>

¹³ SDG&E Clean Transportation Electric Vehicle Forecast 2019-2024. SDG&E’s forecast is the expected growth in our service territory without the influence of SDG&E’s EV programs.

¹⁴ D.11-07-029, p. 3.

policies for the next stages of PEV market development.¹⁵ 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.¹⁶

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, 2012.¹⁷ 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, 2013.¹⁸ The IOUs filed the 1st Load Research Report in December 2012. The First Extension Decision extended the research an additional three years¹⁹ to begin in December 2013²⁰ and directed the Energy Division to work with stakeholders to revise the load research methodology.²¹ The deadline for the December

¹⁵ D.11-07-029, p. 60.

¹⁶ D.11-07-029, Ordering Paragraph 6.

¹⁷ See Advice Letters 2403-E for SDG&E, 2786-E for SCE, and 4115-E for PG&E.

¹⁸ D.11-07-029, Ordering Paragraph 7.

¹⁹ D.13-06-014, p. 15.

²⁰ D.13-06-014, Ordering Paragraph 4.

²¹ D.13-06-014, Ordering Paragraph 3.

2013 report was extended to January 31, 2014 by CPUC Executive Director Paul Clanon, to allow the IOUs more time to prepare the report under the revised methodology. Additionally, the IOUs received an extension for the December 2018 report from the CPUC Executive Director to a March 31, 2019 deadline.²² This results in an additional four months of data, September to December 2018, being included in this seventh Load Research Report.

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.”²³ 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.”²⁴ 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.”²⁵

The Second Extension Decision extended the “common facility treatment” for costs in excess of the allowance to June 30, 2019,²⁶ and extended the cost tracking and research an additional three years²⁷ 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

²² As March 31st is a Sunday and April 1st is a State holiday, the report is to be filed on April 2, 2019.

²³ D.11-07-029, Ordering Paragraph 5.

²⁴ D.11-07-029, Ordering Paragraph 6.

²⁵ D.11-07-029, Ordering Paragraph 6.

²⁶ D.16-06-11, Ordering Paragraph 1.

²⁷ D. 16-06-11, Ordering Paragraph 2.

accommodate the new PEV load, then the customer service line and the distribution system supporting the customer service are evaluated to determine if one or both need to be upgraded. As part of the evaluation, the service planning departments consider if the upgrade was needed before the addition of the PEV, and the PEV simply brought attention to the need for the upgrade. If an upgrade was needed before the addition of the PEV, then the upgrade is not attributed to the PEV because the PEV did not cause the need for the upgrade.²⁸ 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.²⁹ 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.

²⁸ 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.

²⁹ The upgrade would be completed absent the PEV because other new load is being added.

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

Table IOU-1: Summary of Upgrade Costs and Responsibilities

	Customer Assigned Costs	Allowance?	Utility Assigned Costs
Equipment on Customer Side of Meter	Customer pays all costs for charging equipment, including costs to plan, design, install, own, maintain, and operate facilities and equipment beyond the Service Delivery Point		
Service Line Upgrade	<ul style="list-style-type: none"> • 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 	<p>Yes, to cover work responsibility assigned to utility. Customer pays amount exceeding allowance. This is in addition to Customer assigned costs.</p> <p>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.</p>	<ul style="list-style-type: none"> • 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 December 2018.

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

	PG&E	SCE	SDG&E	Total
Residential Customers				
Estimated PEV customers through December 31, 2018	216,845	163,594	34,833	415,272
Residential Upgrades				
Number of PEV-related Infrastructure Checks Completed	10,138	Not tracked ³⁰	Not tracked ³¹	N/A
Number PEV-related Service Line and/or Distribution System Upgrades ³²	323	243	52	618
Total Costs Incurred by Utility for Upgrades	\$6,627,544	\$351,675	\$53,365	\$7,032,584
Range of Costs for Upgrades	\$14 to \$338,274	\$1 to \$30,067	\$47 to \$10,958	N/A
Average Cost for Distribution System Upgrade ³³	\$19,262	\$4,514	\$4,089	N/A
Average Cost for Service Line Upgrade	\$1,168	\$1,382	\$730	N/A
Number of Service Line Upgrades Exceeding Residential Allowance	39	33	0	72
Current Residential Allowance	\$2,431 ³⁴	\$3,084 ³⁵	\$3,241 ³⁶	N/A
Amount of Foregone Billings to Customers for Service Line Upgrades Pursuant to “Common Facility Treatment” Policy Exemption for PEVs	\$190,207	\$37,887	\$0	\$228,094

³⁰ SCE does not separately track distribution infrastructure checks related to PEVs. The PEV infrastructure check is accounted for if an upgrade work order is opened.

³¹ 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.

³² If a both a service line upgrade and distribution line upgrade was performed at the same residence, it is counted as one upgrade.

³³ 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.

³⁴ PG&E Electric Rule 15, Section C.3: http://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_15.pdf.

³⁵ SCE Electric Rule 15, Section C.3: <https://www.sce.com/NR/sc3/tm2/pdf/Rule15.pdf>

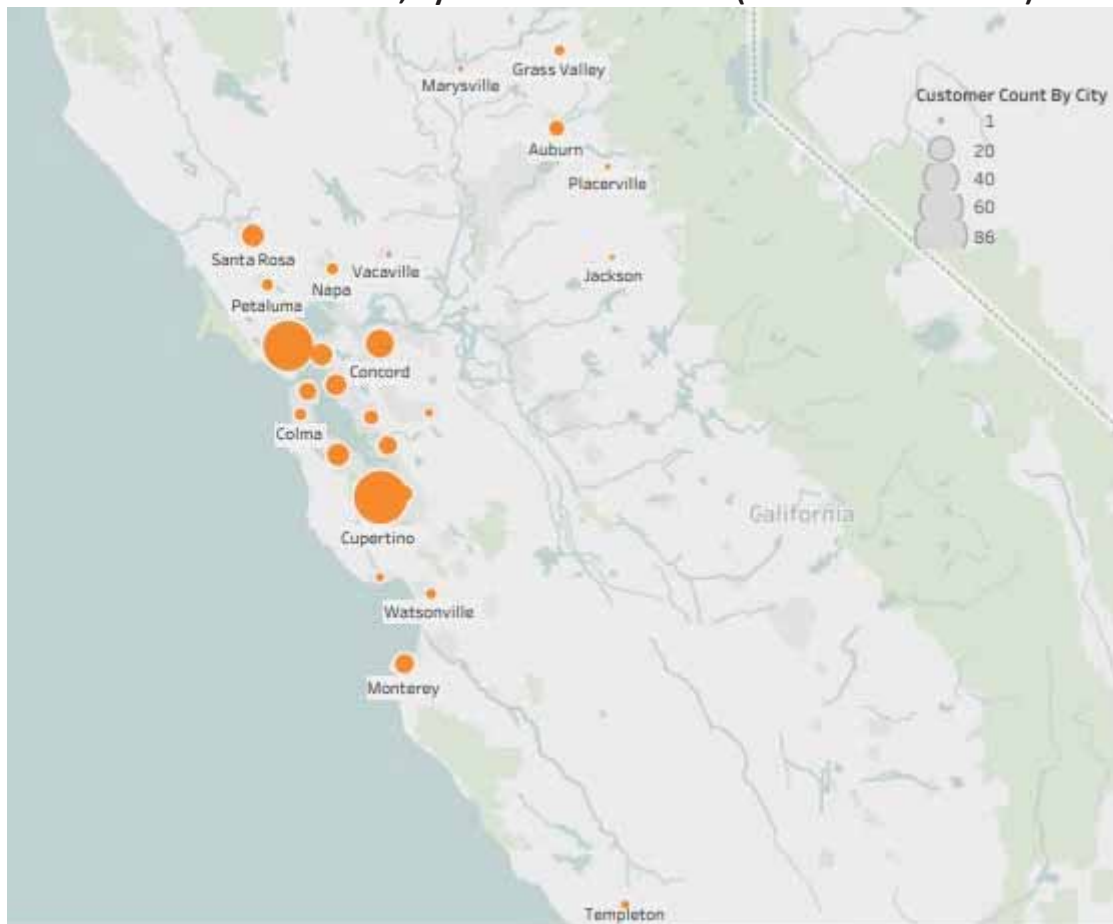
³⁶ SDG&E Electric Rule 15, Section C.3: http://regarchive.sdge.com/tm2/pdf/ELEC_ELECRULES_ERULE15.pdf

PG&E Specific Details

As of December 2018, PG&E's best estimate of the number of PEVs in the PG&E service territory is 216,845. 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 216,845, PG&E is only able to perform service assessments for customers that notify the utility of their PEV status. As of December 31, 2018, PG&E had completed 10,138 such service assessments. Of the 10,138 service assessments completed to date, 323, or 3.2%, have required upgrades due solely to the addition of PEV load. In 39 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 39 customers combined was \$190,207. The map below identifies the service center locations of all 323 upgrades.

Figure PG&E-1: Locations of Customers Requiring a Residential Upgrade Due to a PEV, by PG&E Service Center (as of December 2018)

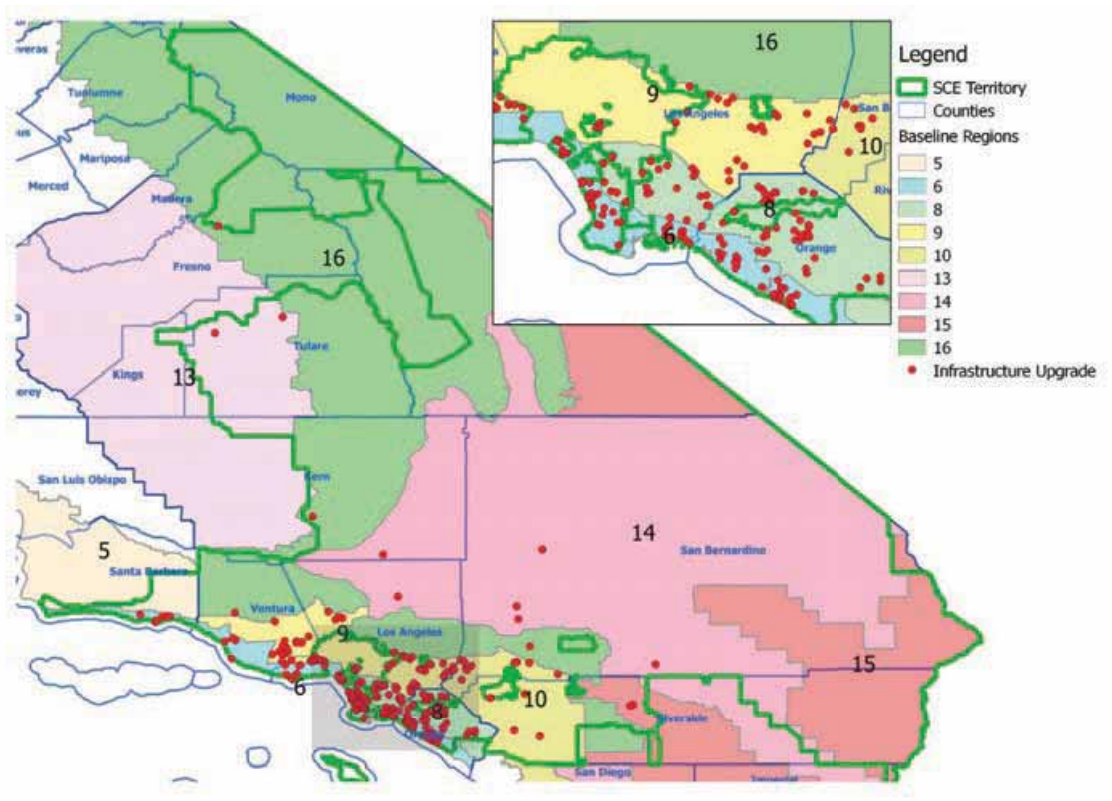


SCE Specific Details

As of December 2018, SCE's best estimate of the number of PEVs registered to residential customers in SCE's service territory is about 163,594. 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. Additionally, specific PEV infrastructure checks (as opposed to general infrastructure checks) are accounted for only if an upgrade work order is opened. 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 163,594 residential PEVs in SCE's service territory, only 243 or 0.15% 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 33 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 33 customers combined was \$37,887.

Figure SCE-1: PEVs in the SCE Service Territory Requiring a Residential Upgrade as of December 2018



From 2011 to 2018, SCE had 71 commercial upgrade products totaling \$1,621,071.

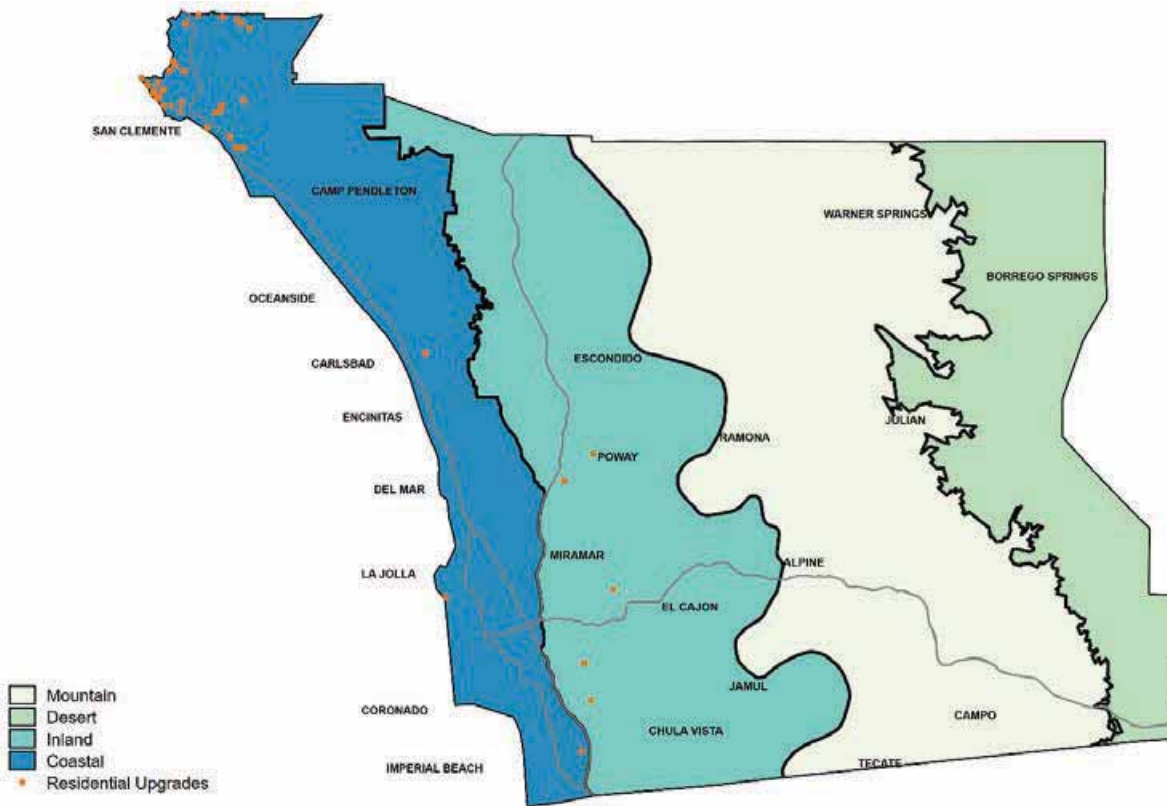
SCE is also reporting that this is the third year where it is collecting the data used to complete Table IOU-2 for this report in a system of record data query process. From 2011-2015, SCE gathered data through a mostly manual process. While preparing for submittal of the 2017 report, SCE moved from a manual collection process to a system of record data query process to provide the information detailed in Table IOU-2. SCE identified a number of discrepancies in previously reported data. As a result, SCE restated the PEV cost data for the entire reporting period (i.e., from July 25, 2011, to October 30, 2016) in the 2017 report. Since 2017, SCE continues to collect and report data using the system of record data query process to provide the information detailed in Table IOU-2.

SDG&E Specific Details

As of December 2018, SDG&E's best estimate of the number of PEVs registered to residential customers in the SDG&E service territory is 34,833. 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 34,833 residential PEVs in SDG&E's service territory, 52, or less than 0.15%, 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 December 2018³⁷



Conclusions/Recommendations

As of December 31, 2018, the IOUs estimate there are approximately 415,272 PEVs within the three service territories. Of the 415,272 vehicles estimated to be currently on the road, only 618 or 0.15%, have required a service line and/or distribution system upgrade. In all but 72 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

³⁷ Map is missing five customers due to insufficient geographic location information.

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.³⁸

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 PEVs³⁹
- 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:⁴⁰

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

The data for this 7th Load Research Report covers the 16-month period of September 2017 to December 2018. 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 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-

³⁸ D.11-07-029, Ordering Paragraph 6.

³⁹ 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).

⁴⁰ 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.

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 EV⁴¹ 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					Rate: EVB				
Hour	Winter Weekday	Winter Weekend / Holidays	Summer Weekday	Summer Weekend / Holidays	Hour	Winter Weekday	Winter Weekend / Holidays	Summer Weekday	Summer Weekend / Holidays
12mn - 1am	0.12866	0.12866	0.12559	0.12559	12mn - 1am	0.12815	0.12815	0.12511	0.12511
1am - 2am	0.12866	0.12866	0.12559	0.12559	1am - 2am	0.12815	0.12815	0.12511	0.12511
2am - 3am	0.12866	0.12866	0.12559	0.12559	2am - 3am	0.12815	0.12815	0.12511	0.12511
3am - 4am	0.12866	0.12866	0.12559	0.12559	3am - 4am	0.12815	0.12815	0.12511	0.12511
4am - 5am	0.12866	0.12866	0.12559	0.12559	4am - 5am	0.12815	0.12815	0.12511	0.12511
5am - 6am	0.12866	0.12866	0.12559	0.12559	5am - 6am	0.12815	0.12815	0.12511	0.12511
6am - 7am	0.12866	0.12866	0.12559	0.12559	6am - 7am	0.12815	0.12815	0.12511	0.12511
7am - 8am	0.20726	0.12866	0.26503	0.12559	7am - 8am	0.20370	0.12815	0.26168	0.12511
8am - 9am	0.20726	0.12866	0.26503	0.12559	8am - 9am	0.20370	0.12815	0.26168	0.12511
9am - 10am	0.20726	0.12866	0.26503	0.12559	9am - 10am	0.20370	0.12815	0.26168	0.12511
10am - 11am	0.20726	0.12866	0.26503	0.12559	10am - 11am	0.20370	0.12815	0.26168	0.12511
11am - 12nn	0.20726	0.12866	0.26503	0.12559	11am - 12nn	0.20370	0.12815	0.26168	0.12511
12nn - 1pm	0.20726	0.12866	0.26503	0.12559	12nn - 1pm	0.20370	0.12815	0.26168	0.12511
1pm - 2pm	0.20726	0.12866	0.26503	0.12559	1pm - 2pm	0.20370	0.12815	0.26168	0.12511
2pm - 3pm	0.34021	0.12866	0.48889	0.12559	2pm - 3pm	0.33308	0.12815	0.48220	0.12511
3pm - 4pm	0.34021	0.34021	0.48889	0.48889	3pm - 4pm	0.33308	0.33308	0.48220	0.48220
4pm - 5pm	0.34021	0.34021	0.48889	0.48889	4pm - 5pm	0.33308	0.33308	0.48220	0.48220
5pm - 6pm	0.34021	0.34021	0.48889	0.48889	5pm - 6pm	0.33308	0.33308	0.48220	0.48220
6pm - 7pm	0.34021	0.34021	0.48889	0.48889	6pm - 7pm	0.33308	0.33308	0.48220	0.48220
7pm - 8pm	0.34021	0.12866	0.48889	0.12559	7pm - 8pm	0.33308	0.12815	0.48220	0.12511
8pm - 9pm	0.34021	0.12866	0.48889	0.12559	8pm - 9pm	0.33308	0.12815	0.48220	0.12511
9pm - 10pm	0.20726	0.12866	0.26503	0.12559	9pm - 10pm	0.20370	0.12815	0.26168	0.12511
10pm - 11pm	0.20726	0.12866	0.26503	0.12559	10pm - 11pm	0.20370	0.12815	0.26168	0.12511
11pm - 12mn	0.12866	0.12866	0.12559	0.12559	11pm - 12mn	0.12815	0.12815	0.12511	0.12511

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.

⁴¹ Pacific Gas and Electric Company. Electric Schedule EV. Residential Time-of-Use Service for Plug-in Electric Vehicle Customers. Retrieved from [https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHEDS_EV%20\(Sch\).pdf](https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHEDS_EV%20(Sch).pdf) .

** Rates effective March 1, 2019. For details see Electric Schedule EV, Residential Time-of-Use Service for Plug-in Electric Vehicle Customers, retrieved from [https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHS_EV%20\(Sch\).pdf](https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHS_EV%20(Sch).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

Season	EV-A		EV-B	
	Between Off-Peak and Partial Peak	Between Off-Peak and Peak Period	Between Off-Peak and Partial Peak	Between Off-Peak and Peak Period
Winter	0.62	0.38	0.63	0.39
Summer	0.47	0.26	0.48	0.26

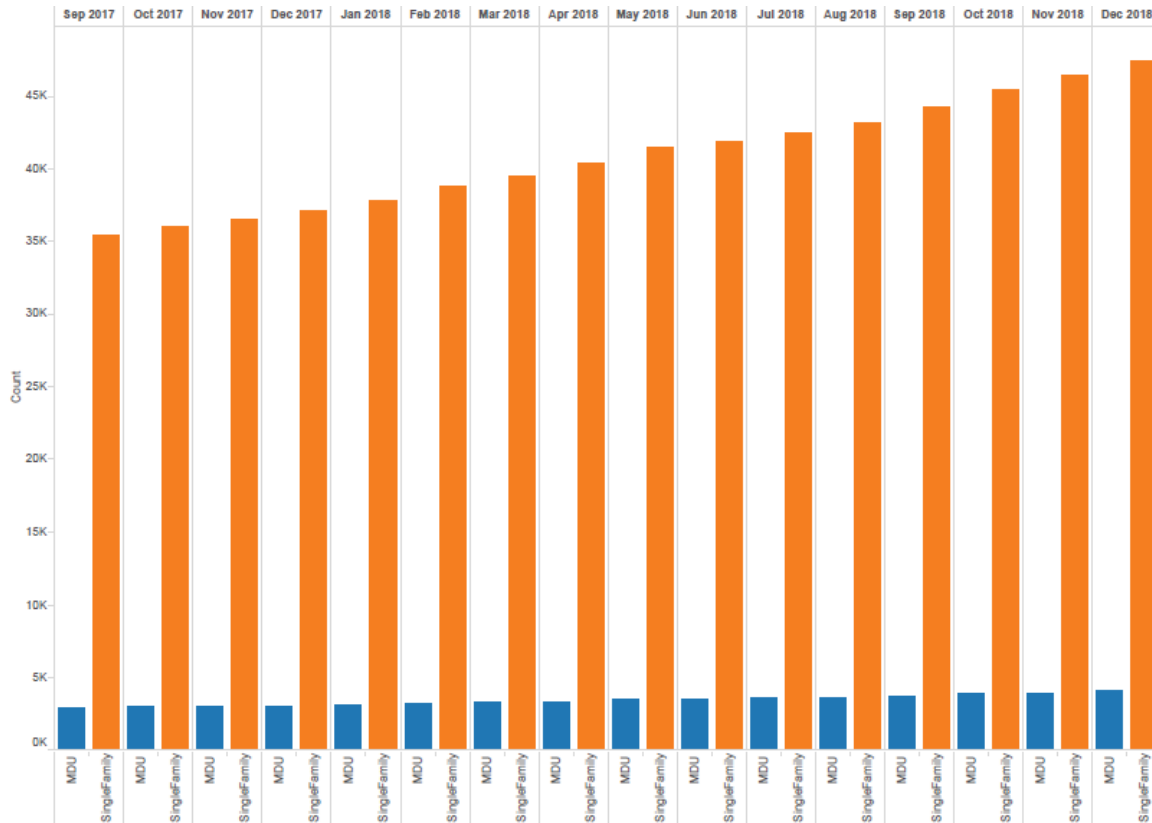
Single Metering (EV-A) Rate Growth

Participation in EV-A increased steadily during the study period. Participation in EV-B remained relatively steady, with a decrease among Single Family customers in the middle of the period when Phase 2 of PG&E’s EV submetering pilot program concluded. It is important to note that not all PEV customers have adopted PEV rates.⁴² Of the customers on PEV rates, the majority 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, primarily in the Single Family subcategories. Between September 2017 and December 2018, the number of accounts in the EV-A group as a whole increased by 25% at the last reported month compared to the base month.

⁴² 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 the EV-A rate, up to 25% were also on NEM at any given time during the study period. Virtually all 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.⁴³

⁴³ 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
2017	Sep	8,372	22%	23%	8%
2017	Oct	8,579	22%	23%	8%
2017	Nov	8,833	22%	23%	8%
2017	Dec	9,124	22%	24%	8%
2018	Jan	9,364	23%	24%	8%
2018	Feb	9,601	23%	24%	8%
2018	Mar	9,921	23%	24%	8%
2018	Apr	10,225	23%	24%	8%
2018	May	10,484	23%	24%	8%
2018	Jun	10,698	23%	25%	8%
2018	Jul	10,888	23%	25%	8%
2018	Aug	11,289	24%	25%	8%
2018	Sep	11,480	24%	25%	9%
2018	Oct	11,727	24%	26%	9%
2018	Nov	11,926	25%	26%	9%
2018	Dec	12,096	25%	27%	9%

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 an EV-A rate, up to 4% were also participating in a DR program at any given time during the study period. 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.

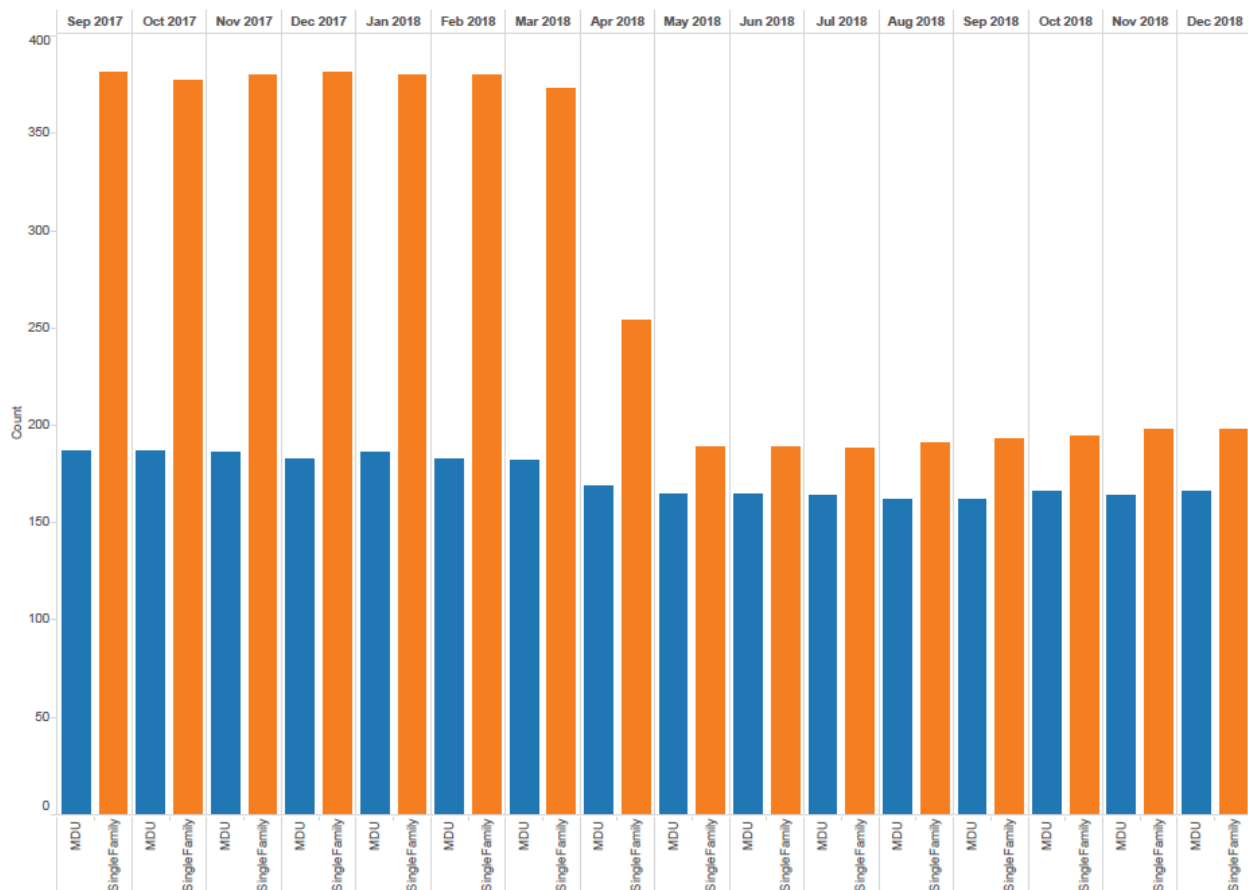
Table PG&E-3: Single Metering (EV-A) DR Program Enrollment by Customer Type

Year	Month	Number of Single Metering (EV-A) DR Enrollments	DR % of Single Metering	DR % of SF Single Metering	DR % of MDU Single Metering
2017	Sep	1,399	4%	4%	3%
2017	Oct	1,410	4%	4%	3%
2017	Nov	1,431	4%	4%	3%
2017	Dec	1,442	4%	4%	3%
2018	Jan	1,483	4%	4%	3%
2018	Feb	1,500	4%	4%	3%
2018	Mar	1,530	4%	4%	3%
2018	Apr	1,594	4%	4%	3%
2018	May	1,627	4%	4%	3%
2018	Jun	1,615	4%	4%	3%
2018	Jul	1,638	4%	4%	3%
2018	Aug	1,646	4%	4%	3%
2018	Sep	1,774	4%	4%	3%
2018	Oct	1,849	4%	4%	3%
2018	Nov	1,891	4%	4%	3%
2018	Dec	1,954	4%	4%	3%

Separate Metering (EV-B) Rate Growth

All EV-B Customers: The number of customers on the EV-B rate decreased in the middle of the period (see Chart PG&E-2). The decrease in EV-B rate enrollment in the middle of the period is likely due to the end of Phase 2 of PG&E’s EV submetering pilot program. Customers’ submetered EV charging usage was billed on the EV-B rate while participating in the submetering pilot. After the conclusion of the pilot, these customers were returned to their previous rate. Separate metering remains a much less popular option for PEV rate customers than single metering, as shown by the lower participation post-pilot and relatively flat adoption of the rate plan across the entire period.

Chart PG&E-2: Separate Metering (EV-B) Accounts by Customer Type



NEM EV-B Customers: The number of PEV 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
2017	Sep	12	2%	2%	3%
2017	Oct	12	2%	2%	3%
2017	Nov	12	2%	2%	3%
2017	Dec	12	2%	2%	3%
2018	Jan	12	2%	2%	3%
2018	Feb	13	2%	2%	3%
2018	Mar	14	3%	2%	3%
2018	Apr	14	3%	3%	3%
2018	May	14	4%	5%	3%
2018	Jun	14	4%	5%	3%
2018	Jul	15	4%	5%	4%
2018	Aug	15	4%	5%	4%
2018	Sep	15	4%	5%	4%
2018	Oct	15	4%	5%	4%
2018	Nov	15	4%	5%	4%
2018	Dec	15	4%	5%	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. However, a slightly higher percentage of all dual PEV Rate/DR customers were on the separately-metered EV-B rate (see Tables PG&E-3 and PG&E-5).

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
2017	Sep	28	5%	3%	8%
2017	Oct	28	5%	3%	8%
2017	Nov	28	5%	3%	8%
2017	Dec	29	5%	4%	8%
2018	Jan	30	5%	4%	9%
2018	Feb	30	5%	4%	9%
2018	Mar	29	5%	3%	9%
2018	Apr	25	6%	4%	9%
2018	May	23	6%	4%	10%
2018	Jun	23	6%	4%	10%
2018	Jul	23	7%	4%	10%
2018	Aug	22	6%	4%	9%
2018	Sep	22	6%	4%	9%
2018	Oct	22	6%	4%	9%
2018	Nov	21	6%	3%	9%
2018	Dec	21	6%	3%	9%

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 current group of PEV owners is still largely 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.
2. 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).
3. 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.
4. The mix of customers being evaluated changed over time due to customers joining or leaving the EV-A or EV-B.
5. 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

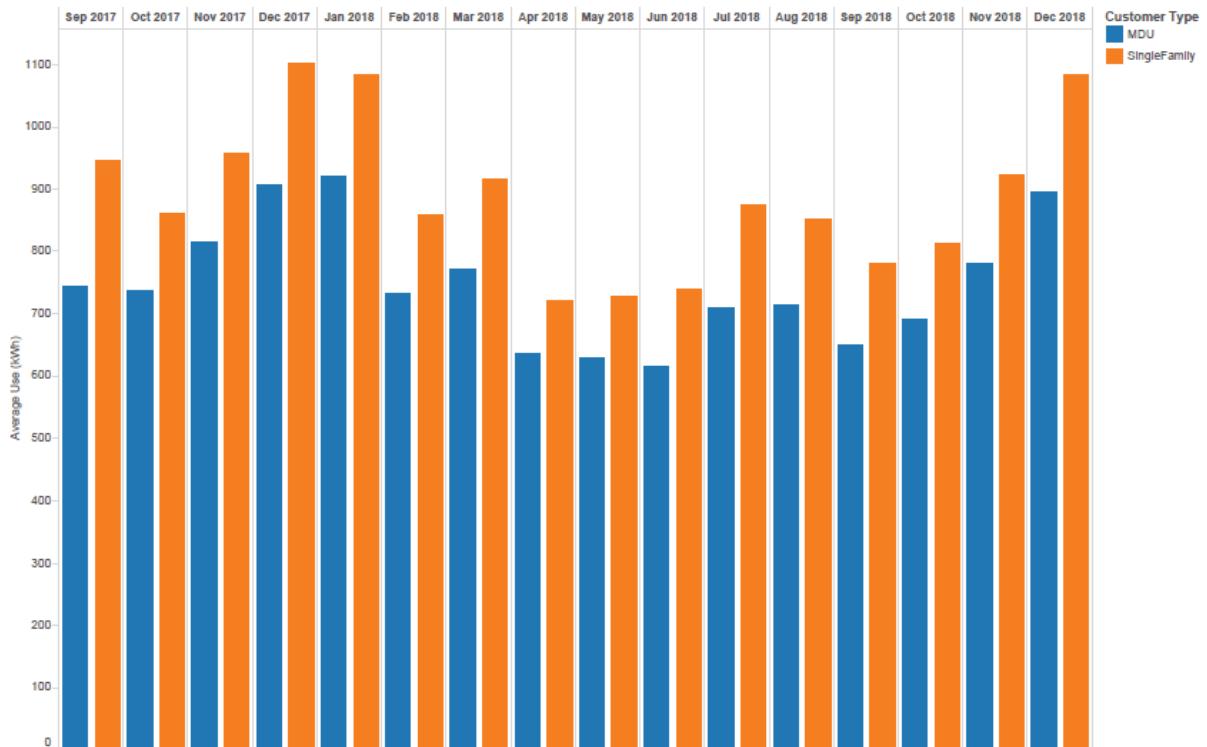
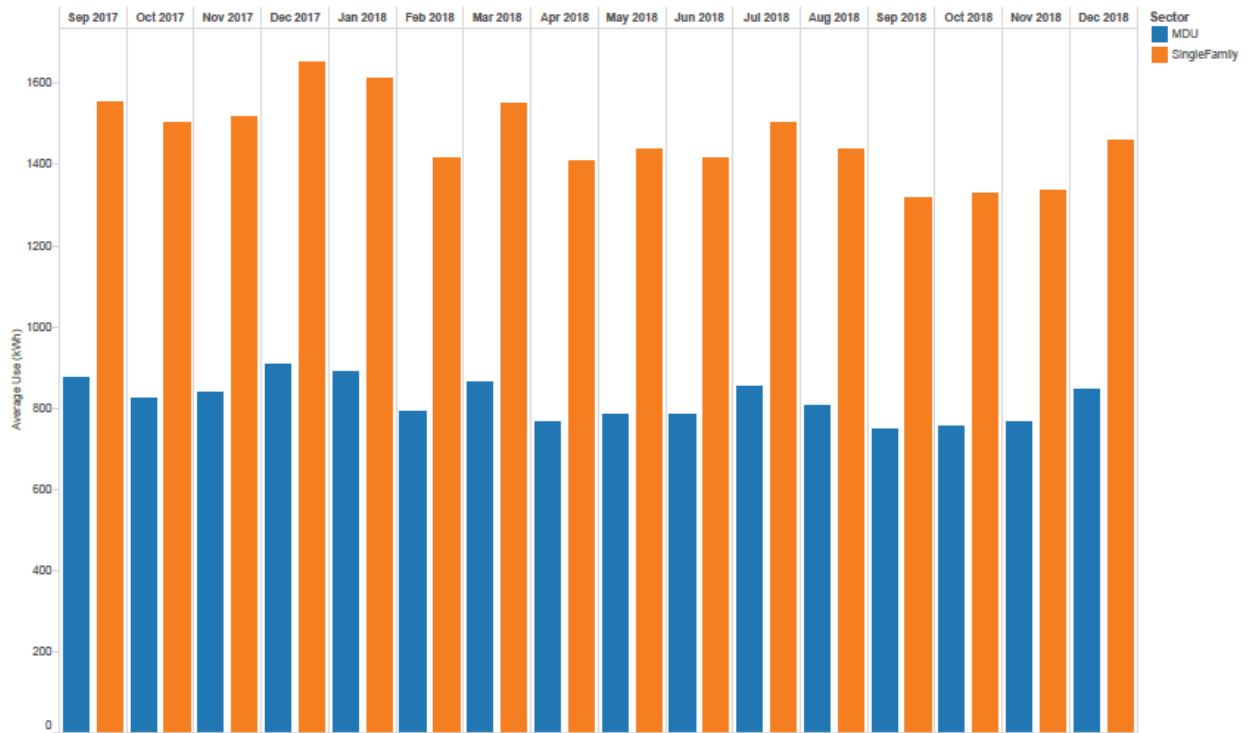


Chart PG&E-4: Single Metering (EV-A) Average Monthly Usage (kWh) by Customer Type Without NEM



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

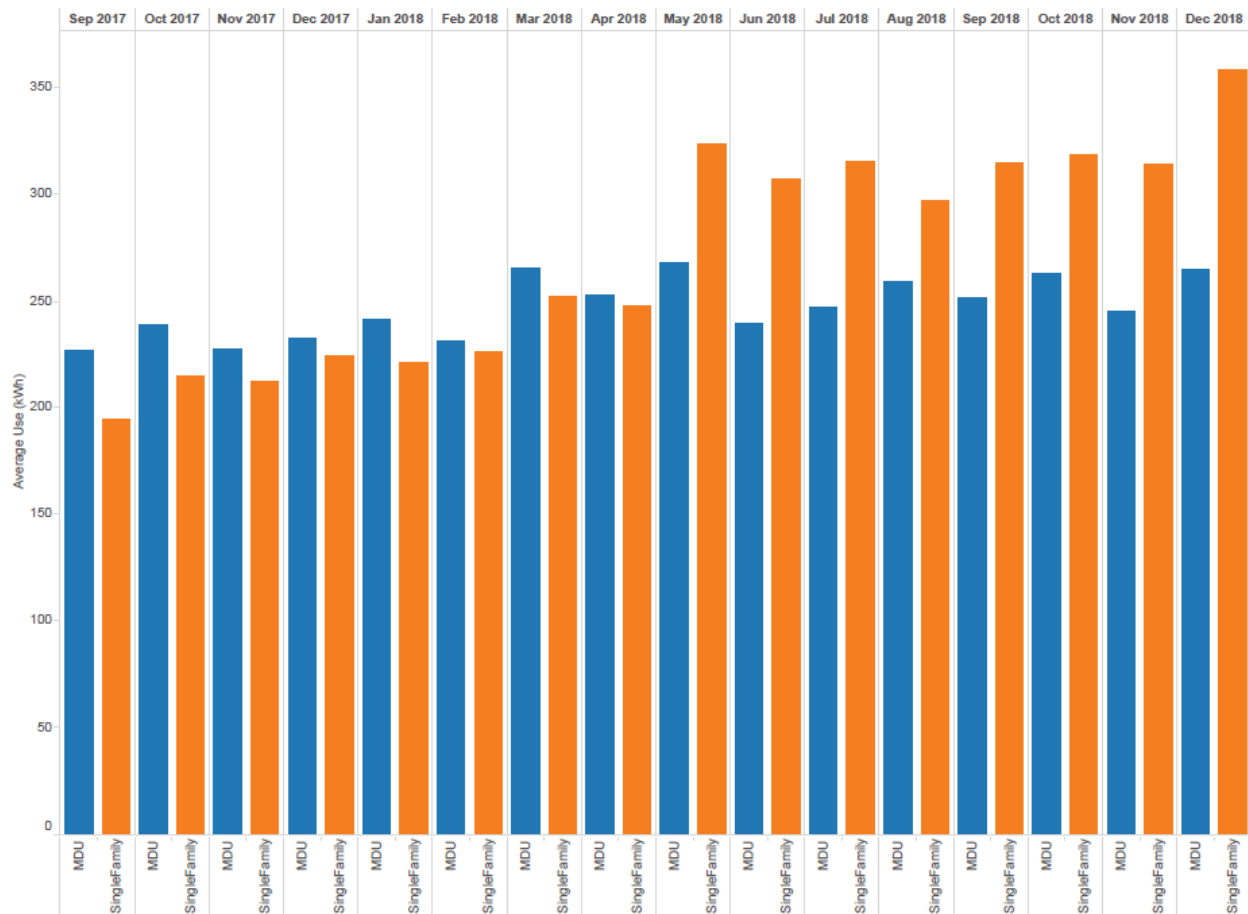


Chart PG&E-5 shows that, absent other loads on the meter, researchers can better observe that PEV rate customers’ total charging amount remains relatively consistent over time. The results in Chart PG&E-5 are flatter near the beginning of the study period, perhaps due to the increased enrollment in EV-B through the Phase 2 submetering pilot program, 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 customer groups in Tables PG&E-6, 7 and 8.⁴⁴

- 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 9% less energy during the peak period than the average PG&E residential customer and NEM customers on EV-A used 12% less energy than the residential population. Likewise, non-NEM customers on EV-B used an average of 22% less energy during the peak period, and NEM customers on EV-B used 11% 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 42% more energy off-peak and NEM customers on EV-B used 33% 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 21% less energy during partial peak periods, and NEM customers on EV-B used 23% less than the residential population. These groups met

⁴⁴ For the total residential population data, January to December 2017 data is used as a proxy for September 2017 to August 2018 due to the fact that 2018 residential data is not available until July 2019. The 2017 data was matched to the corresponding month in 2018. Total residential population data for September to December 2018 is not included as it would be a duplicate of the September to December 2017 data.

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 84% 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
2017	Sep	30%	22%	22%	23%	17%	6%	6%	7%	17%
2017	Oct	29%	21%	21%	21%	18%	7%	6%	8%	11%
2017	Nov	28%	21%	21%	22%	26%	7%	7%	7%	23%
2017	Dec	26%	21%	21%	22%	26%	6%	6%	7%	21%
2018	Jan	28%	21%	21%	22%	25%	6%	5%	8%	23%
2018	Feb	27%	20%	20%	21%	20%	7%	6%	8%	23%
2018	Mar	29%	21%	21%	21%	18%	8%	8%	8%	18%
2018	Apr	29%	20%	20%	20%	9%	9%	9%	8%	9%
2018	May	31%	20%	20%	20%	8%	9%	9%	7%	17%
2018	Jun	33%	22%	22%	22%	11%	9%	10%	7%	21%
2018	Jul	32%	24%	24%	24%	17%	9%	10%	8%	26%
2018	Aug	33%	23%	23%	23%	15%	9%	10%	7%	24%
2018	Sep		21%	21%	21%	14%	8%	10%	6%	18%
2018	Oct		21%	21%	21%	16%	8%	9%	7%	19%
2018	Nov		21%	21%	21%	25%	8%	10%	6%	18%
2018	Dec		22%	22%	21%	25%	8%	9%	7%	20%
Max		33%	24%	24%	24%	26%	9%	10%	8%	26%
Average		30%	21%	21%	22%	18%	8%	8%	7%	19%

* See footnote 44

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
2017	Sep	43%	55%	55%	56%	74%	87%	88%	86%	79%
2017	Oct	41%	55%	55%	56%	73%	86%	86%	84%	83%
2017	Nov	43%	56%	56%	57%	64%	86%	86%	85%	68%
2017	Dec	46%	56%	56%	57%	63%	88%	89%	87%	69%
2018	Jan	45%	56%	56%	56%	62%	87%	88%	84%	67%
2018	Feb	45%	57%	57%	57%	71%	86%	86%	86%	72%
2018	Mar	38%	55%	55%	56%	72%	80%	79%	81%	80%
2018	Apr	43%	56%	56%	57%	82%	82%	80%	84%	90%
2018	May	38%	57%	57%	58%	84%	83%	81%	86%	82%
2018	Jun	37%	56%	56%	57%	82%	83%	80%	86%	76%
2018	Jul	42%	54%	54%	55%	75%	83%	81%	86%	70%
2018	Aug	37%	54%	54%	56%	76%	83%	80%	86%	72%
2018	Sep		56%	56%	58%	78%	83%	81%	87%	76%
2018	Oct		56%	56%	57%	75%	82%	80%	86%	74%
2018	Nov		57%	57%	58%	65%	83%	81%	87%	72%
2018	Dec		56%	56%	57%	63%	84%	82%	88%	70%
Max		46%	57%	57%	58%	84%	88%	89%	88%	90%
Average		42%	56%	56%	57%	73%	84%	83%	86%	75%

* See footnote 44

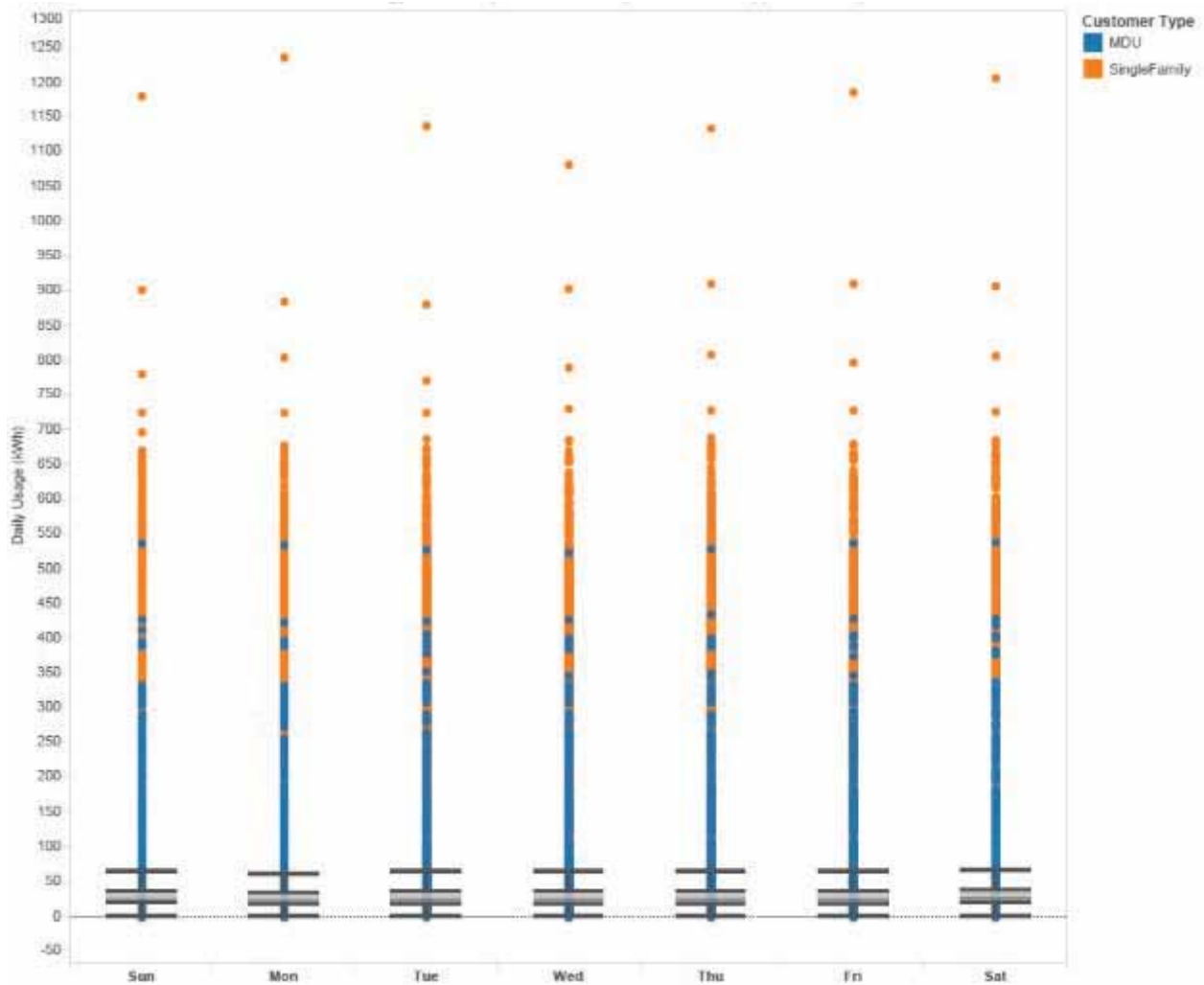
Table PG&E-8: Share of Partial-Peak Usage by Tariff and Customer Type

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
2017	Sep	26%	23%	23%	21%	9%	6%	6%	7%	4%
2017	Oct	30%	24%	24%	23%	10%	8%	8%	8%	6%
2017	Nov	30%	23%	23%	22%	10%	8%	7%	8%	9%
2017	Dec	27%	22%	22%	22%	11%	6%	6%	7%	10%
2018	Jan	27%	23%	23%	22%	13%	7%	6%	7%	10%
2018	Feb	28%	23%	23%	22%	9%	7%	7%	7%	6%
2018	Mar	33%	24%	24%	23%	9%	12%	13%	10%	2%
2018	Apr	28%	24%	24%	23%	9%	10%	11%	7%	1%
2018	May	31%	23%	23%	22%	8%	8%	9%	7%	2%
2018	Jun	30%	23%	23%	21%	7%	8%	10%	6%	3%
2018	Jul	26%	23%	23%	21%	8%	8%	9%	7%	3%
2018	Aug	29%	23%	23%	22%	8%	9%	10%	7%	4%
2018	Sep		23%	23%	21%	8%	8%	9%	7%	6%
2018	Oct		23%	23%	22%	9%	9%	11%	8%	7%
2018	Nov		22%	22%	21%	10%	9%	10%	7%	10%
2018	Dec		22%	22%	21%	12%	8%	9%	6%	10%
2018	Max	33%	24%	24%	23%	13%	12%	13%	10%	10%
2018	Average	29%	23%	23%	22%	9%	8%	9%	7%	6%

* See footnote 44

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 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

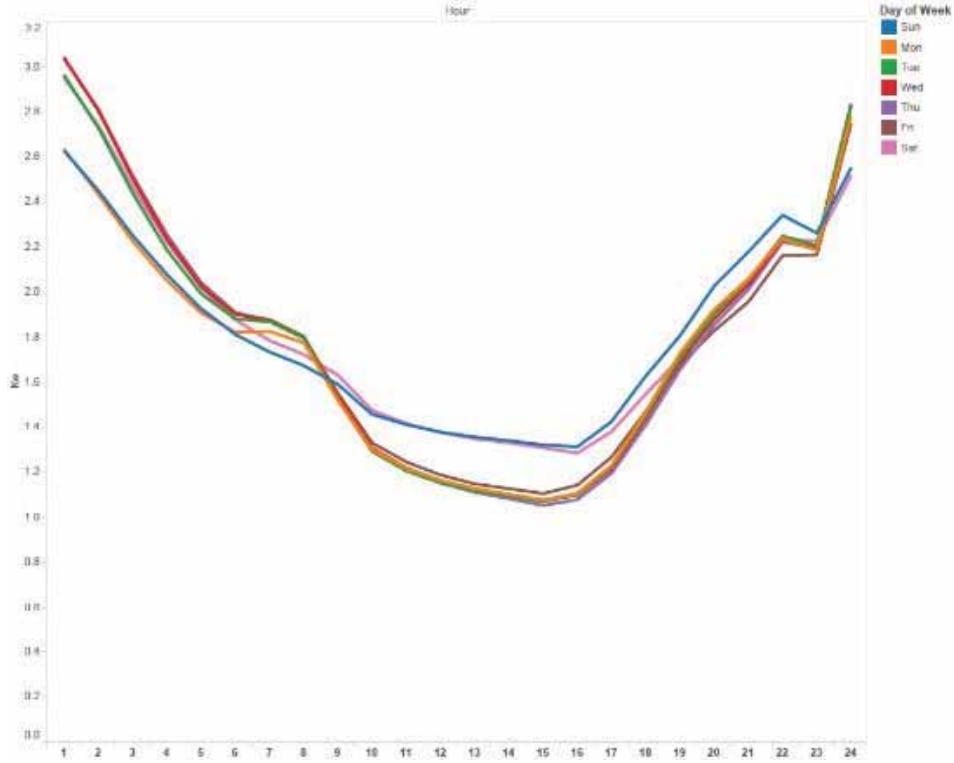


Chart PG&E-7b: Average Load Profile for MDU Single Metering (EV-A) by Day of the Week

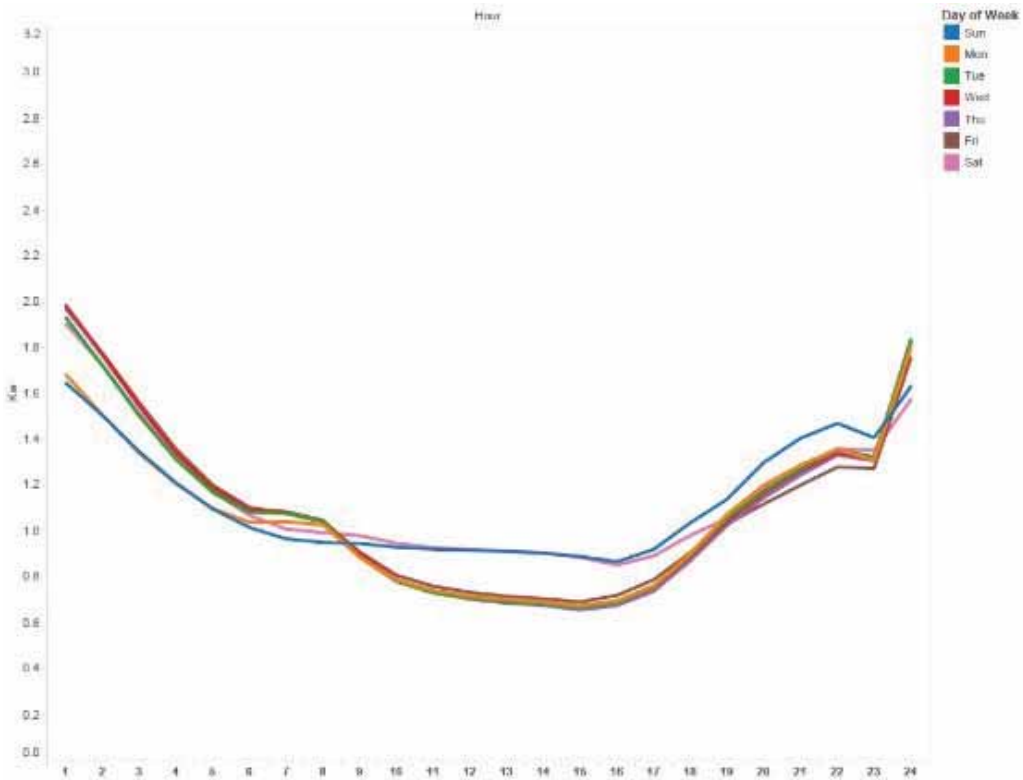


Chart PG&E-8a: Average Load Profile for SF Separate Metering (EV-B) by Day of the Week

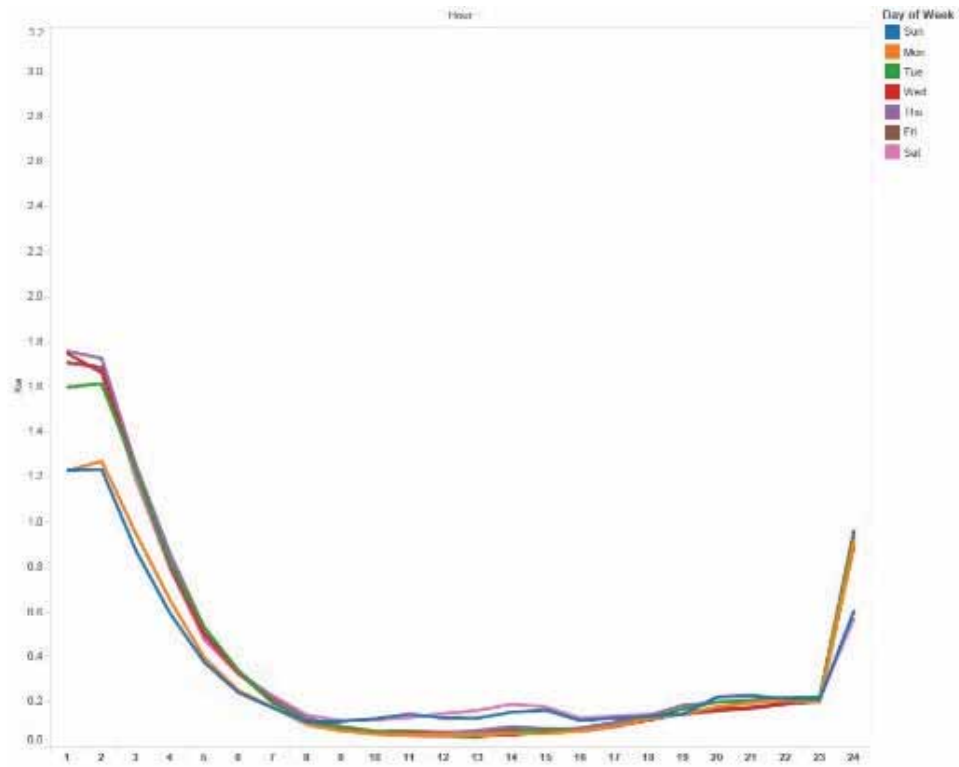
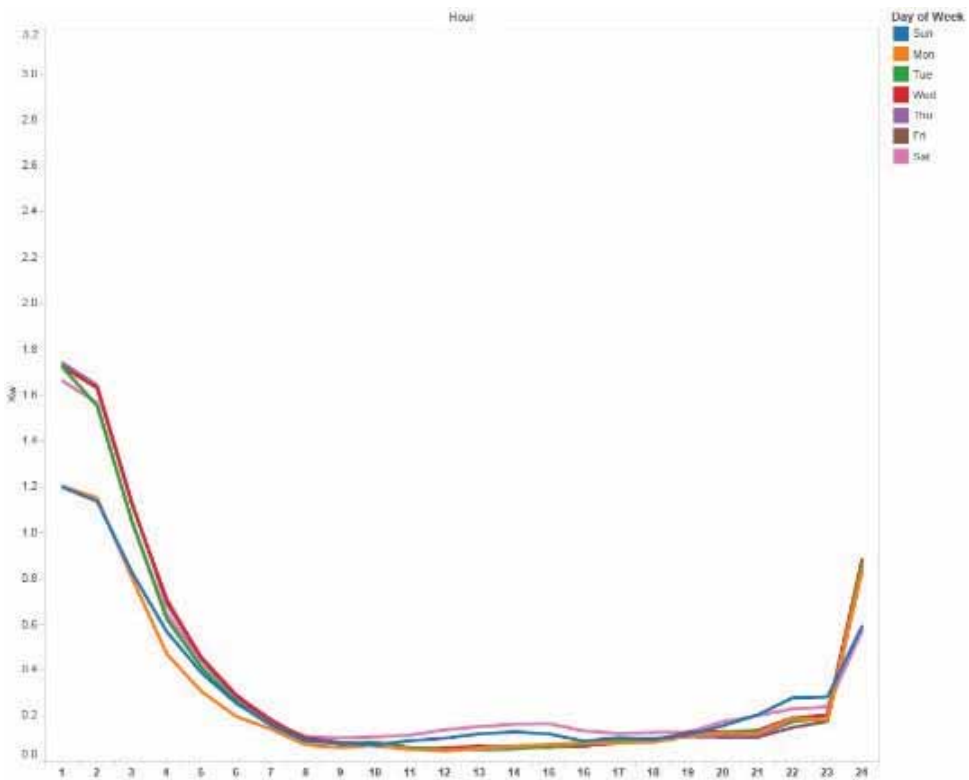


Chart PG&E-8b: Average Load Profile for MDU Separate Metering (EV-B) by Day of the Week



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 3.85 kW higher for the EV-A group category compared to the average residential peak.⁴⁵ This was 3.42 kW higher for single family customers and 3.51 kW higher for multi-family customers. The average non-coincident peak was 3.12 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.

⁴⁵ 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)
2017	Sep	4.51	5.20	2.80	8.52	8.69	6.46	6.57	6.91	5.86
2017	Oct	3.69	4.19	2.46	7.80	7.94	6.01	6.76	7.05	6.18
2017	Nov	3.90	4.42	2.60	7.95	8.10	6.11	6.68	6.93	6.17
2017	Dec	4.12	4.63	2.84	8.25	8.40	6.36	6.85	7.14	6.25
2018	Jan	4.30	4.85	2.93	8.08	8.23	6.27	6.76	6.96	6.35
2018	Feb	4.19	4.76	2.78	7.88	8.02	6.17	6.95	7.31	6.21
2018	Mar	3.81	4.30	2.60	7.92	8.07	6.18	7.04	7.39	6.33
2018	Apr	3.67	4.16	2.45	7.64	7.78	5.98	7.19	7.77	6.32
2018	May	3.89	4.44	2.54	7.76	7.90	6.04	7.74	8.85	6.47
2018	Jun	4.60	5.32	2.81	8.12	8.26	6.33	7.47	8.50	6.28
2018	Jul	4.78	5.54	2.88	8.22	8.38	6.35	7.63	8.71	6.40
2018	Aug	4.76	5.49	2.93	8.12	8.27	6.31	7.48	8.33	6.47
2018	Sep				7.84	7.99	6.08	7.82	8.86	6.59
2018	Oct				7.71	7.85	6.07	7.81	8.74	6.73
2018	Nov				7.99	8.14	6.27	7.73	8.61	6.66
2018	Dec				8.28	8.43	6.53	7.78	8.71	6.67
	Average	4.18	4.78	2.72	8.01	8.15	6.22	7.27	7.92	6.37

* See footnote 44

** 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

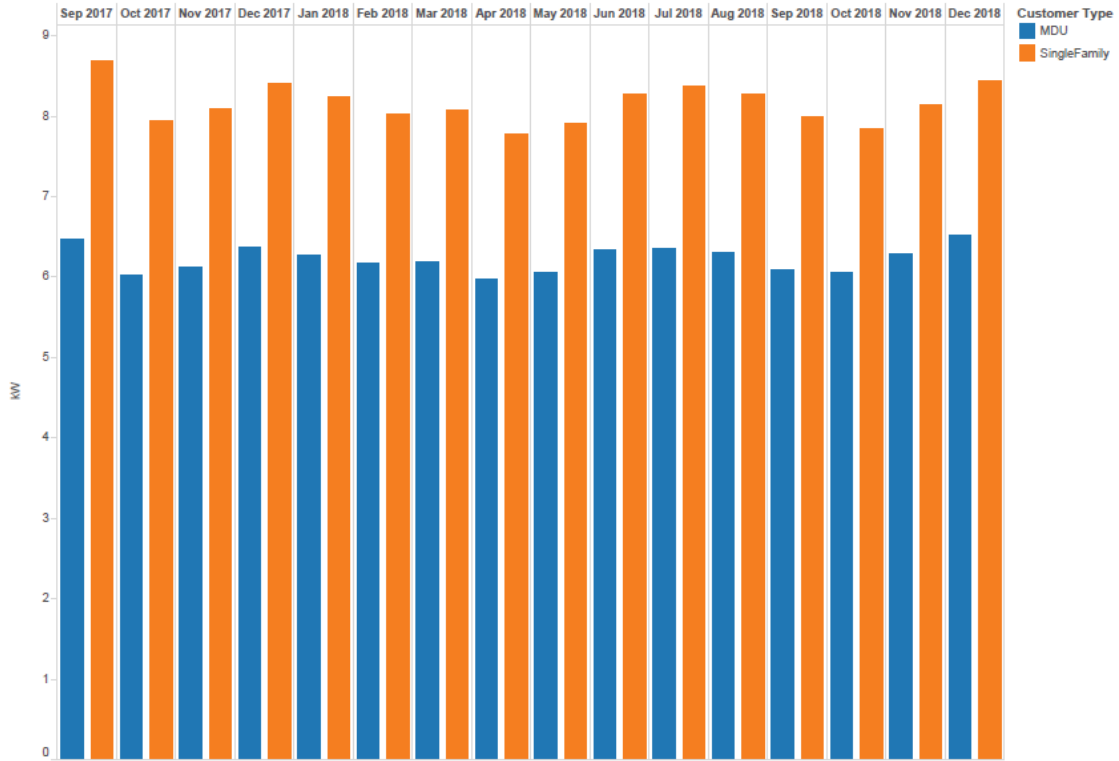


Chart PG&E-9b: Average Non-Coincident Peak Load (kW) for Separate Metering (EV-B) by Customer Type by Month

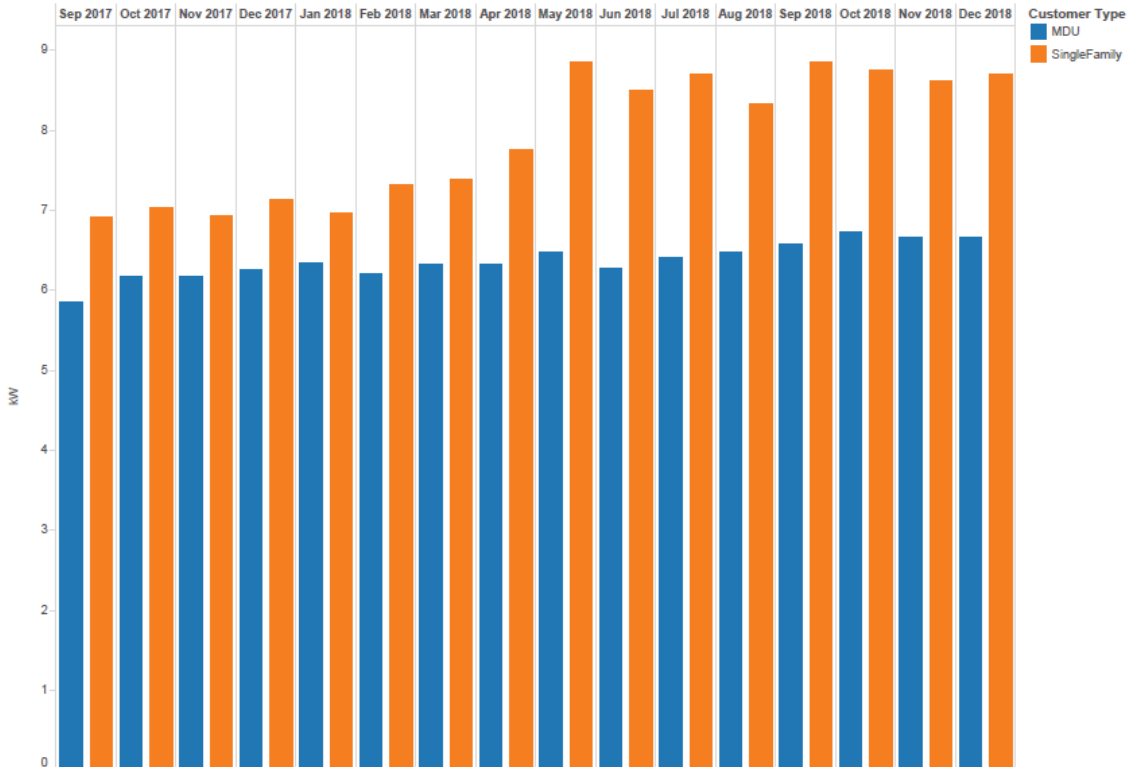


Chart PG&E-10a: Histogram of the Hour at Which the Non-Coincident Peak Load Occurred for Single Metering (EV-A) by Customer Type

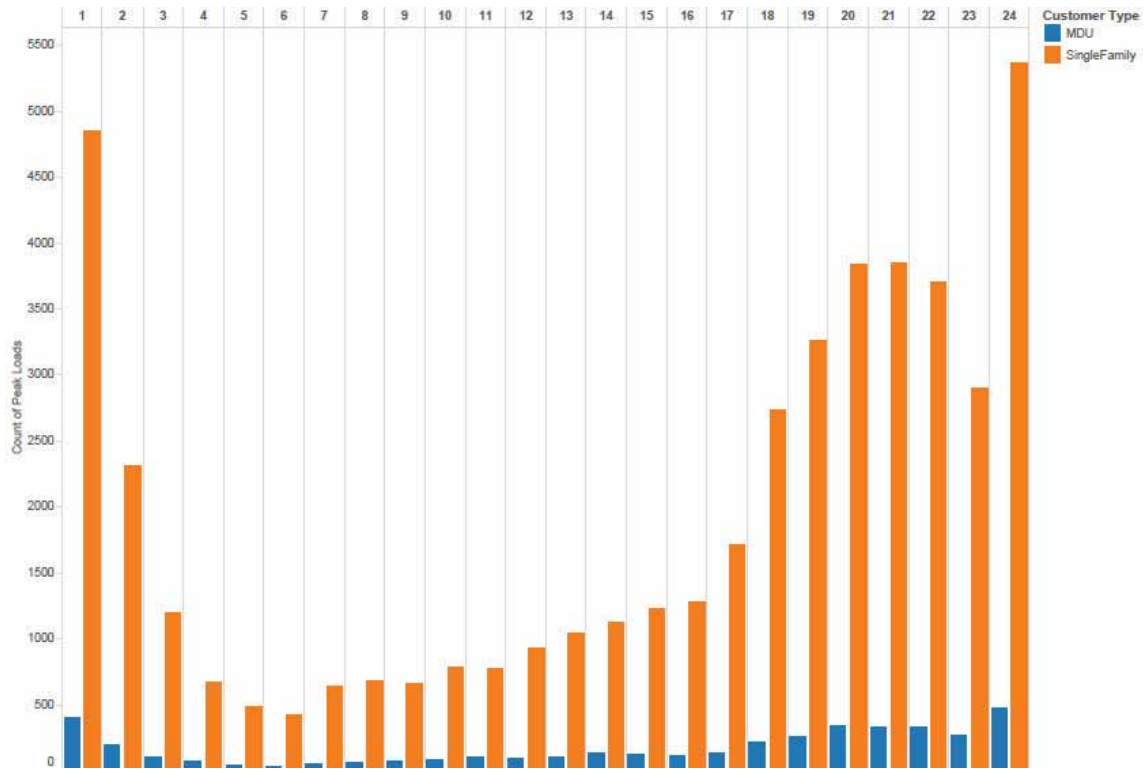
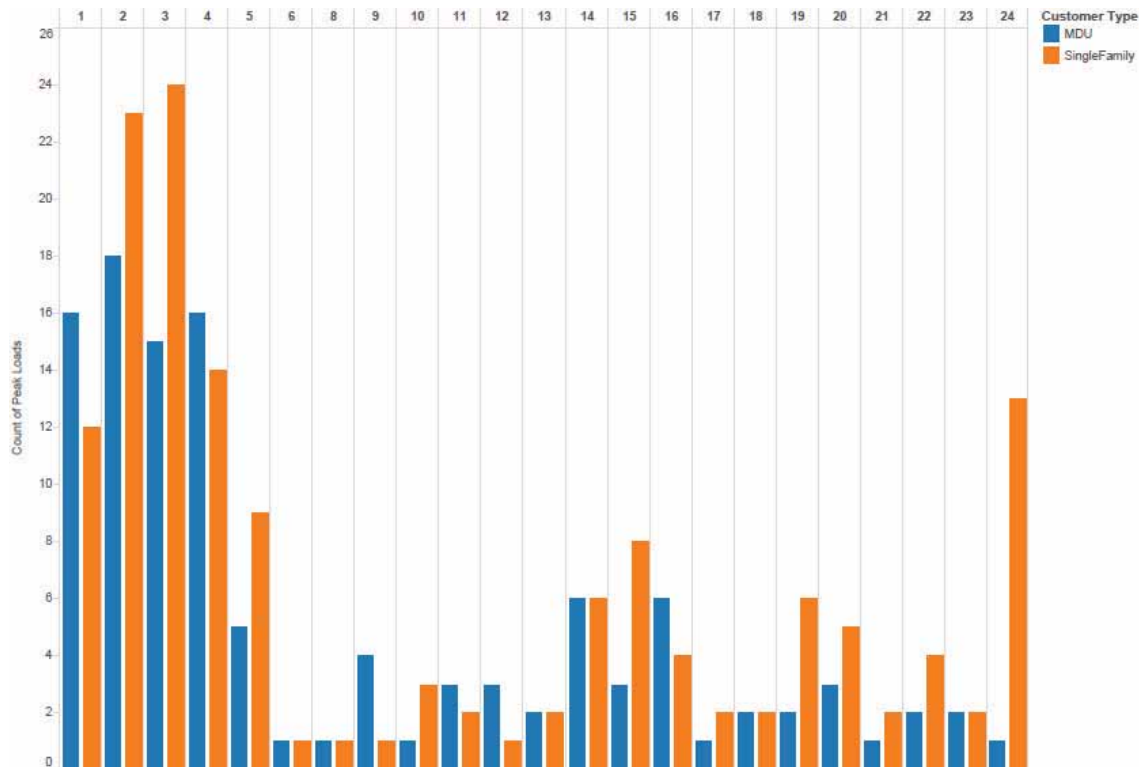


Chart PG&E-10b: Histogram of the Hour at Which the Non-Coincident Peak Load Occurred for Separate Metering (EV-B) by Customer Type



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

* See footnote 44

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
2017	Sep	1.51	20	1.82	20	0.86	15
2017	Oct	1.12	13	1.35	13	0.60	14
2017	Nov	1.07	12	1.28	12	0.60	12
2017	Dec	1.03	12	1.22	12	0.69	21
2018	Jan	1.16	13	1.38	13	0.74	21
2018	Feb	1.30	13	1.57	13	0.68	12
2018	Mar	1.27	14	1.55	14	0.65	21
2018	Apr	1.27	14	1.54	14	0.62	13
2018	May	1.25	14	1.51	14	0.68	14
2018	Jun	1.42	21	1.70	20	0.85	15
2018	Jul	1.46	15	1.72	20	0.87	15
2018	Aug	1.51	19	1.81	20	0.87	15

* See footnote 44

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	SF Single Metering Demand	SF Single Metering hour	MDU Single Metering Demand	MDU Single Metering Hour
2017	Sep	3.54	1	3.64	1	2.34	1
2017	Oct	3.11	1	3.19	1	2.06	1
2017	Nov	3.21	1	3.31	1	2.16	1
2017	Dec	3.33	1	3.42	1	2.21	1
2018	Jan	3.31	1	3.40	1	2.21	1
2018	Feb	3.23	1	3.32	1	2.16	1
2018	Mar	3.17	1	3.26	1	2.10	1
2018	Apr	2.98	1	3.06	1	2.04	1
2018	May	2.93	1	3.02	1	2.00	1
2018	Jun	2.95	1	3.03	1	1.99	1
2018	Jul	3.01	1	3.09	1	2.08	1
2018	Aug	3.01	1	3.09	1	2.05	1
2018	Sep	2.87	1	2.94	1	2.00	1
2018	Oct	2.84	1	2.92	1	2.00	1
2018	Nov	2.98	1	3.06	1	2.03	1
2018	Dec	3.10	1	3.18	1	2.16	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	SF Separate Metering Demand	SF Separate Metering hour	MDU Separate Metering Demand	MDU Separate Metering Hour
2017	Sep	<i>1.64</i>	2	<i>1.62</i>	2	<i>2.18</i>	1
2017	Oct	<i>1.73</i>	1	<i>1.74</i>	2	<i>2.01</i>	2
2017	Nov	<i>1.73</i>	1	<i>1.72</i>	2	<i>1.99</i>	1
2017	Dec	<i>1.73</i>	1	<i>1.74</i>	2	<i>2.26</i>	1
2018	Jan	<i>2.04</i>	1	<i>1.93</i>	1	<i>2.25</i>	1
2018	Feb	<i>2.04</i>	1	<i>1.98</i>	1	<i>2.28</i>	1
2018	Mar	<i>2.05</i>	2	<i>2.00</i>	2	<i>2.39</i>	2
2018	Apr	<i>2.16</i>	1	<i>2.19</i>	2	<i>2.35</i>	1
2018	May	<i>2.25</i>	1	<i>2.71</i>	1	<i>2.20</i>	1
2018	Jun	<i>2.23</i>	1	<i>2.42</i>	1	<i>2.16</i>	1
2018	Jul	<i>1.93</i>	1	<i>2.24</i>	1	<i>2.08</i>	1
2018	Aug	<i>2.13</i>	2	<i>2.33</i>	1	<i>2.18</i>	1
2018	Sep	<i>2.33</i>	1	<i>2.52</i>	1	<i>2.27</i>	1
2018	Oct	<i>2.47</i>	1	<i>3.06</i>	1	<i>2.29</i>	1
2018	Nov	<i>2.28</i>	1	<i>2.42</i>	1	<i>2.11</i>	1
2018	Dec	<i>2.50</i>	1	<i>2.75</i>	2	<i>2.47</i>	1

** 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)	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)
2017	Sep	1.34	1.58	0.72	2.76	2.83	1.82	0.23	0.26	0.19
2017	Oct	0.69	0.78	0.45	1.82	1.87	1.14	0.11	0.11	0.10
2017	Nov	0.78	0.87	0.53	1.89	1.95	1.19	0.21	0.13	0.37
2017	Dec	0.95	1.09	0.62	2.10	2.16	1.29	0.10	0.09	0.12
2018	Jan	0.92	1.04	0.64	2.04	2.11	1.29	0.07	0.06	0.08
2018	Feb	0.85	0.96	0.60	1.90	1.96	1.25	0.10	0.07	0.17
2018	Mar	0.80	0.89	0.59	2.02	2.07	1.33	0.12	0.15	0.07
2018	Apr	0.62	0.69	0.45	1.95	2.00	1.27	0.12	0.10	0.15
2018	May	0.89	1.03	0.53	1.79	1.84	1.16	0.13	0.19	0.06
2018	Jun	1.29	1.52	0.74	2.29	2.36	1.55	0.14	0.19	0.08
2018	Jul	1.32	1.57	0.69	2.03	2.09	1.29	0.19	0.31	0.06
2018	Aug	1.38	1.64	0.74	2.06	2.12	1.32	0.12	0.20	0.03
2018	Sep				1.41	1.46	0.88	0.18	0.14	0.21
2018	Oct				1.71	1.76	1.11	0.17	0.23	0.10
2018	Nov				1.69	1.74	1.11	0.24	0.35	0.10
2018	Dec				1.88	1.93	1.23	0.13	0.17	0.07
Average		0.99	1.14	0.61	1.96	2.02	1.26	0.15	0.17	0.12

* See footnote 44

** 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 December 2018). 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).⁴⁶ Furthermore, dual participating NEM and PEV rate customers are highly concentrated in the Bay Area per Figure PG&E-3.

⁴⁶ California Energy Commission (2019). California Building Climate Zones with 2019 Zip Codes. Retrieved from: <https://www.energy.ca.gov/maps/renewable/BuildingClimateZonesByZIPCode.pdf> .

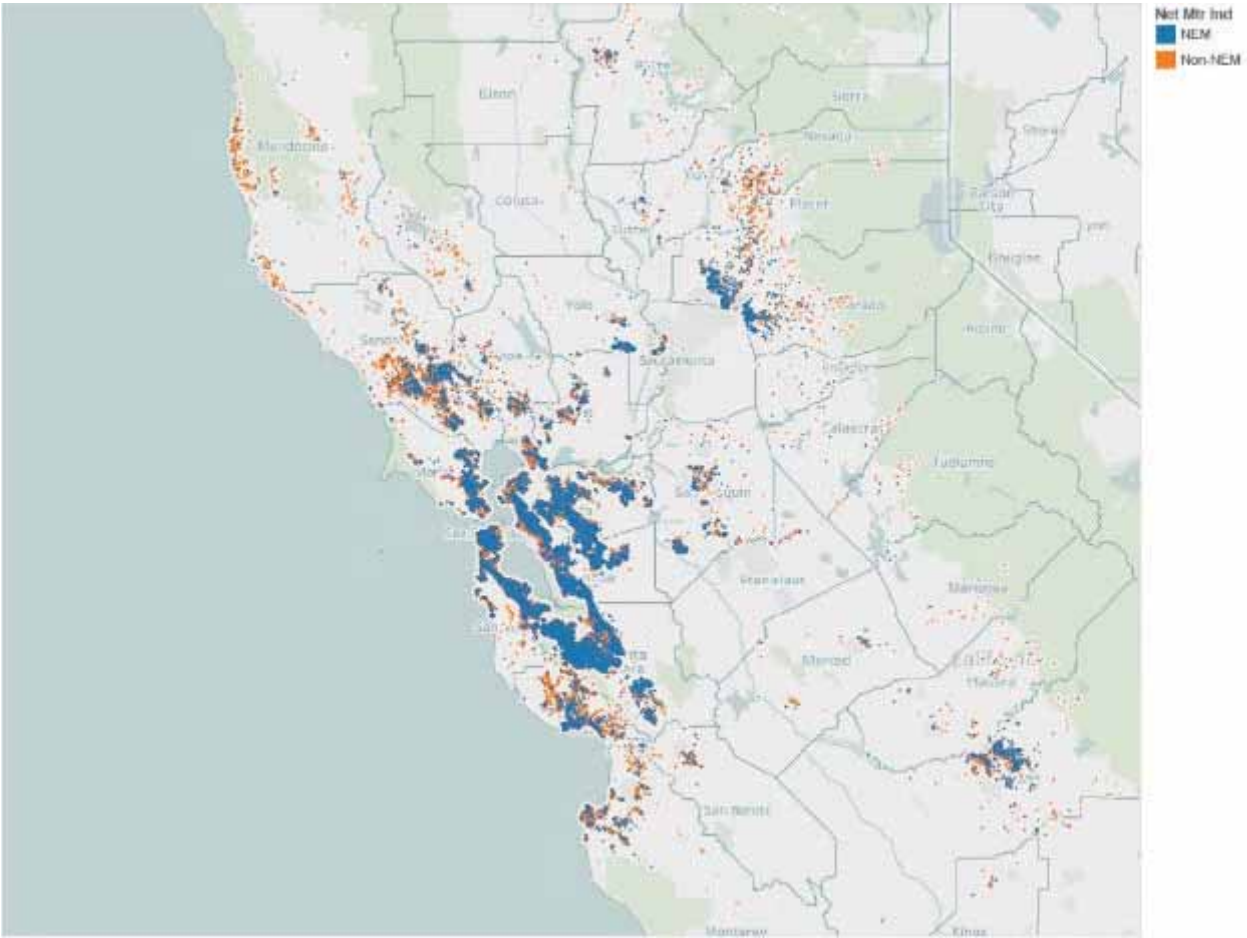
Table PG&E-12a: Geographic Concentration of PEVs by Climate Zone

Climate Zone	% Single Metering (EV-A)	% Separate Metering (EV-B)	% Residential Population
Z01	2%	<1%	1%
Z02	10%	7%	8%
Z03	38%	45%	31%
Z04	26%	28%	14%
Z05	1%	1%	3%
Z06	0%	0%	<1%
Z09	0%	0%	<1%
Z11	2%	3%	7%
Z12	18%	12%	22%
Z13	2%	4%	13%
Z14	0%	0%	<1%
Z16	<1%	<1%	1%

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

Rate	Zip Code	Customers	% Total
Single Meter (EV-A)	94539	1,221	2.29%
	94568	983	1.84%
	94582	967	1.81%
	95120	915	1.71%
	95070	879	1.65%
Separate Meter (EV-B)	94022	8	3.62%
	95113	8	3.62%
	94010	7	3.17%
	94402	6	2.71%
	94941	6	2.71%

Figure PG&E-3: Customers on EV Rates by NEM/Non-NEM in the PG&E Service Territory as of December 2018



Southern California Edison

During the period covered in this report, SCE offered residential customers two rate schedules⁴⁷ designed to facilitate the charging of PEVs. Both of these schedules employed price-differentiated time-of-use periods. The TOU-D tariff with Option A or B (TOU-D-A/B) applies to regular household loads and PEV charging loads that are both 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 required 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. PEV owners could also opt to remain on their existing tariff, likely Schedule D (domestic rate schedule). Based on the number of PEVs that SCE estimates are within its service territory, the majority of PEV owners likely choose to remain on the domestic rate plan. The following sections report the monthly usage characteristics from September 2017 through December 2018 for PEV owners identified on the TOU-D-A/B and TOU-EV-1 tariffs. This report covers an additional four months pursuant to an extension of the January 1, 2019 deadline to March 31, 2019.

SCE designed TOU-D-A/B tariff to provide attractive charging options to PEV owners, and replace the TOU-D-TEV tariff, which was only available to PEV owners. The TOU-D-A/B tariff however, was open to all residential customers whether they own a PEV or not, which means that enrollment in the rate would no longer provide information on PEV ownership. 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 rebate through the Center for Sustainable Energy's (CSE) Clean Vehicle Rebate Project or providing their information through contact with SCE's call center. Since May 2017, SCE began accepting applications for its Clean Fuel Reward Program, which provides cash incentives to PEV owners if they are the first, second, or third owner of that PEV. This has provided a significant source of additional identification of PEV owners who were previously unknown to SCE.

Single-Metered Whole House Rate

The TOU-D-A/B tariff is a single-metered TOU tariff aimed at accommodating PEV charging. 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 \$0.55/meter/day but significantly lower mid-peak and on-peak rates as

⁴⁷ 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 December 2018, there were 78 TOU-EV-3 accounts, 162 TOU-EV-4 accounts and 17 TOU-EV-6 accounts.

compared to Option A. Option A also includes a \$0.08/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.

The TOU-D-A/B tariff closed to new customers on March 1, 2019, and was superseded by the TOU-D-PRIME rate, which became effective on the same date. The new TOU-D-PRIME tariff has different time-of-use periods, which include a narrower 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.

Table SCE – 1a presents the rates that were effective for the largest portion of the reporting period. Rates were in place between January 1, 2018, and May 30, 2018.

Table SCE – 1a: Single Meter (TOU-D-A/B) Tariff⁴⁸ (\$/kWh) – Effective 1/1/2018

Clock Hour Ending	Option A				Option B			
	Winter		Summer		Winter		Summer	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
1	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
2	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
3	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
4	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
5	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
6	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
7	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
8	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
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	0.36	0.27	0.48	0.28	0.25	0.16	0.37	0.17
16	0.36	0.27	0.48	0.28	0.25	0.16	0.37	0.17
17	0.36	0.27	0.48	0.28	0.25	0.16	0.37	0.17
18	0.36	0.27	0.48	0.28	0.25	0.16	0.37	0.17
19	0.36	0.27	0.48	0.28	0.25	0.16	0.37	0.17
20	0.36	0.27	0.48	0.28	0.25	0.16	0.37	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	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12
24	0.13	0.13	0.12	0.12	0.13	0.13	0.12	0.12

Option A: \$0.08/kWh/meter/day Baseline Credit

Option B: \$0.55 meter/day Basic Charge

⁴⁸ <https://www.sce.com/wps/portal/home/regulatory/tariff-books>.

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

		Summer	Winter
		On-peak : Mid-peak : Off-peak	On-peak : Mid-peak : Off-peak
Option A	Weekday	3.9 : 2.3 : 1.0	2.8 : 2.1 : 1.0
	Weekend	2.2 : 2.2 : 1.0	2.1 : 2.1 : 1.0
Option B	Weekday	3.0 : 1.3 : 1.0	1.9 : 1.3 : 1.0
	Weekend	1.3 : 1.3 : 1.0	1.3 : 1.3 : 1.0

Separately-Metered PEV Rate

The TOU-EV-1 rate was 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 was provided and installed at no additional cost to the customer, however the home’s electrical infrastructure may have needed 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 were the responsibility of the customer. For this rate plan, lower rates apply during off-peak hours of 9:00 p.m. to 12:00 noon, and rates change seasonally. For usage between noon and 9 p.m., rates are higher in summer. The following are the TOU periods for the separately-metered rate:

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

The TOU-EV-1 tariff was also closed to new customers as of March 1, 2019. Existing customers will, however, be permitted to continue taking service on this tariff.

The relevant rates are reported in the following table, Table SCE – 1b.

Table SCE – 1b: Separate Meter (TOU-EV-1) Tariff (\$/kWh) – Effective 1/1/2018

Clock Hour Ending	Winter Weekday	Winter Weekend	Summer Weekday	Summer Weekend
1	0.13	0.13	0.13	0.13
2	0.13	0.13	0.13	0.13
3	0.13	0.13	0.13	0.13
4	0.13	0.13	0.13	0.13
5	0.13	0.13	0.13	0.13
6	0.13	0.13	0.13	0.13
7	0.13	0.13	0.13	0.13
8	0.13	0.13	0.13	0.13
9	0.13	0.13	0.13	0.13
10	0.13	0.13	0.13	0.13
11	0.13	0.13	0.13	0.13
12	0.13	0.13	0.13	0.13
13	0.24	0.13	0.37	0.13
14	0.24	0.13	0.37	0.13
15	0.24	0.13	0.37	0.13
16	0.24	0.13	0.37	0.13
17	0.24	0.13	0.37	0.13
18	0.24	0.13	0.37	0.13
19	0.24	0.13	0.37	0.13
20	0.24	0.13	0.37	0.13
21	0.24	0.13	0.37	0.13
22	0.13	0.13	0.13	0.13
23	0.13	0.13	0.13	0.13
24	0.13	0.13	0.13	0.13

Meter Charge: \$2.76/month

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

	Summer On-peak : Off-peak	Winter On-peak : Off-peak
Weekday	2.9 : 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 was 30% as of December 2018 as shown in Table SCE – 3a. The percent of single-metered accounts participating in a Demand Response (DR) program, as shown in Table SCE – 4, was consistently 14%.

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. 2017	3,696	24%	26%	9%
Oct. 2017	3,774	24%	27%	9%
Nov. 2017	3,874	24%	27%	9%
Dec. 2017	3,967	25%	27%	10%
Jan. 2018	4,767	25%	27%	9%
Feb. 2018	4,979	25%	28%	10%
Mar. 2018	5,261	26%	29%	10%
Apr. 2018	5,474	26%	29%	10%
May 2018	5,644	26%	29%	10%
Jun. 2018	5,807	27%	30%	11%
Jul. 2018	5,973	29%	30%	11%
Aug. 2018	6,137	28%	31%	11%
Sep. 2018	6,304	28%	31%	11%
Oct. 2018	6,450	29%	32%	11%
Nov. 2018	6,621	29%	32%	12%
Dec. 2018	6,775	30%	33%	12%

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

Month	NEM Customers with Separate Metering	NEM as % Separate Metering
Sep. 2017	3	0%
Oct. 2017	3	0%
Nov. 2017	3	0%
Dec. 2017	3	0%
Jan. 2018	3	0%
Feb. 2018	3	0%
Mar. 2018	3	0%
Apr. 2018	3	0%
May 2018	3	0%
Jun. 2018	4	1%
Jul. 2018	4	1%
Aug. 2018	4	1%
Sep. 2018	4	1%
Oct. 2018	4	1%
Nov. 2018	4	1%
Dec. 2018	4	1%

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. 2017	2,285	15%	15%	11%
Oct. 2017	2,290	14%	15%	11%
Nov. 2017	2,299	14%	15%	11%
Dec. 2017	2,310	14%	15%	11%
Jan. 2018	2,813	14%	15%	11%
Feb. 2018	2,888	15%	15%	11%
Mar. 2018	2,975	14%	15%	11%
Apr. 2018	3,029	14%	15%	11%
May 2018	3,022	14%	15%	11%
Jun. 2018	3,042	14%	15%	11%
Jul. 2018	3,074	14%	15%	11%
Aug. 2018	3,085	14%	15%	11%
Sep. 2018	3,067	14%	14%	11%
Oct. 2018	3,079	14%	14%	11%
Nov. 2018	3,136	14%	14%	11%
Dec. 2018	3,146	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 were four separately-metered accounts on NEM as of December 2018, as shown in Table SCE-3b.

Number of PEV Time-of-Use Accounts

SCE’s single-metered rate option was open to all residential customers and therefore it is necessary to find a means of identifying which customers on the rate own PEVs. The distribution of Low Carbon Fuel Standard credits to PEV owners through the Clean Fuel Reward Program has significantly impacted the number of PEV owners identified. The date of acquisition, however, is still unknown so this report includes any owners of vehicles where the model year of their vehicle is older than the current year. As such, statistics for September through December of 2017 only include PEV owners with vehicles of model year 2016 or older and January through December of 2018 statistics include any accounts with PEVs from model year 2017 or older.

It is still the case 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 or other factors that may influence the rates of self-identification (e.g. rebate incentives, tariff changes, propensities to contact the Call Center, utility or industry marketing efforts, new vehicle models with different specifications, etc.). As of December 2018, SCE identified 22,959 single-metered PEV owners, of which 85% 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**

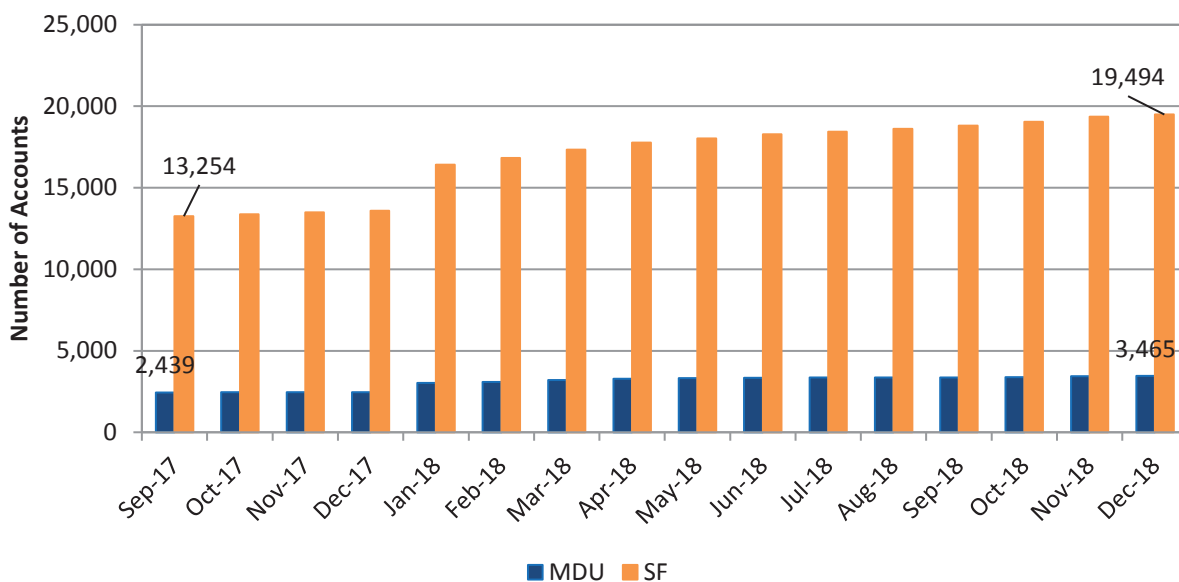
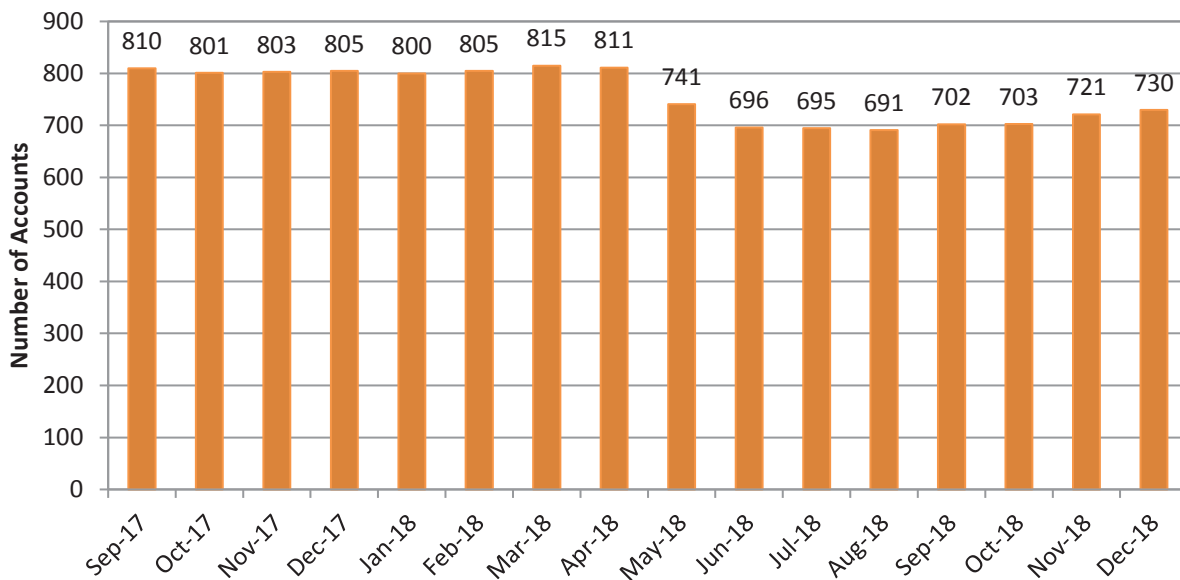


Chart SCE – 2 shows a slight upward trend of separately-metered accounts over the last four months of this reporting period but the total remains at 730 separately-metered accounts as of December 2018. From April 2018 to June 2018 there was a decrease in the number of accounts, which is the result of a submetering pilot study concluding and the meters being removed. The number of TOU-EV-1 accounts that are reported here are only the accounts that register charging during the month. There are a number of accounts with zero usage. This could occur if the location is not a primary residence or if there was a change of ownership and the PEV is no longer present. It could also occur if all the charging is done away from the residence.

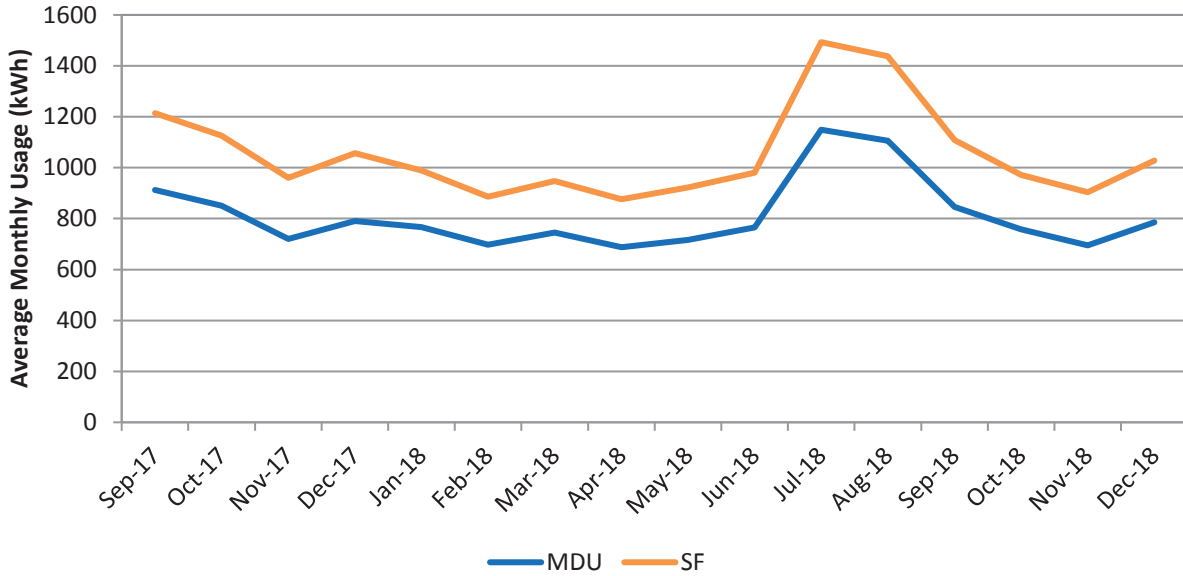
Chart SCE – 2: Separate Meter (TOU-EV-1) – Number of Accounts at the Beginning of Each Month



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 occurring 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 during these twelve months occurred in July at 1,493 kWh for SF and at 1,149 kWh for MDU.

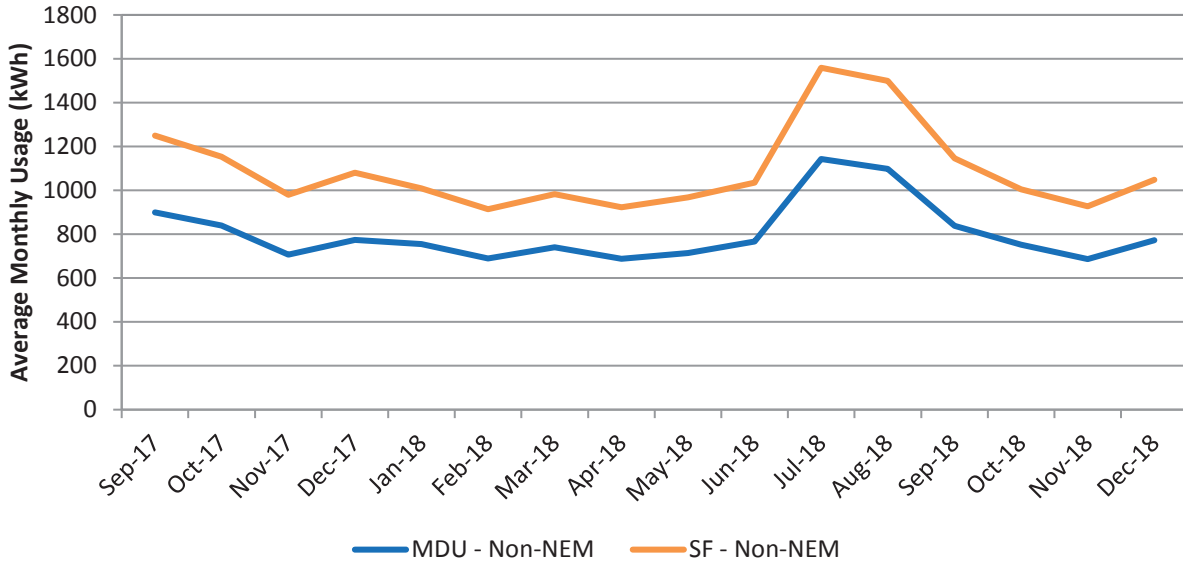
**Chart SCE – 3: Single Meter (TOU-D-A/B) –
Average Monthly Usage (kWh) by Customer Type Including NEM**



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 households 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 or the delivered energy net of exports. 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.

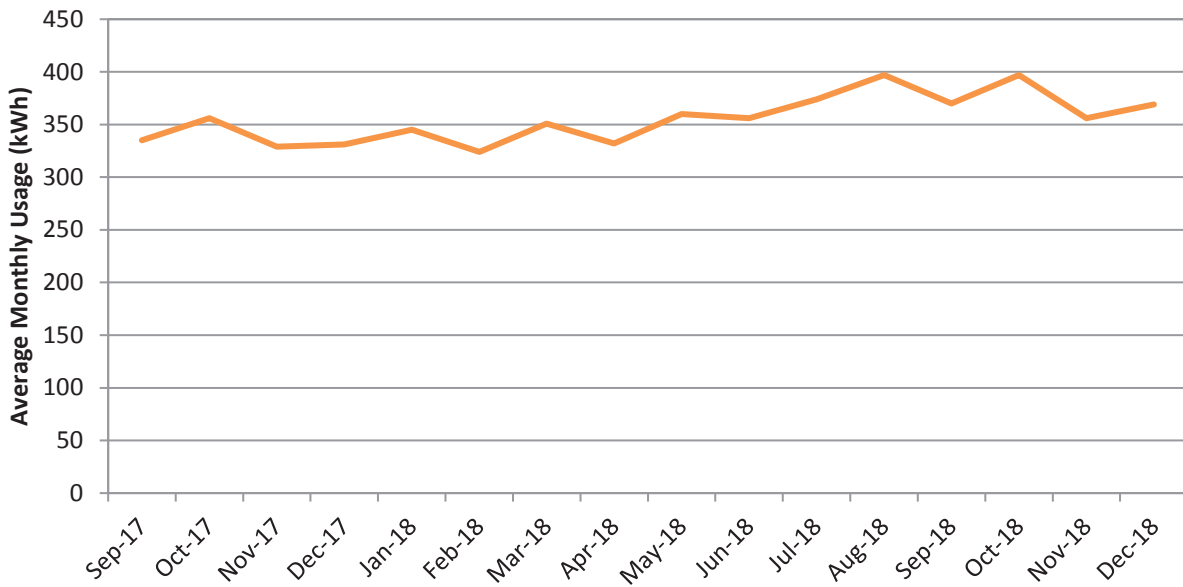
If non-coincident demand were used as an indication of consumption, the non-coincident demands for NEM households with PEVs are higher than the average household. Non-coincident demands for all single-meter PEV owners are presented in Table SCE – 9a and discussed in greater detail below. However, the monthly average non-coincident demands for NEM households range from 7.7 kW to 10.2 kW, indicating that demands for the NEM households with a PEV are about 0.7 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 displayed in Chart SCE – 5 for separately-metered PEVs appears to have crept upwards of the 350 kWh per month level it has been at since 2015. Usage averaged 377 kWh for the last two quarters of 2018. The consistent usage observed 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 2017 Domestic Rate Group Load Study, which is based on the 2017 calendar year. As such, the statistics for the residential population are not presented in chronological order. The data for January 2018 through August 2018 is from the corresponding months in 2017.

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. 2017	21.8%	16.5%	16.5%	16.3%	14.4%
Oct. 2017	24.1%	18.1%	18.1%	17.8%	17.0%
Nov. 2017	20.9%	15.9%	16.0%	15.6%	16.6%
Dec. 2017	18.5%	15.0%	15.1%	14.4%	15.7%
Jan. 2018	19.1%	15.8%	15.8%	15.3%	16.3%
Feb. 2018	19.1%	14.4%	14.4%	13.9%	13.9%
Mar. 2018	21.1%	14.4%	14.4%	14.1%	12.0%
Apr. 2018	18.9%	14.5%	14.5%	14.3%	10.2%
May 2018	22.0%	14.7%	14.8%	14.4%	10.5%
Jun. 2018	25.7%	17.4%	17.5%	17.1%	13.2%
Jul. 2018	23.7%	20.1%	20.2%	19.4%	17.8%
Aug. 2018	27.1%	21.5%	21.7%	20.7%	19.2%
Sep. 2018	21.8%	16.2%	16.3%	15.8%	14.7%
Oct. 2018	24.1%	16.8%	16.9%	16.4%	14.8%
Nov. 2018	20.9%	15.2%	15.3%	14.7%	15.8%
Dec. 2018	18.5%	15.0%	15.1%	14.5%	15.6%

* 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. 2017	46.5%	39.4%	39.5%	38.7%	29.2%
Oct. 2017	43.2%	36.2%	36.3%	35.5%	25.6%
Nov. 2017	44.3%	36.8%	37.0%	35.8%	25.7%
Dec. 2017	44.5%	38.2%	38.3%	37.2%	27.2%
Jan. 2018	43.9%	35.9%	36.0%	35.1%	25.2%
Feb. 2018	44.3%	35.8%	36.0%	35.0%	23.8%
Mar. 2018	42.6%	35.4%	35.6%	34.7%	24.0%
Apr. 2018	45.9%	35.9%	36.1%	35.1%	23.1%
May 2018	44.2%	35.8%	36.0%	34.9%	24.2%
Jun. 2018	43.7%	36.2%	36.4%	35.5%	24.5%
Jul. 2018	47.1%	40.4%	40.5%	39.8%	30.6%
Aug. 2018	43.1%	37.9%	38.0%	37.2%	28.2%
Sep. 2018	46.5%	40.0%	40.1%	39.2%	29.6%
Oct. 2018	43.2%	35.0%	35.2%	34.1%	24.2%
Nov. 2018	44.3%	37.2%	37.4%	36.1%	25.8%
Dec. 2018	44.5%	37.9%	38.1%	37.0%	27.8%

* 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. 2017	31.7%	44.1%	44.0%	45.0%	56.4%
Oct. 2017	32.7%	45.7%	45.6%	46.8%	57.4%
Nov. 2017	34.8%	47.3%	47.1%	48.6%	57.7%
Dec. 2017	37.0%	46.8%	46.6%	48.3%	57.1%
Jan. 2018	37.0%	48.4%	48.2%	49.6%	58.5%
Feb. 2018	36.6%	49.8%	49.6%	51.1%	62.3%
Mar. 2018	36.3%	50.2%	50.0%	51.2%	64.0%
Apr. 2018	35.2%	49.6%	49.4%	50.6%	66.7%
May 2018	33.8%	49.4%	49.2%	50.6%	65.3%
Jun. 2018	30.5%	46.4%	46.2%	47.4%	62.2%
Jul. 2018	29.3%	39.5%	39.3%	40.8%	51.6%
Aug. 2018	29.9%	40.6%	40.3%	42.1%	52.6%
Sep. 2018	31.7%	43.8%	43.6%	45.0%	55.7%
Oct. 2018	32.7%	48.2%	48.0%	49.5%	61.0%
Nov. 2018	34.8%	47.7%	47.4%	49.1%	58.4%
Dec. 2018	37.0%	47.0%	46.7%	48.5%	56.5%

* 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 – 6b. Very similar results were present in previous reports as well.

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

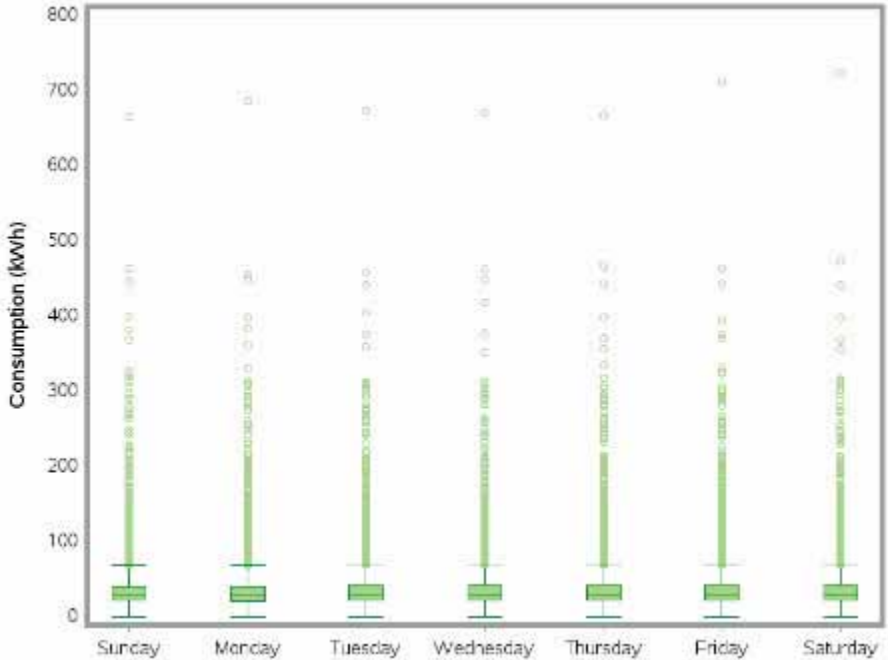
Month	On-peak	Off-peak
Sep. 2017	12.1%	87.9%
Oct. 2017	11.8%	88.2%
Nov. 2017	12.1%	87.9%
Dec. 2017	12.6%	87.4%
Jan. 2018	13.4%	86.6%
Feb. 2018	13.3%	86.7%
Mar. 2018	12.5%	87.5%
Apr. 2018	12.6%	87.4%
May 2018	11.8%	88.2%
Jun. 2018	12.4%	87.6%
Jul. 2018	12.7%	87.3%
Aug. 2018	11.9%	88.1%
Sep. 2018	11.9%	88.1%
Oct. 2018	11.6%	88.4%
Nov. 2018	13.0%	87.0%
Dec. 2018	12.9%	87.1%

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-whisker⁴⁹ 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 686 kWh per day. For the separately-metered accounts, which should only include PEV charging, accounts with an average greater than 30 kWh/day may result from multiple vehicles being located on the account.

⁴⁹ 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**

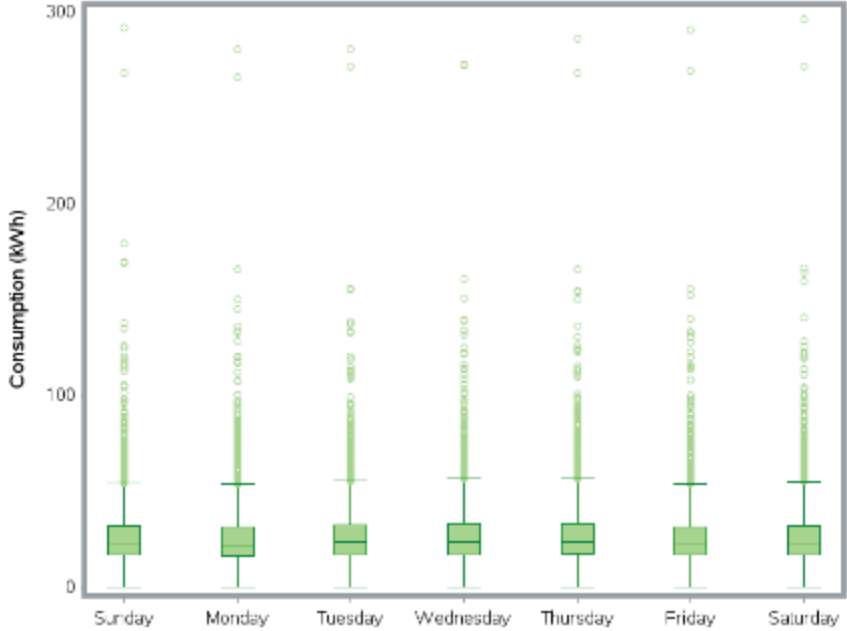
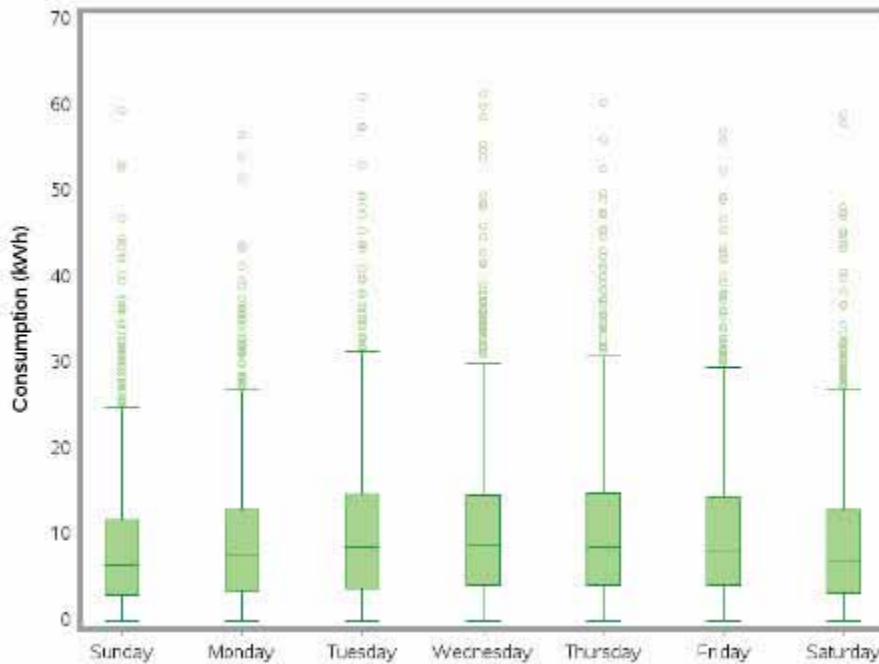


Chart SCE – 6c: Separate Meter (TOU-EV-1)
Box-and-Whisker Plot of Individual Average Daily Consumption(kWh) by Day of the Week



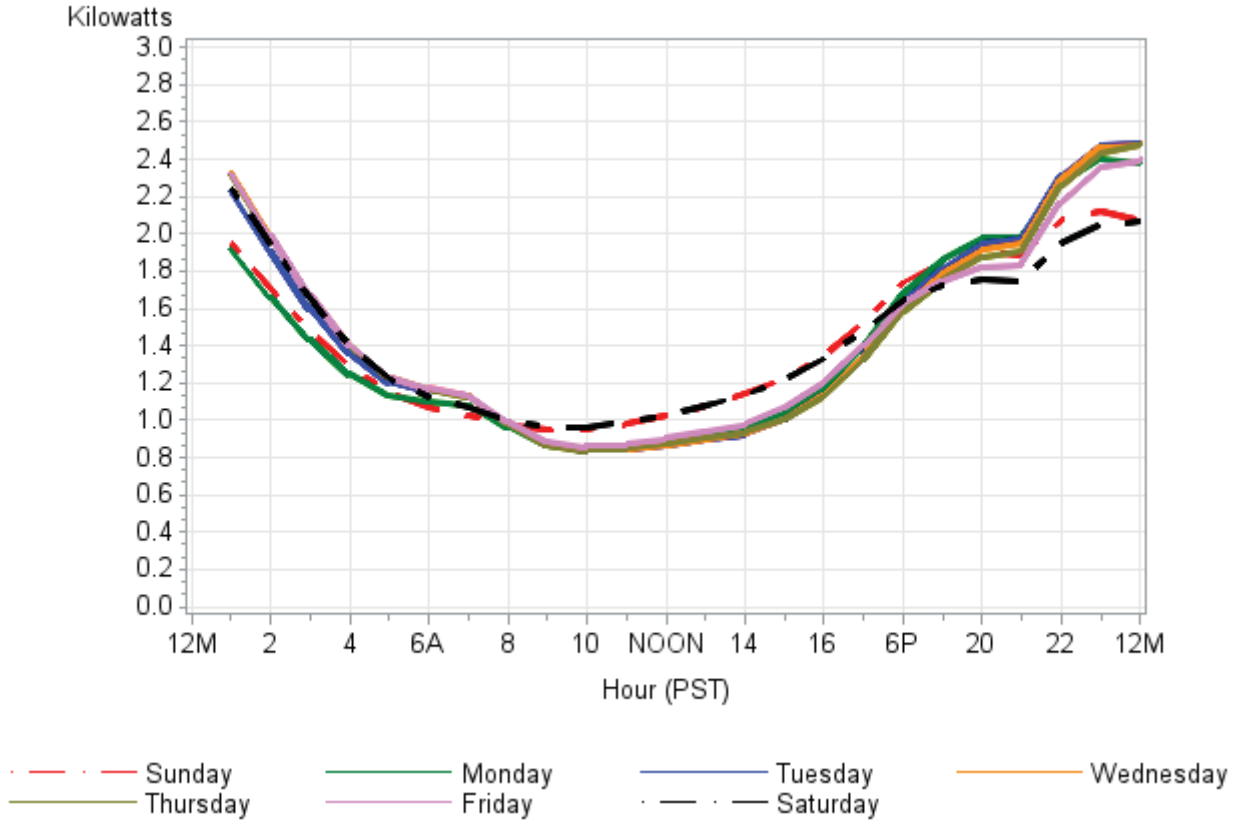
Average Load Profiles

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

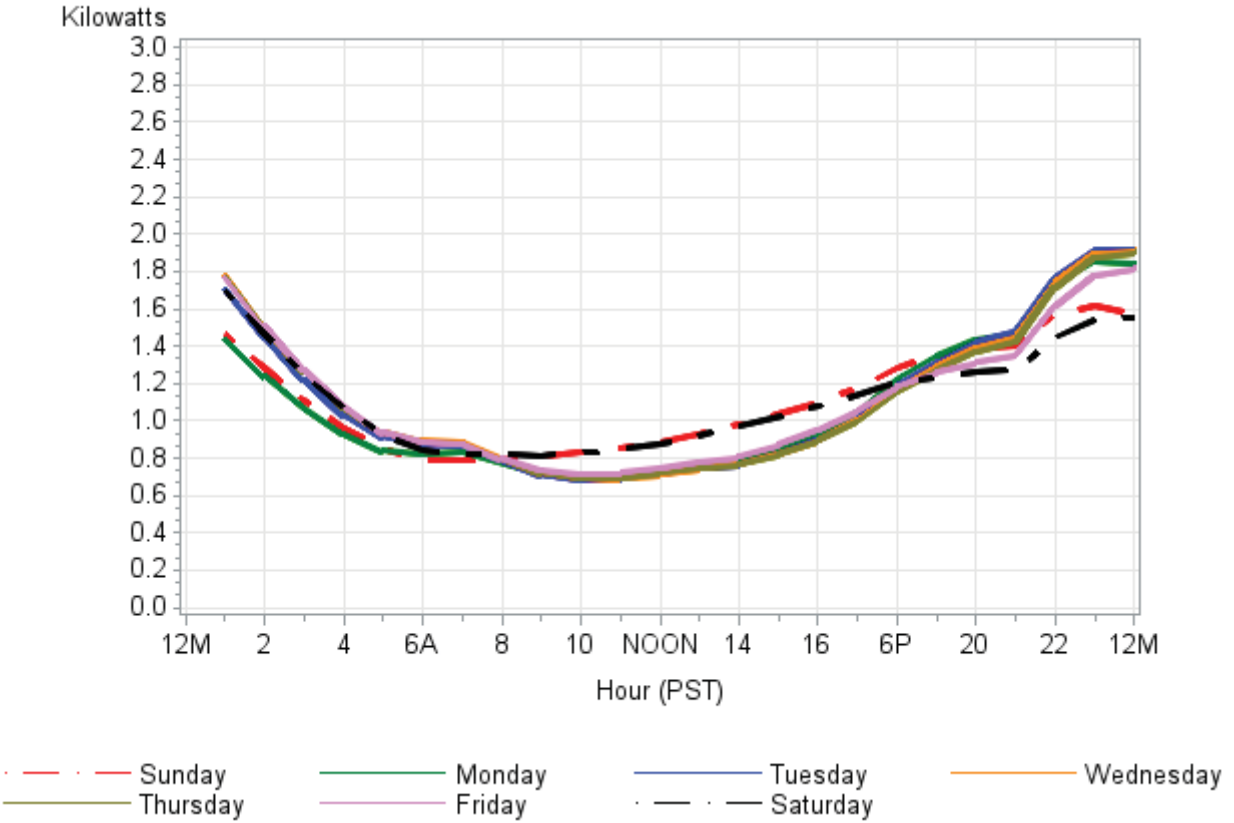
The load profiles for single-family households with a PEV that opted for the TOU-D-A/B tariff are shown in Chart SCE – 7a. As is typical with residential annual average hourly usage, usage peaks in the evening around 8:00 p.m. Midday usage is lower every day, but not quite as low on weekend days as weekdays. Rather than declining into the morning hours, however, these profiles exhibit a large spike beginning 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 average 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-metered 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 1.2 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

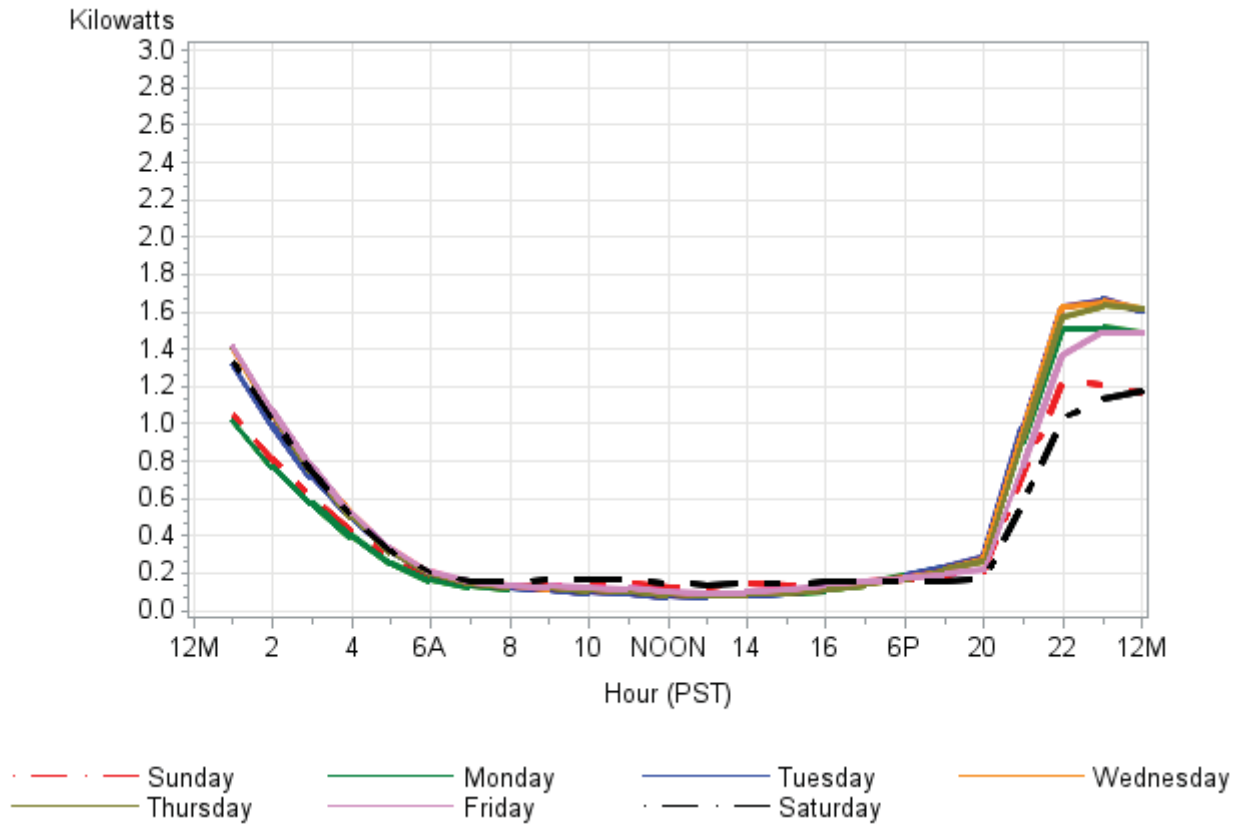
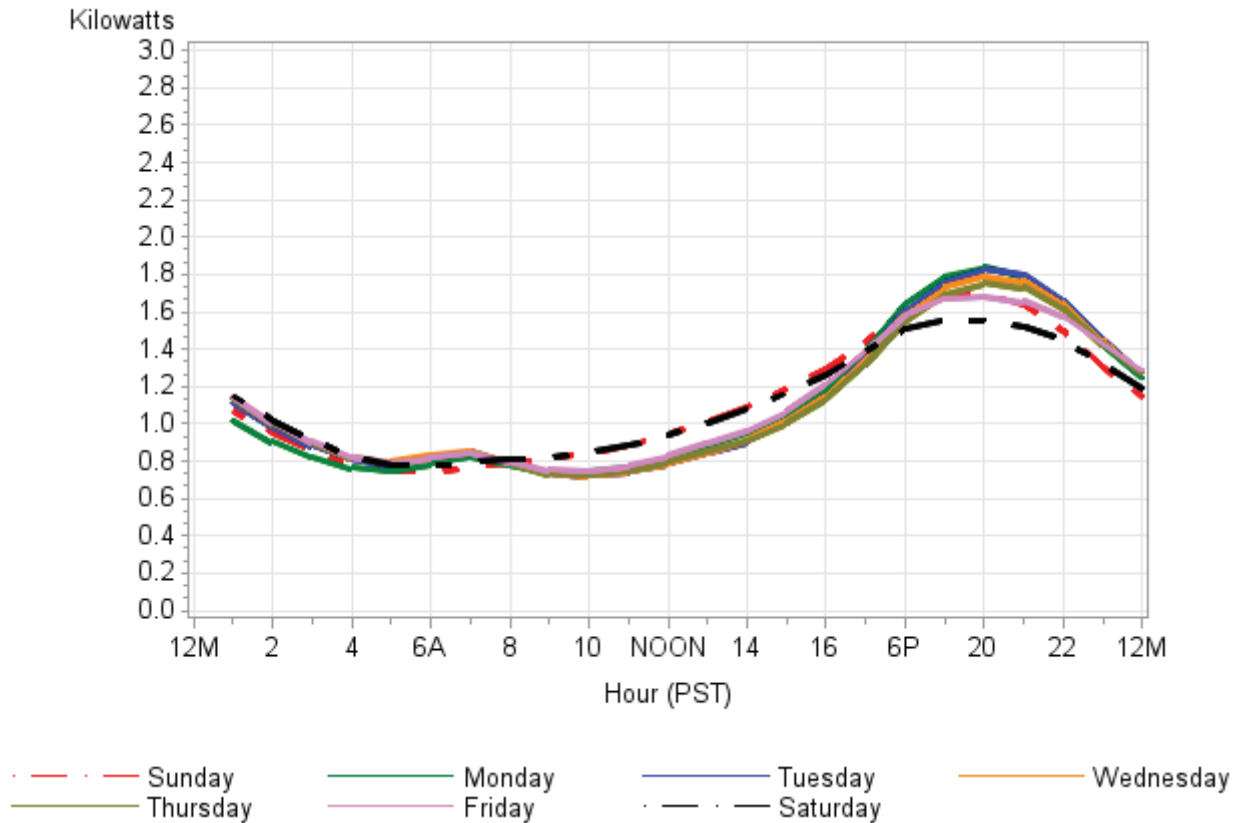


Chart SCE – 9 shows the load profile for a portion of the SF customers who are believed by SCE to own a PEV but choose to remain on the regular, tiered domestic rate. Their daytime demand begins to rise around 10:00 a.m. where it is 0.7 kW on weekdays and increases gradually until it peaks in the evening at 9:00 p.m. at about 1.8 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.

Chart SCE – 9: Single Meter, SF PEV Owners⁵⁰ 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 individual accounts with EVs. 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 7.6 kW in Table SCE – 9a is on average 4.2 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 9.2 kW in July to a low of 6.8 kW in March. The non-coincident demands for single-metered households are about twice as large as the non-

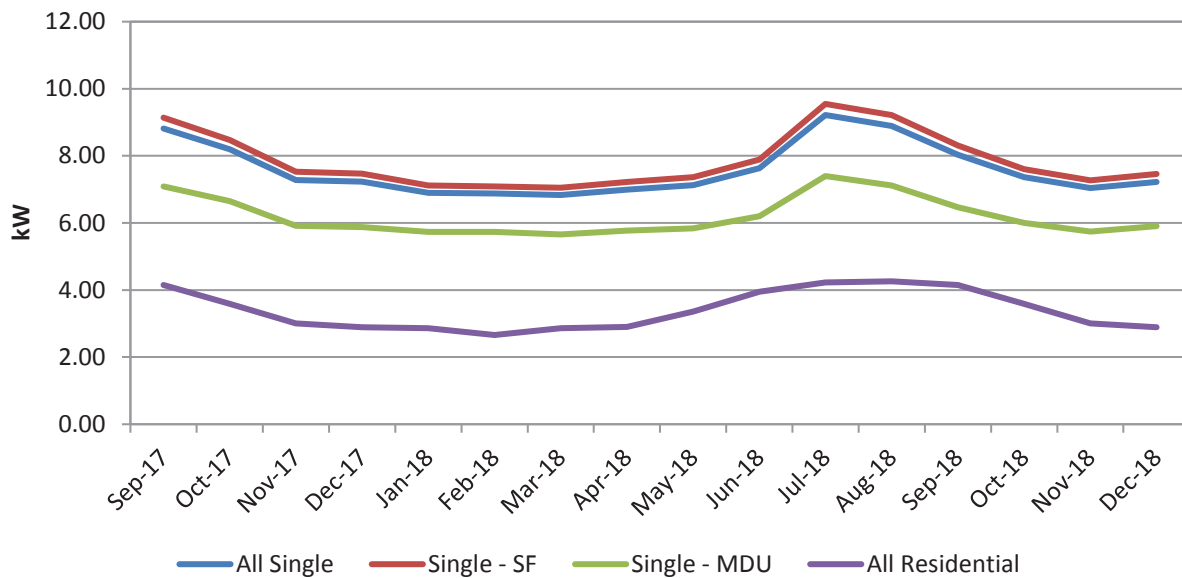
⁵⁰ 27,857 accounts on the regular Domestic rate schedule (including NEM customers) with load data between September 1, 2017, and December 31, 2018, and known to own a PEV.

coincident demands for general residential population. The general residential population, however, displays a similar seasonal variation in non-coincident demand levels.

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. 2017	4.15	4.91	3.02	8.82	9.14	7.09
Oct. 2017	3.59	4.17	2.74	8.19	8.47	6.65
Nov. 2017	3.01	3.41	2.41	7.28	7.52	5.91
Dec. 2017	2.89	3.18	2.47	7.23	7.47	5.88
Jan. 2018	2.86	3.07	2.55	6.90	7.12	5.74
Feb. 2018	2.66	2.87	2.36	6.87	7.08	5.73
Mar. 2018	2.86	3.12	2.46	6.83	7.05	5.66
Apr. 2018	2.90	3.23	2.40	7.00	7.22	5.77
May 2018	3.36	3.86	2.61	7.13	7.36	5.84
Jun. 2018	3.95	4.68	2.87	7.63	7.89	6.20
Jul. 2018	4.23	5.01	3.06	9.22	9.55	7.40
Aug. 2018	4.26	5.06	3.07	8.89	9.21	7.12
Sep. 2018	4.15	4.91	3.02	8.03	8.31	6.46
Oct. 2018	3.59	4.17	2.74	7.36	7.61	6.00
Nov. 2018	3.01	3.41	2.41	7.04	7.27	5.74
Dec. 2018	2.89	3.18	2.47	7.22	7.46	5.91

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 steady monthly non-coincident demand that was higher for the last half of 2018. The non-coincident demand averaged 8.4 kW from July 2018. This is consistent with the increased monthly usage seen in Chart SCE – 5. The increased demands may be the result of an influx of Tesla Model 3s which dominated the market in 2018 and charge at higher levels.

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

Month	Separate Metering
Sep. 2017	7.55
Oct. 2017	7.64
Nov. 2017	7.58
Dec. 2017	7.66
Jan. 2018	7.68
Feb. 2018	7.64
Mar. 2018	7.76
Apr. 2018	7.75
May 2018	8.01
Jun. 2018	8.20
Jul. 2018	8.34
Aug. 2018	8.38
Sep. 2018	8.46
Oct. 2018	8.47
Nov. 2018	8.48
Dec. 2018	8.44

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

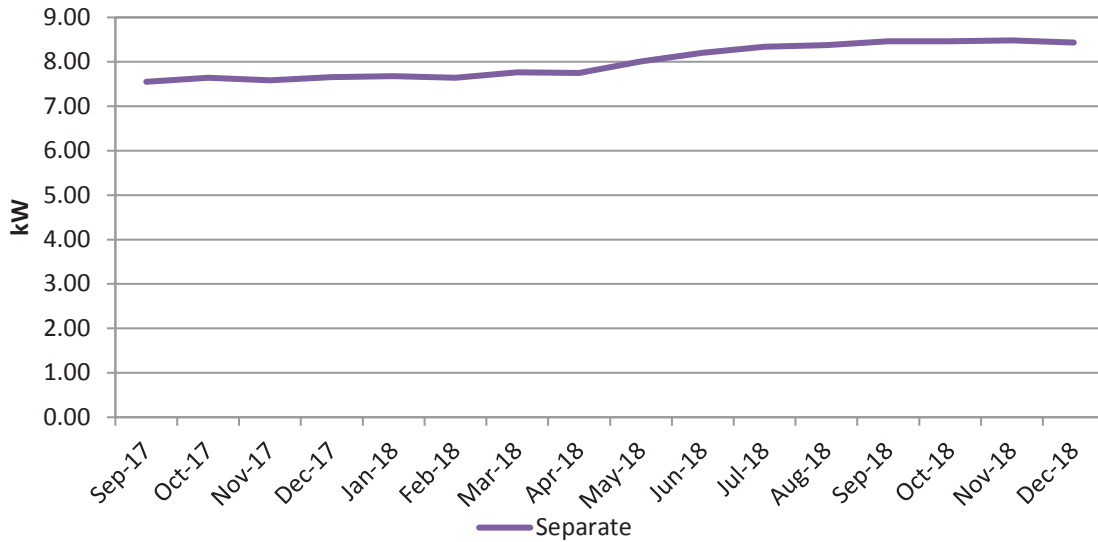
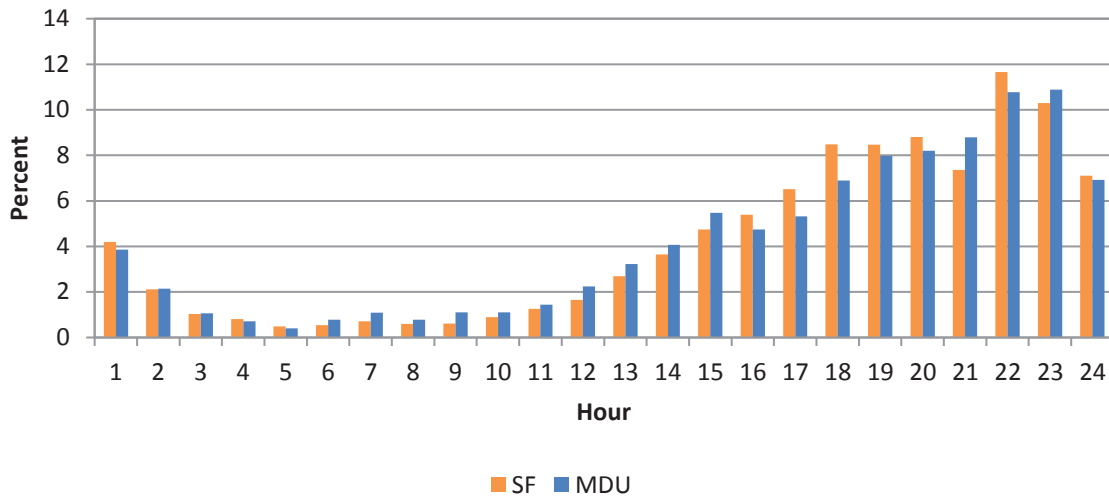


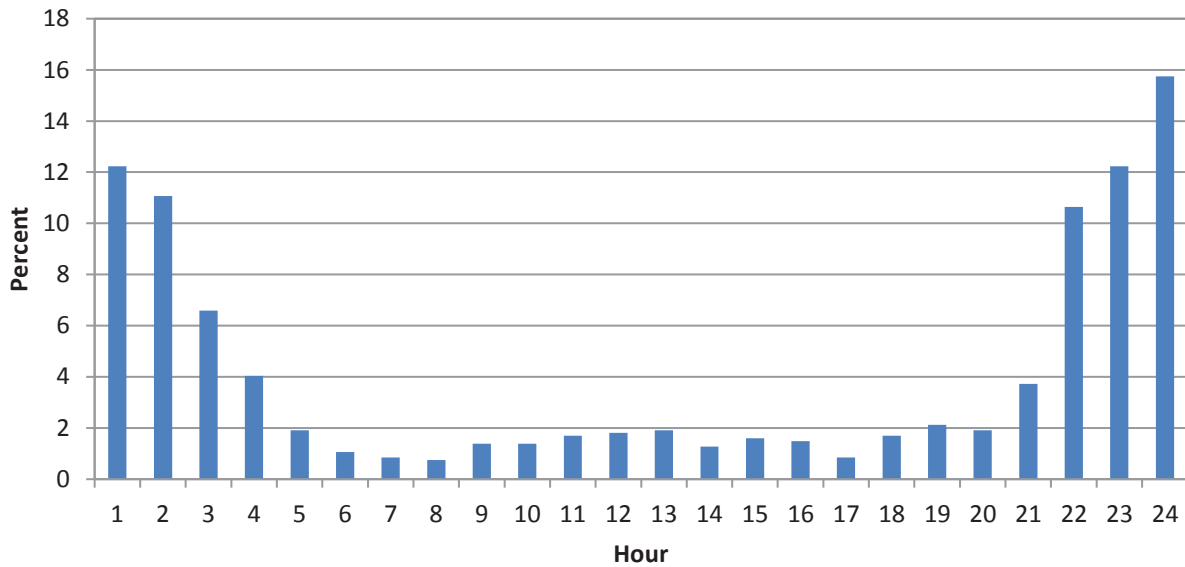
Chart SCE – 11a provides a contrast to the average hourly demands seen in the load profiles previously. For single-metered households, while the average demand is highest during the off-peak hours in the early morning, the hour of the annual non-coincident peak most frequently occurs in the evening. 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 15% 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%	0%	1%	4%	4%	4%	12%
2	0%	0%	0%	2%	2%	2%	11%
3	0%	0%	0%	1%	1%	1%	7%
4	0%	0%	1%	1%	1%	1%	4%
5	0%	0%	0%	0%	0%	0%	2%
6	0%	0%	1%	1%	1%	1%	1%
7	1%	1%	1%	1%	1%	1%	1%
8	1%	1%	2%	1%	1%	1%	1%
9	1%	1%	2%	1%	1%	1%	1%
10	2%	2%	3%	1%	1%	1%	1%
11	3%	2%	4%	1%	1%	1%	2%
12	4%	4%	4%	2%	2%	2%	2%
13	6%	6%	6%	3%	3%	3%	2%
14	9%	10%	7%	4%	4%	4%	1%
15	9%	10%	7%	5%	5%	5%	2%
16	9%	10%	9%	5%	5%	5%	1%
17	10%	10%	9%	6%	7%	5%	1%
18	9%	9%	9%	8%	8%	7%	2%
19	9%	9%	10%	8%	8%	8%	2%
20	8%	8%	8%	9%	9%	8%	2%
21	7%	7%	7%	8%	7%	9%	4%
22	4%	4%	4%	12%	12%	11%	11%
23	3%	2%	3%	10%	10%	11%	12%
24	1%	1%	2%	7%	7%	7%	16%

Average Diversified Peak Load and Timing

In the general population, 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 occurring between 10 p.m. and 1:00 a.m. The presumed 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. 2017	2.37	16	2.89	16	1.49	15
Oct. 2017	1.82	17	2.17	17	1.22	19
Nov. 2017	1.27	15	1.51	16	0.85	15
Dec. 2017	1.12	21	1.29	21	0.80	21
Jan. 2018	1.14	19	1.30	19	0.87	20
Feb. 2018	1.04	20	1.17	20	0.79	20
Mar. 2018	0.99	19	1.13	19	0.74	19
Apr. 2018	1.10	17	1.28	17	0.79	17
May 2018	1.44	17	1.74	17	0.94	17
Jun. 2018	2.01	17	2.48	17	1.21	18
Jul. 2018	2.21	15	2.70	15	1.39	15
Aug. 2018	2.38	17	2.93	17	1.46	17
Sep. 2018	2.37	16	2.89	16	1.49	15
Oct. 2018	1.82	17	2.17	17	1.22	19
Nov. 2018	1.27	15	1.51	16	0.85	15
Dec. 2018	1.12	21	1.29	21	0.80	21

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. 2017	2.55	24	2.66	24	1.98	24
Oct. 2017	2.40	24	2.50	24	1.90	24
Nov. 2017	2.13	1	2.21	1	1.67	1
Dec. 2017	2.21	1	2.30	1	1.75	1
Jan. 2018	2.14	1	2.21	1	1.73	1
Feb. 2018	2.20	1	2.28	1	1.79	1
Mar. 2018	2.11	24	2.19	24	1.70	24
Apr. 2018	2.13	24	2.21	24	1.70	24
May 2018	2.16	24	2.24	24	1.72	24
Jun. 2018	2.25	22	2.34	22	1.75	23
Jul. 2018	3.00	22	3.12	22	2.35	22
Aug. 2018	2.91	22	3.03	22	2.28	22
Sep. 2018	2.42	22	2.52	22	1.88	22
Oct. 2018	2.19	24	2.27	24	1.75	24
Nov. 2018	2.01	1	2.08	1	1.59	1
Dec. 2018	2.15	23	2.23	23	1.68	1

Average monthly diversified peak loads for separately-metered PEVs is 1.6 kW with the peaks occurring between 10:00 and 11:00 p.m. This indicates a significant amount of diversity in charging as the non-coincident peak loads were 8.0 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. 2017	1.57	22
Oct. 2017	1.65	22
Nov. 2017	1.60	23
Dec. 2017	1.48	23
Jan. 2018	1.63	23
Feb. 2018	1.63	23
Mar. 2018	1.51	23
Apr. 2018	1.61	22
May 2018	1.63	24
Jun. 2018	1.59	24
Jul. 2018	1.61	24
Aug. 2018	1.71	22
Sep. 2018	1.67	22
Oct. 2018	1.77	22
Nov. 2018	1.70	23
Dec. 2018	1.59	23

Average Load Coincident With System Peak

The average load coincident with system peak is the average load of the group 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 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 2018 through August 2018 of the table is from 2017 and thus the peak loads and hours differ from those in 2018.

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. 2017	2.27	2.77	1.42	2.97	3.09	2.31
Oct. 2017	1.81	2.17	1.18	2.77	2.89	2.12
Nov. 2017	1.06	1.26	0.70	1.80	1.89	1.32
Dec. 2017	0.91	1.09	0.61	1.54	1.62	1.09
Jan. 2018	1.10	1.25	0.83	1.58	1.65	1.19
Feb. 2018	1.02	1.15	0.77	1.43	1.50	1.08
Mar. 2018	0.95	1.09	0.71	1.45	1.51	1.13
Apr. 2018	1.00	1.17	0.70	1.31	1.35	1.09
May 2018	1.29	1.56	0.83	1.14	1.18	0.94
Jun. 2018	1.90	2.33	1.15	1.70	1.76	1.38
Jul. 2018	2.15	2.64	1.32	3.27	3.40	2.53
Aug. 2018	2.32	2.86	1.40	2.66	2.77	2.09
Sep. 2018	2.27	2.77	1.42	1.77	1.84	1.37
Oct. 2018	1.81	2.17	1.18	1.69	1.75	1.34
Nov. 2018	1.06	1.26	0.70	1.08	1.11	0.87
Dec. 2018	0.91	1.09	0.61	1.59	1.67	1.17

Table SCE – 11a cont’d shows the average load coincident with system peak for accounts that have a PEV and are NEM or DR. In comparison to all single-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. 2017	2.20	2.57
Oct. 2017	2.60	2.60
Nov. 2017	2.12	1.62
Dec. 2017	1.74	1.36
Jan. 2018	1.80	1.37
Feb. 2018	1.65	1.27
Mar. 2018	1.68	1.30
Apr. 2018	1.01	1.17
May 2018	0.81	1.04
Jun. 2018	1.36	1.61
Jul. 2018	2.70	3.38
Aug. 2018	2.00	2.86
Sep. 2018	1.38	1.75
Oct. 2018	1.42	1.57
Nov. 2018	0.84	0.92
Dec. 2018	1.81	1.44

Table SCE – 11b corroborates 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. 2017	0.12
Oct. 2017	0.10
Nov. 2017	0.21
Dec. 2017	0.13
Jan. 2018	0.20
Feb. 2018	0.19
Mar. 2018	0.20
Apr. 2018	0.13
May 2018	0.12
Jun. 2018	0.23
Jul. 2018	0.18
Aug. 2018	0.08
Sep. 2018	0.18
Oct. 2018	0.09
Nov. 2018	0.15
Dec. 2018	0.14

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, 59% 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 Zone⁵¹ as Compared to Residential Population

Climate	Zone(s)	Residential Population*	Single Meter	Separate Meter
mild	5, 6, 8, 16	45%	59%	55%
moderate/hot	9, 10, 13, 14, 15	55%	41%	44%

*Percentages are based on residential customers at the end of February 2019.

⁵¹ SCE’s baseline information can be found at: <http://www.sce.com/NR/sc3/tm2/pdf/ce63map.pdf>.

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

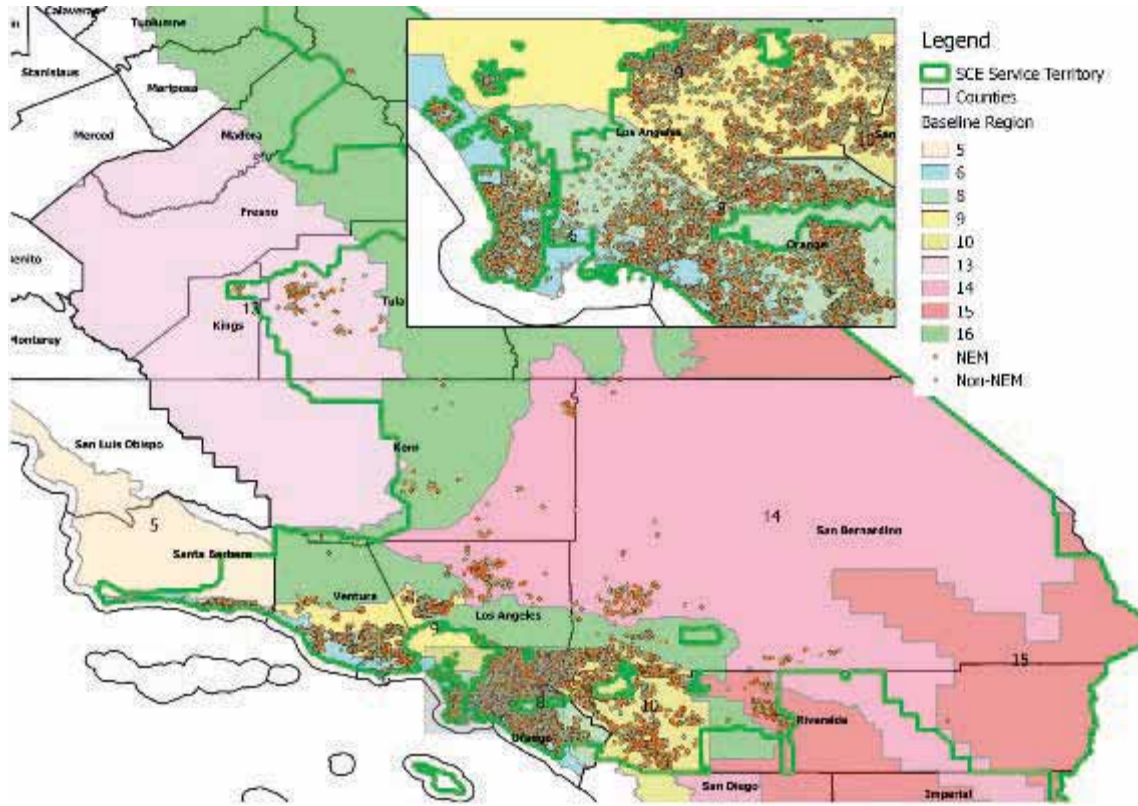
- Their socio-demographic attributes such as income, education, and housing type correlate with those of coastal dwellers.
- Coastal dwellers have less air conditioning load, which may make them less resistant to TOU rates and their higher on-peak prices.
- Residents in the more densely populated zones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

Nearly the same zip codes maintain the greatest prevalence of PEVs as in the previous report. Table SCE 12 – b shows that Irvine has replaced Manhattan Beach as the top zip code by prevalence for single-metered households. Irvine also added another zip code and Yorba Linda made the list, bumping Newport Beach as the fifth highest number of PEVs by zip code. For separately-metered PEVs, Santa Monica zip code 90402 still remains the zip code with the most separately-metered PEVs, with 30 accounts. Calabasas remains in the top five, having increased by 2 accounts. Los Alamitos still has 16 accounts and remains in the fourth rank joined by Altadena, San Marino, and Santa Clarita. The two beach communities of Laguna Beach and Palos Verdes Peninsula fill out the remainder of the top five most populous zip codes.

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	92620	Irvine	457
	90266	Manhattan Beach	411
	90275	Rancho Palos Verdes	390
	92618	Irvine	345
	92886	Yorba Linda	332
Separate Meter	90402	Santa Monica	30
	91302	Calabasas	20
	90401	Santa Monica	19
	90720, 91001, 91108, 91354, 92651	Los Alamitos, Altadena, San Marino, Santa Clarita, Laguna Beach	16
	90274, 91011	Palos Verdes Peninsula, La Canada Flintridge	15

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



San Diego Gas and Electric

SDG&E offers residential customers four rates with two different meter configurations for PEV owners. First, single-meter (i.e. whole-house) captures load associated with both the PEV and the whole house on a single meter. Single-meter rates include EV-TOU-2, which also includes a grandfathered version EV-TOU-2 (GF) reflecting prior TOU periods, and EV-TOU-5 which includes a \$16 fixed monthly fee. Second, is one separately-metered rate EV-TOU which captures load associated with EV charging only. SDG&E is only reporting on customers on three of these rates and will not include EV-TOU-5. EV-TOU-5 was introduced at the end of 2018, hence there is insufficient data to warrant inclusion of load profiles and monthly consumption levels. A rate description for EV-TOU-5 is included, and those customers are part of the total single-meter record counts. SDG&E estimates that approximately 63% of its PEV population are not on these four rates. The rates provided below were effective July 1, 2018 through September 30, 2018. SDG&E does not currently offer a commercial EV rate option. Table 1a provides the TOU periods for the four rates and their respective seasonal prices per kWh.

SDG&E Table 1a: Tariff (\$/kWh)⁵²

Tariff	TOU	Day type	Summer Period	Winter Period	Summer Price	Winter Price
EV-TOU	Super Off-peak	Weekday	Midnight to 6am	Midnight to 6am. 10am to 2pm in March and April	0.23	0.23
		Weekend/Holiday	Midnight to 2pm	Midnight to 2pm		
	On-Peak	Weekday/weekend /Holiday	4pm to 9pm	4pm to 9pm	0.53	0.25
	Off-Peak	Weekday/weekend /Holiday	All Other Hours	All Other Hours	0.28	0.24
EV-TOU-2	Super Off-peak	Weekday	Midnight to 6am	Midnight to 6am. 10am to 2pm in March and April	0.23	0.23
		Weekend/Holiday	Midnight to 2pm	Midnight to 2pm		
	On-Peak	Weekday/weekend /Holiday	4pm to 9pm	4pm to 9pm	0.53	0.25
	Off-Peak	Weekday/weekend /Holiday	All Other Hours	All Other Hours	0.28	0.24
EV-TOU-5	Super Off-peak	Weekday	Midnight to 6am	Midnight to 6am. 10am to 2pm in March and April	0.09	0.09
		Weekend/Holiday	Midnight to 2pm	Midnight to 2pm		
	On-Peak	Weekday/weekend /Holiday	4pm to 9pm	4pm to 9pm	0.52	0.24
	Off-Peak	Weekday/weekend /Holiday	All Other Hours	All Other Hours	0.28	0.23
EV-TOU-2 (GF)	Super Off-peak	Weekday/weekend /Holiday	Midnight to 5am	Midnight to 5am	0.23	0.23
	On-Peak	Weekday/weekend	Noon to 6pm	Noon to 6pm	0.39	0.24
	Off-Peak	Weekday/weekend /Holiday	All Other Hours	All Other Hours	0.36	0.24

⁵² Based on rates effective November 1, 2018.

Table 1b provides the price ratios between the different TOU periods for each rate. All four 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
EV-TOU	1.04:1	1.08:1	1.25:1	2.34:1
EV-TOU-2	1.04:1	1.08:1	1.25:1	2.34:1
EV-TOU-5	2.48:1	2.58:1	3.01:1	5.68:1
EV-TOU-2 (GF)	1.04:1	1.04:1	1.60:1	1.71:1

SDG&E Single-Meter PEV Rates

EV TOU-2:

The EV-TOU-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.

EV-TOU-2 (GF):

The EV-TOU-2 (GF) rate, which is the grandfathered version of the EV-TOU-2 rate has the same design criteria as the EV-TOU-2 rate, but with different TOU periods and pricing. This rate is comprised of NEM customers who opted into a TOU tariff prior to July 31, 2017.

EV-TOU-5:

The EV-TOU-5 rate also has the same design criteria as the EV-TOU-2 rate. It has the same TOU periods as the EV-TOU-2 rates, but with different pricing. The main difference is that customers under this rate pay a \$16 monthly fixed charge, and subsequently have a much lower super off-peak price.

Please note that the current information drawn from these subgroups is preliminary and any judgments and/or policy decisions made from this information would be premature. As can be seen from 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 2017, the number of customers taking service under the single-meter rates has grown by 38%.

SDG&E Table 2a: NEM and DR Program Enrollment for EV-TOU-2 Rate

Month	Total Customers on EV-TOU-2	Total Customers on NEM	NEM as a % of EV-TOU-2	Total Customers on DR	DR as a % of EV-TOU-2
Sep2017	10349	3607	34.85%	1948	18.82%
Oct2017	10561	3693	34.97%	1992	18.86%
Nov2017	10734	3781	35.22%	2046	19.06%
Dec2017	7855	823	10.48%	1340	17.06%
Jan2018	8108	929	11.46%	1400	17.27%
Feb2018	8340	1022	12.25%	1434	17.19%
Mar2018	8718	1175	13.48%	1514	17.37%
Apr2018	9049	1288	14.23%	1589	17.56%
May2018	9412	1443	15.33%	1655	17.58%
Jun2018	9662	1580	16.35%	1710	17.70%
Jul2018	9765	1655	16.95%	1747	17.89%
Aug2018	9729	1719	17.67%	1753	18.02%
Sep2018	9614	1779	18.50%	1730	17.99%
Oct2018	9522	1835	19.27%	1710	17.96%
Nov2018	9303	1873	20.13%	1652	17.76%
Dec2018	9092	1927	21.19%	1581	17.39%

SDG&E Table 2b: NEM and DR Program Enrollment for EV-TOU-2 (GF) Rate⁵³

Month	Total Customers on EV-TOU-2 (GF)	Total Customers on NEM	NEM as a % of EV-TOU-2 (GF)	Total Customers on DR	DR as a % of EV-TOU-2 (GF)
Dec2017	3068	3068	100.00%	762	24.84%
Jan2018	3055	3055	100.00%	762	24.94%
Feb2018	3031	3031	100.00%	738	24.35%
Mar2018	3006	3006	100.00%	734	24.42%
Apr2018	2978	2978	100.00%	735	24.68%
May2018	2953	2953	100.00%	739	25.03%
Jun2018	2926	2926	100.00%	739	25.26%
Jul2018	2894	2894	100.00%	737	25.47%
Aug2018	2861	2861	100.00%	730	25.52%
Sep2018	2787	2787	100.00%	719	25.80%
Oct2018	2728	2728	100.00%	705	25.84%
Nov2018	2665	2665	100.00%	685	25.70%
Dec2018	2616	2616	100.00%	666	25.46%

SDG&E Table 2c: NEM and DR Program Enrollment for Single-Meter Rates⁵⁴

Month	Total Customers on Single-Meter	Total Customers on NEM	NEM as a % of Single-Meter	Total Customers on DR	DR as a % of Single-Meter
Sep2017	10349	3607	34.85%	1948	18.82%
Oct2017	10561	3693	34.97%	1992	18.86%
Nov2017	10734	3781	35.22%	2046	19.06%
Dec2017	10923	3891	35.62%	2102	19.24%
Jan2018	11163	3984	35.69%	2162	19.37%
Feb2018	11371	4053	35.64%	2172	19.10%
Mar2018	11724	4181	35.66%	2248	19.17%
Apr2018	12027	4266	35.47%	2324	19.32%
May2018	12365	4396	35.55%	2394	19.36%
Jun2018	12588	4506	35.80%	2449	19.46%
Jul2018	12744	4557	35.76%	2493	19.56%
Aug2018	13038	4660	35.74%	2551	19.57%
Sep2018	13359	4763	35.65%	2611	19.54%
Oct2018	13635	4874	35.75%	2649	19.43%
Nov2018	13897	5009	36.04%	2683	19.31%
Dec2018	14271	5181	36.30%	2724	19.09%

The research presented herein analyzes usage patterns of customers on EV rates, whose characteristics (including consumption patterns) are often markedly different from the general

⁵³ Count for EV-TOU-2 (GF) starts from December 2017.

⁵⁴ Count includes EV-TOU-5. No load data provided for the Rate due to insufficient data.

population, for example, 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 about 11%, while NEM customers represent approximately 36% of the single-meter PEV rate class (as seen in Table 2c). SDG&E believes that customers with PV systems tend to be more affluent with higher monthly consumption and greater awareness and 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 16 months. Prior years had seen expansive growth, which was attributed to more aggressive recruitment strategies.

SDG&E Separate-Meter PEV Rate (EV-TOU):

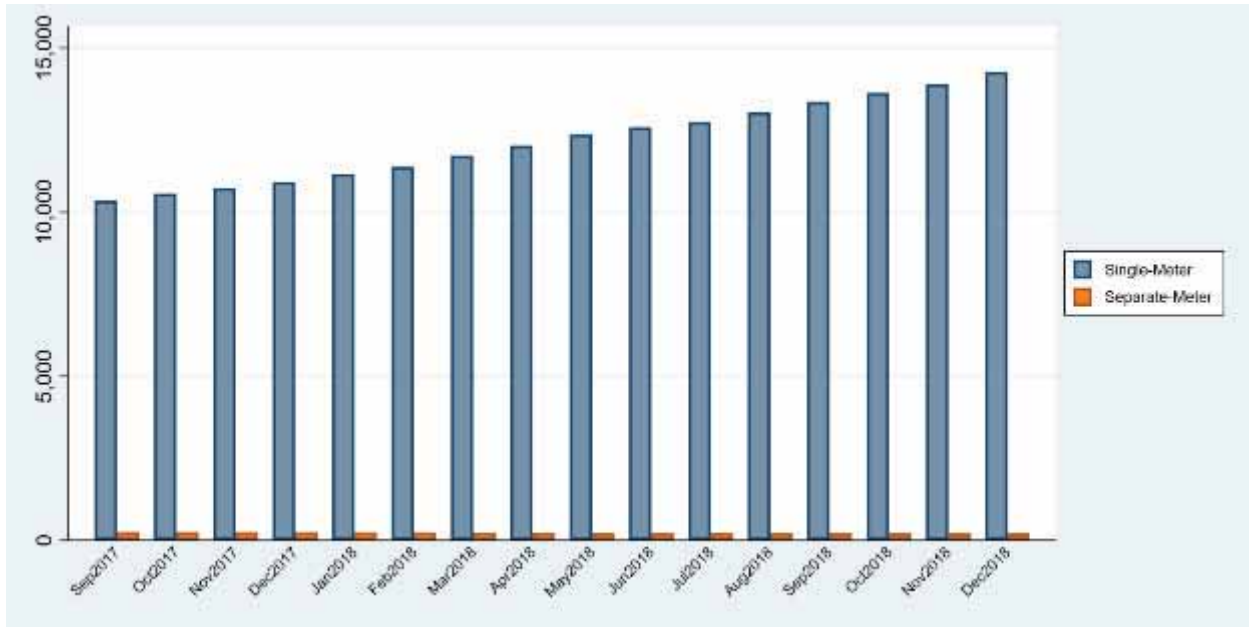
EV-TOU:

The EV-TOU rate option is designed for residential customers that have their PEV load on a dedicated meter. This is an optional rate for residential customers who require service for charging of a currently registered 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.

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
Sep2017	243	94	38.68%	38	15.64%
Oct2017	241	93	38.59%	40	16.60%
Nov2017	241	94	39.00%	41	17.01%
Dec2017	239	94	39.33%	41	17.15%
Jan2018	237	96	40.51%	41	17.30%
Feb2018	234	94	40.17%	38	16.24%
Mar2018	229	90	39.30%	38	16.59%
Apr2018	226	89	39.38%	37	16.37%
May2018	223	86	38.57%	36	16.14%
Jun2018	221	86	38.91%	36	16.29%
Jul2018	224	85	37.95%	36	16.07%
Aug2018	222	84	37.84%	36	16.22%
Sep2018	219	82	37.44%	36	16.44%
Oct2018	217	83	38.25%	36	16.59%
Nov2018	215	85	39.53%	36	16.74%
Dec2018	216	87	40.28%	37	17.13%

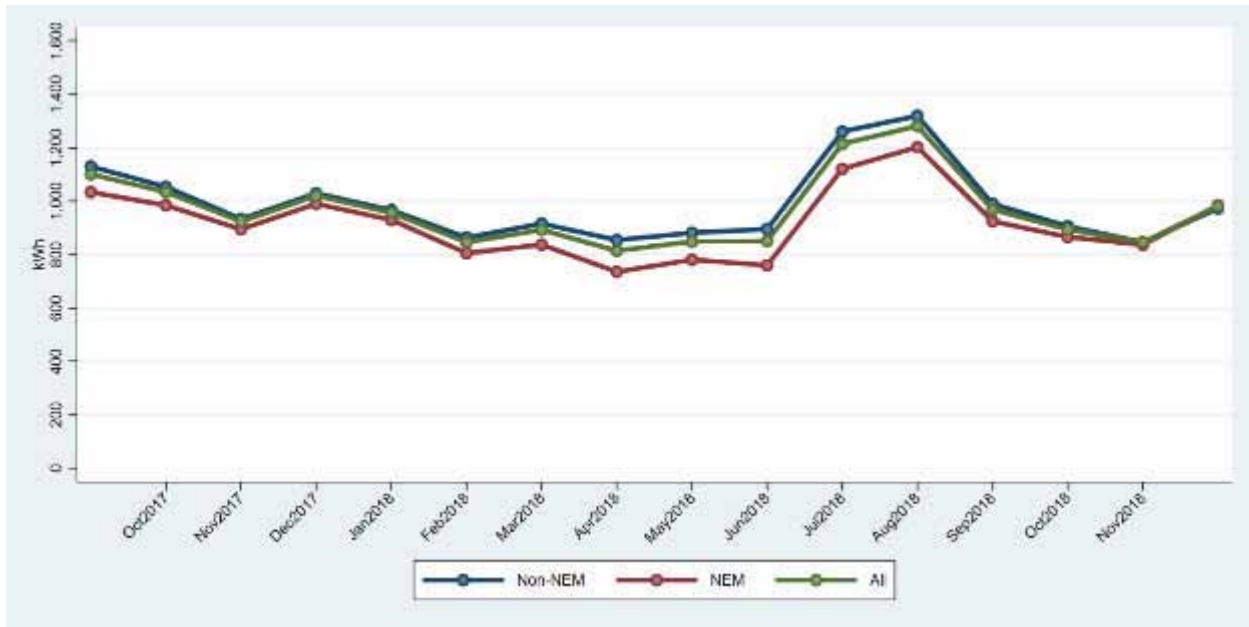
SDG&E Chart 1: Number of PEV Customers over Time by Meter Configuration



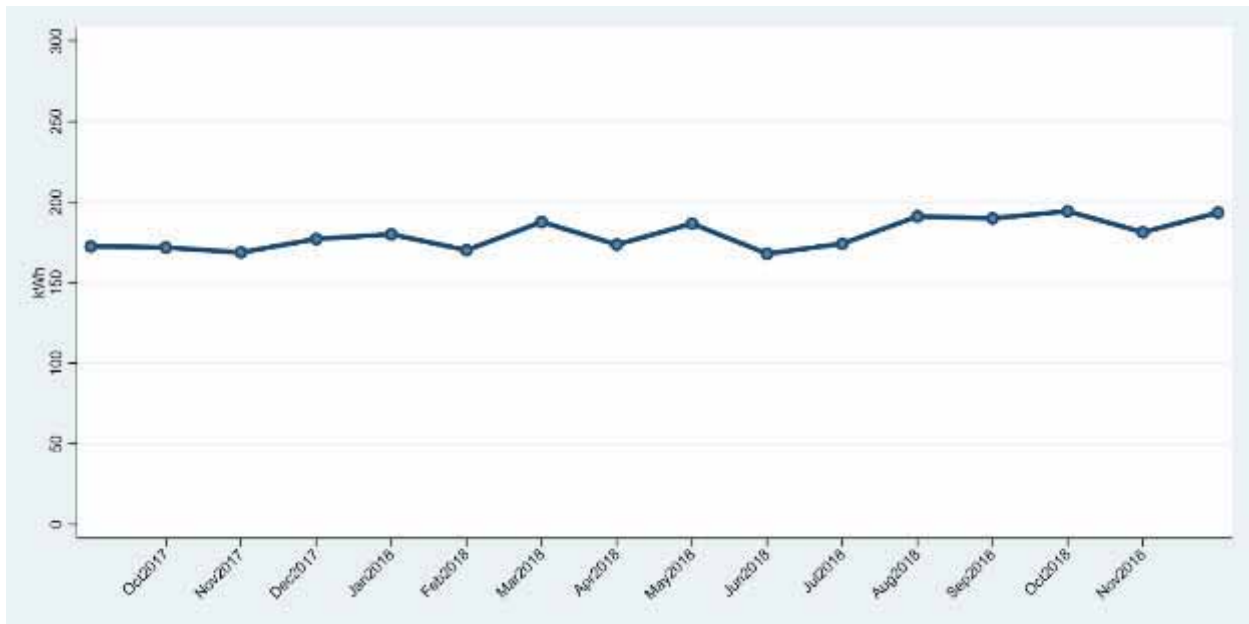
Looking at Table 3 and Chart 1, we can see that the number of customers taking service under these separate-metered rates have decreased slowly over the past 12 months.

NEM penetration is slightly higher in the separately-metered rates compared to single-meter customers. Roughly 39% of separate-meter EV customers had solar generation on their house meter compared to 36% 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 single-meter customers is a little less than double the average residential customer load of 445 kWh per month. Chart 2 and Chart 3 are included for comparison purposes. 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 23% and applies to 36% of the single-meter 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-Meter				Separate-Meter
		EV-TOU-2 Non-NEM	EV-TOU-2 NEM	EV-TOU-2 Total	GEVTOU2 Total	EVTU
2017	9	23.84%	26.98%	24.87%		5.20%
2017	10	24.22%	28.74%	25.73%		4.51%
2017	11	24.28%	29.79%	26.16%		5.80%
2017	12	25.03%	28.80%	25.44%	14.74%	7.99%
2018	1	23.97%	27.61%	24.40%	12.69%	7.40%
2018	2	22.93%	26.48%	23.36%	10.04%	7.01%
2018	3	21.70%	22.98%	21.86%	7.11%	7.66%
2018	4	21.44%	21.39%	21.43%	4.89%	7.81%
2018	5	21.19%	20.58%	21.11%	5.88%	6.79%
2018	6	21.36%	20.86%	21.29%	5.63%	6.66%
2018	7	24.34%	26.17%	24.62%	12.69%	7.10%
2018	8	24.47%	26.58%	24.82%	13.03%	7.88%
2018	9	23.08%	24.77%	23.37%	10.22%	8.08%
2018	10	22.10%	23.84%	22.42%	9.19%	8.85%
2018	11	23.57%	27.49%	24.35%	13.35%	9.54%
2018	12	24.59%	27.92%	25.29%	15.52%	10.50%

One of the questions answered here is whether being on a TOU rate is effective in deterring 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. EV-TOU-2 (GF) customers consume slightly over 50% of their energy during the off-peak TOU period and split the rest between on-peak and super off-peak at approximately 10% and 36% respectively. Total EV-TOU-2 customers consume approximately 36% of their energy during the off-peak TOU period and split the rest between on-peak and super off-peak at approximately 24% and 40% respectively. NEM EV-TOU-2 customers respond fairly well to the signal created by the TOU price differential and consume on average about 45% of their energy during the super off-peak TOU period. Separate-Meter customers respond very well to the signal created by the TOU price differential and consume on average almost 80% 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-Meter				Separate-Meter
		EV-TOU-2 Non-NEM	EV-TOU-2 NEM	EV-TOU-2 Total	GEVTOU2 Total	EVTU
2017	9	38.85%	28.95%	35.60%		11.63%
2017	10	39.27%	29.24%	35.93%		10.80%
2017	11	37.73%	28.40%	34.55%		12.41%
2017	12	37.22%	28.97%	36.32%	52.59%	13.06%
2018	1	38.22%	30.03%	37.26%	53.20%	13.95%
2018	2	38.37%	28.43%	37.17%	53.11%	12.89%
2018	3	30.36%	27.49%	29.99%	54.16%	11.30%
2018	4	30.39%	27.73%	30.05%	54.29%	10.60%
2018	5	40.02%	30.40%	38.68%	53.35%	12.42%
2018	6	40.26%	29.69%	38.74%	53.11%	13.97%
2018	7	41.12%	32.49%	39.77%	54.75%	13.91%
2018	8	42.59%	32.76%	40.99%	54.56%	16.37%
2018	9	38.18%	29.50%	36.67%	54.45%	15.06%
2018	10	39.78%	29.42%	37.86%	53.92%	16.33%
2018	11	37.98%	27.94%	36.00%	51.61%	17.23%
2018	12	37.74%	30.09%	36.12%	52.48%	18.48%

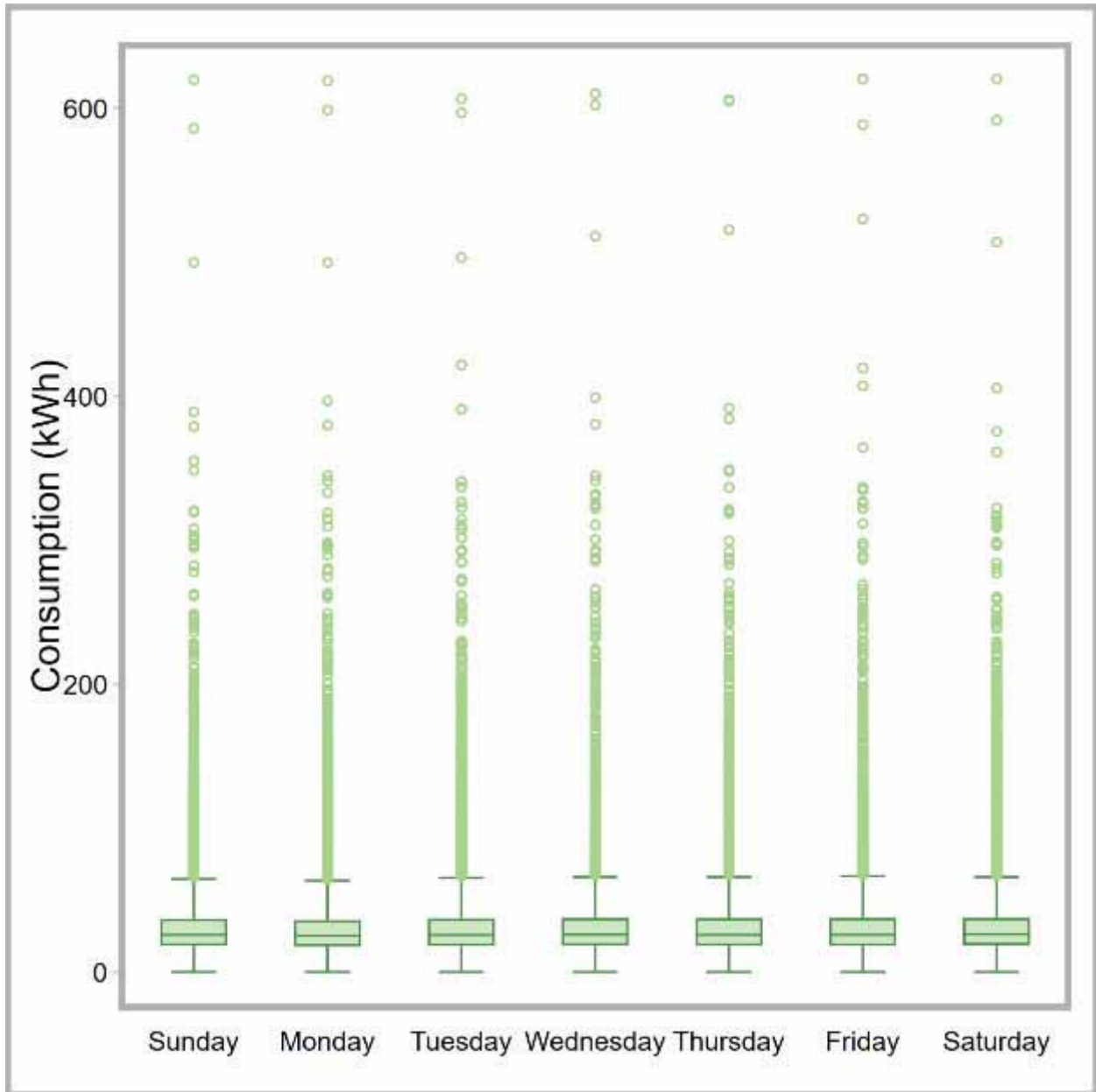
SDG&E Table 8: Percentage of Super Off-Peak Usage by Meter Configuration

Year	Month	Single-Meter				Separate-Meter
		EV-TOU-2 Non-NEM	EV-TOU-2 NEM	EV-TOU-2 Total	GEVTOU2 Total	EVTUO
2017	9	37.32%	44.07%	39.53%		83.17%
2017	10	36.51%	42.02%	38.35%		84.69%
2017	11	37.99%	41.81%	39.29%		81.80%
2017	12	37.75%	42.24%	38.24%	32.67%	78.95%
2018	1	37.81%	42.36%	38.34%	34.10%	78.65%
2018	2	38.70%	45.09%	39.47%	36.85%	80.10%
2018	3	47.95%	49.53%	48.15%	38.73%	81.04%
2018	4	48.17%	50.88%	48.52%	40.81%	81.59%
2018	5	38.79%	49.02%	40.22%	40.77%	80.79%
2018	6	38.37%	49.44%	39.96%	41.26%	79.37%
2018	7	34.54%	41.34%	35.60%	32.56%	78.98%
2018	8	32.93%	40.66%	34.20%	32.41%	75.75%
2018	9	38.74%	45.74%	39.96%	35.33%	76.86%
2018	10	38.12%	46.75%	39.72%	36.90%	74.82%
2018	11	38.44%	44.57%	39.65%	35.04%	73.23%
2018	12	37.68%	41.99%	38.59%	32.00%	71.02%

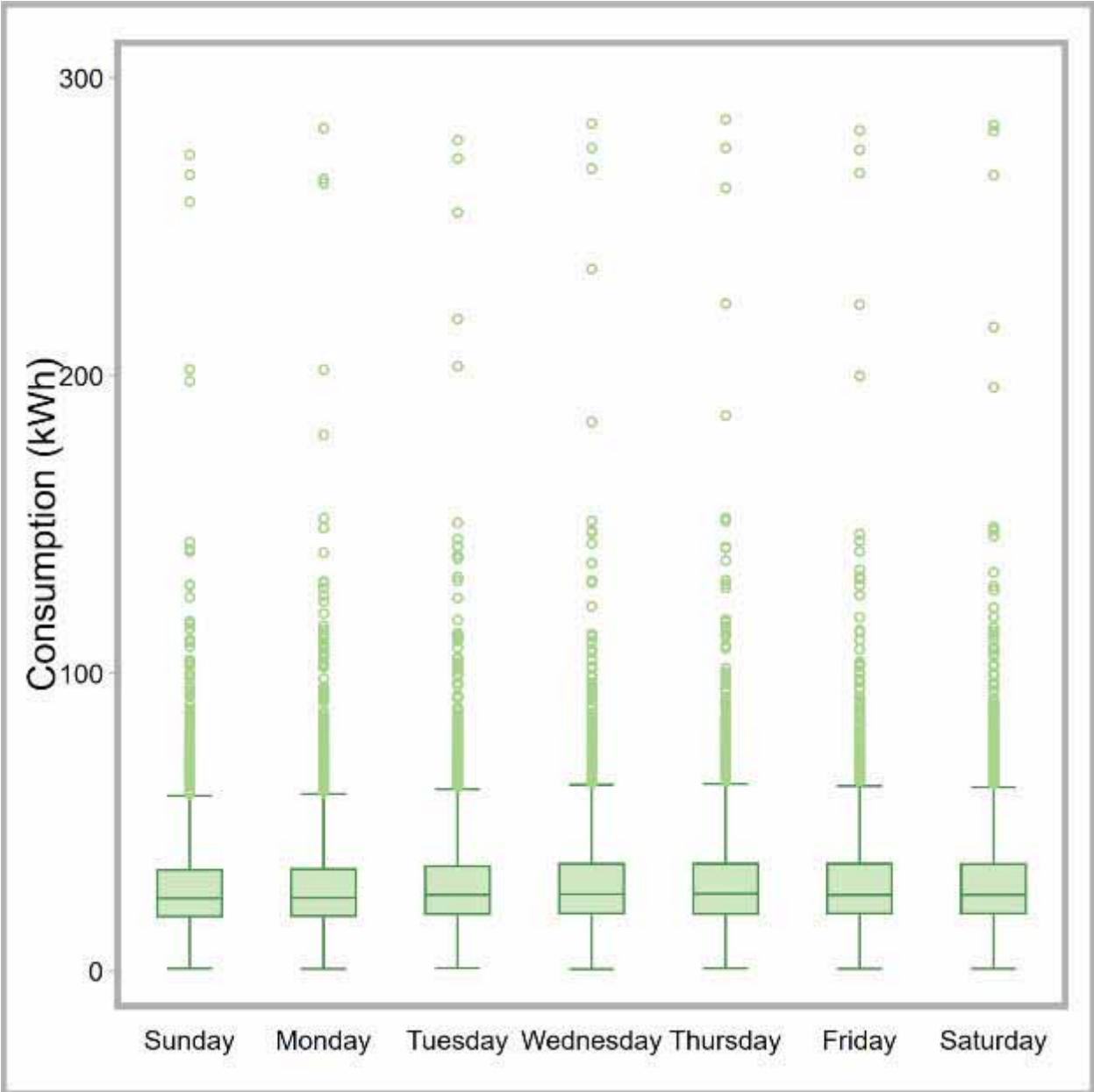
The box and whisker plots in Charts 6c and 6d show the distribution of customers’ average daily usage by day of the week for total single-meter and separate-meter customers. It can be seen by comparing charts 6c and 6d, that there is a lot of variation in the single-meter rate but not in the separate-meter 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 6d that Sunday and Monday have lower kWh on average than the rest of the week. When comparing chart 6a to 6b, EV-TOU-2 (GF) has much lower energy consumption for all days of the week when compared to EV-TOU-2. This is due to EV-TOU-2 (GF) being an all NEM rate, thus having consumption offset by PV generation.

We further explore this finding in the load profiles for each meter type in Chart 7 and 8 below.

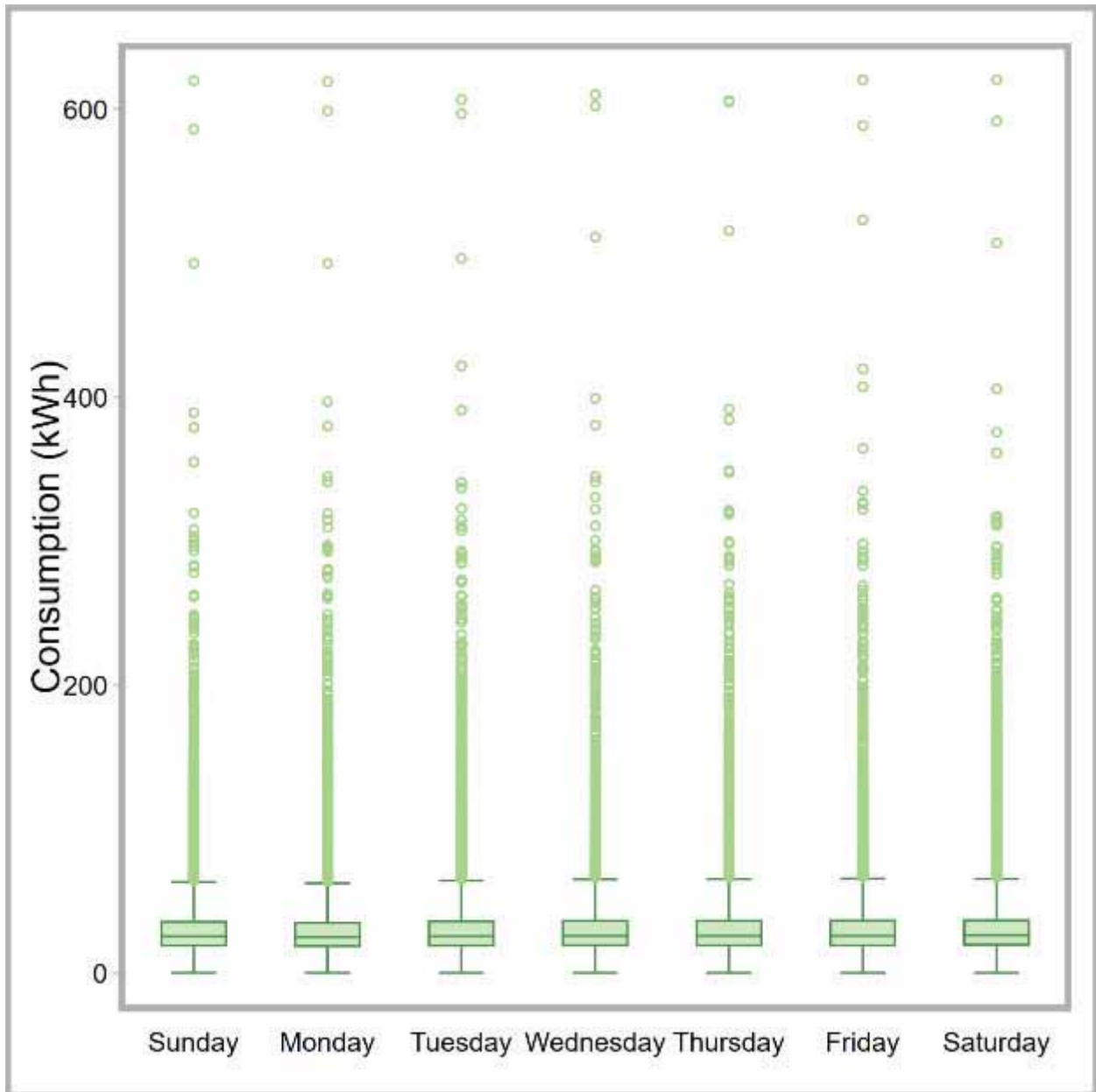
SDG&E Chart 6a: Box and Whisker Plot for EV-TOU-2 Energy Consumption by Day of the Week



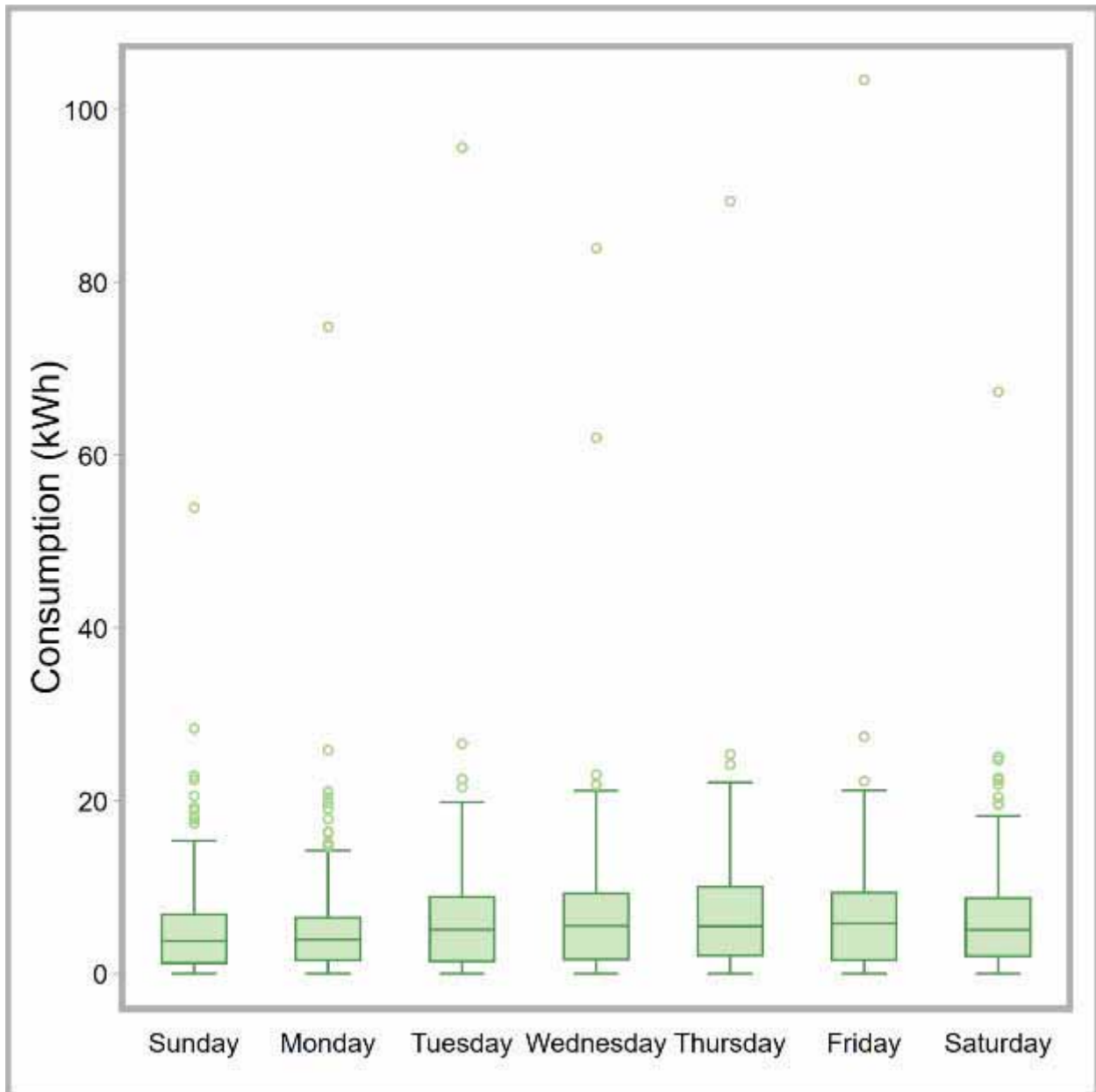
SDG&E Chart 6b: Box and Whisker Plot for EV-TOU-2 (GF) Energy Consumption by Day of the Week



SDG&E Chart 6c: Box and Whisker Plot for Single-Meter (EV-TOU-2 and EV-TOU-2 (GF)) Energy Consumption by Day of the Week



SDG&E Chart 6d: Box and Whisker Plot for Separate-Meter (EV-TOU) Energy Consumption by Day of the Week



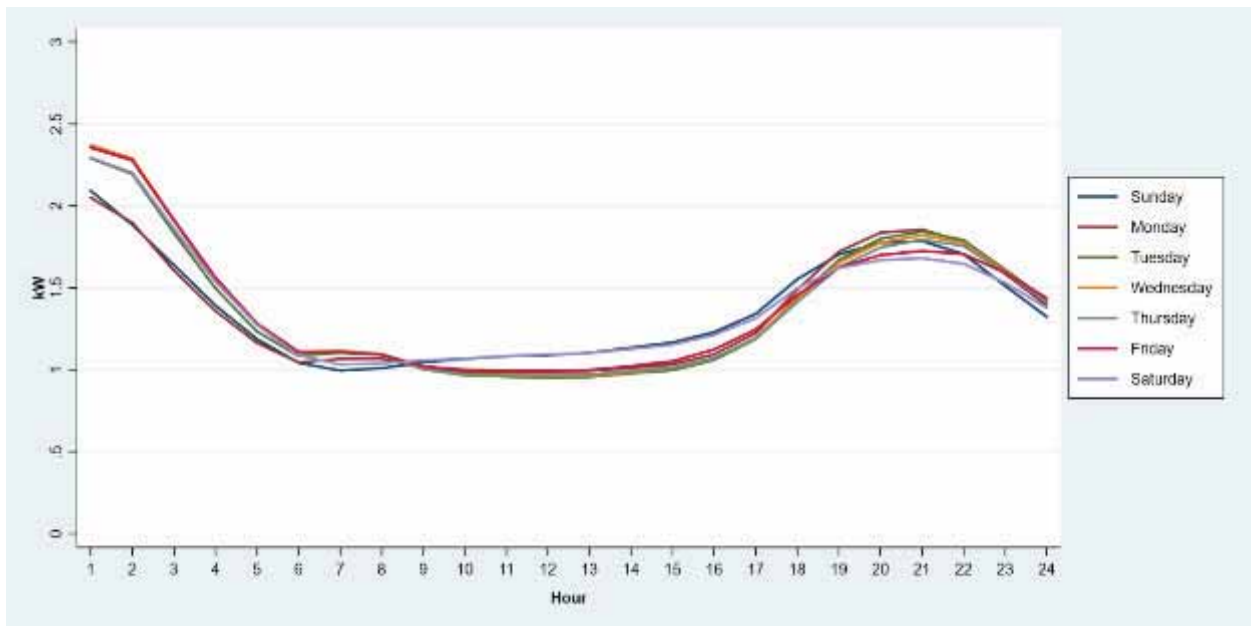
Average Load Profiles

Charts 7a through 7f look at the average load profiles for each day of the week for EV-TOU-2, EV-TOU-2 (GF), and the combination of the two on a net and delivered basis. The delivered load shapes for EV-TOU-2 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

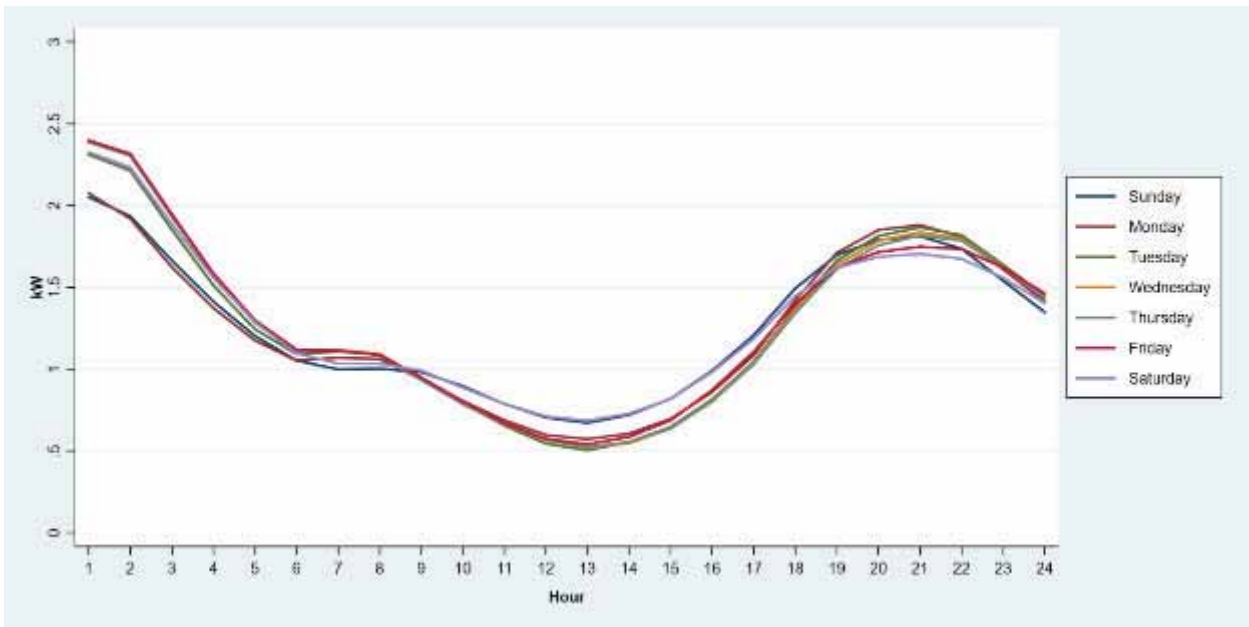
Mondays exhibit similar charging patterns. Since customers change their behavior to take advantage of super off-peak pricing, charging occurs in the early morning on the day after the vehicle was used (presumably driving to work Monday – Friday). If the electric vehicle sits idle during the weekend (Saturday and Sunday) significant charging is not conducted on Sunday and Monday. The net load shape shows an observable dip in the midday hours due to PV generation, as a result of high NEM penetration.

Both the net and delivered load shapes for EV-TOU-2 (GF) show the same due to all customers being NEM. The net shape, however, dips below zero as customers over generate and export to the grid.

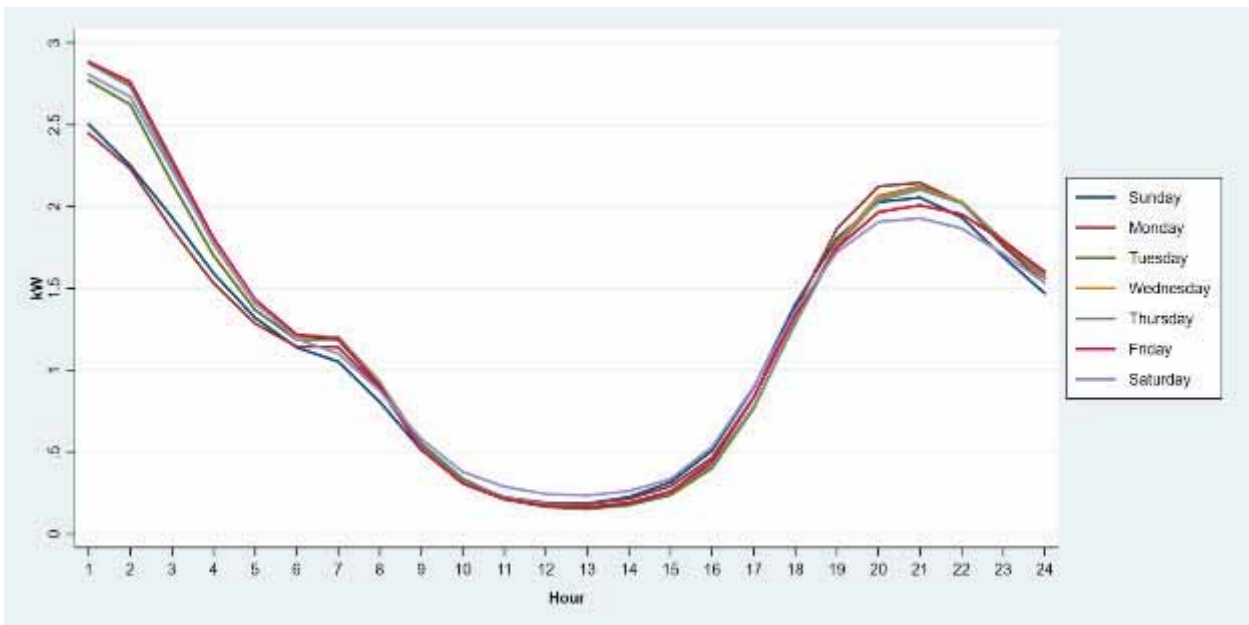
SDG&E Chart 7a: Average Delivered Load Profile for EV-TOU-2 Customers by Day of the Week



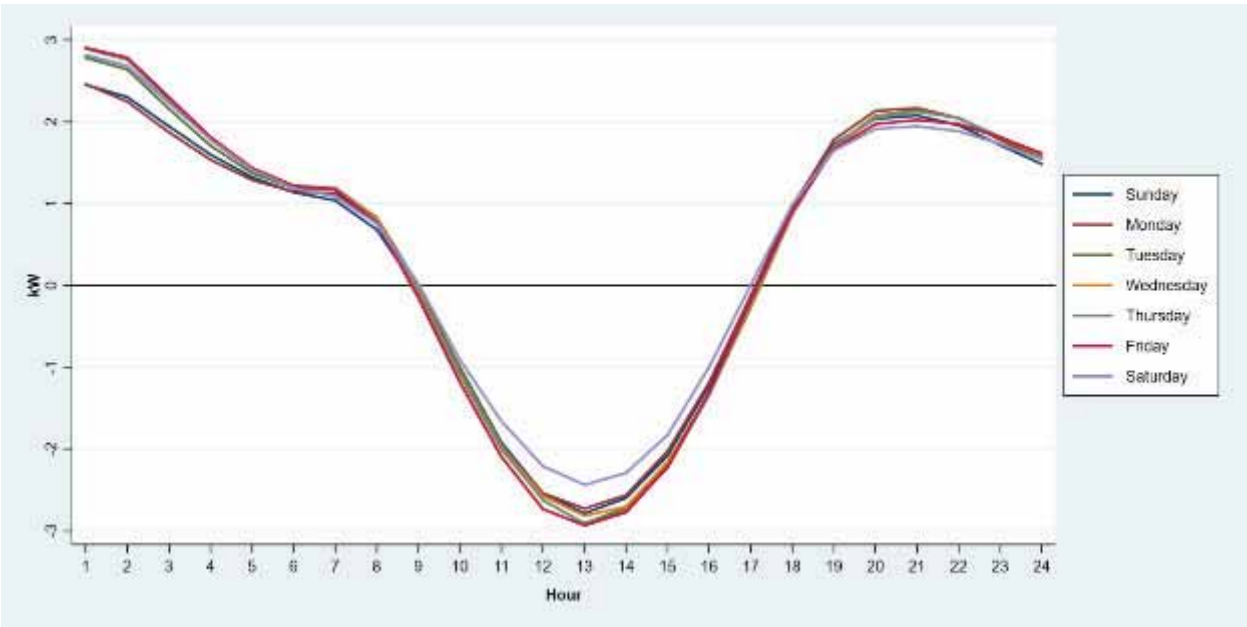
SDG&E Chart 7b: Average Net Load Profile for EV-TOU-2 Customers by Day of the Week



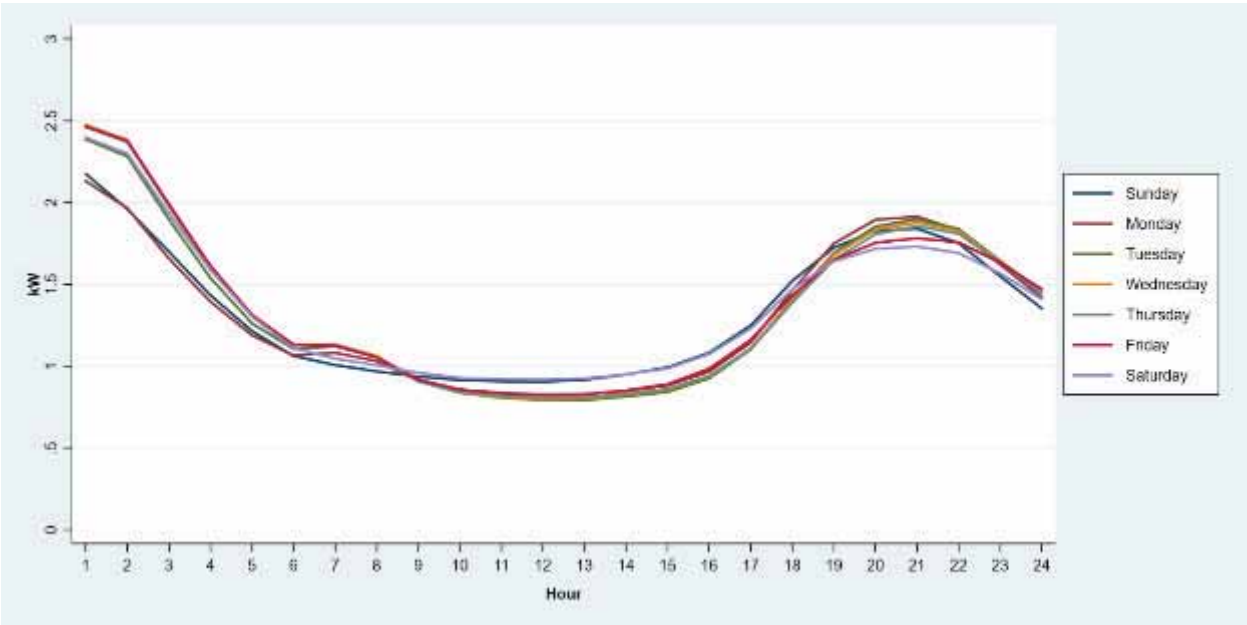
SDG&E Chart 7c: Average Delivered Load Profile for EV-TOU-2 (GF) Customers by Day of the Week



SDG&E Chart 7d: Average Net Load Profile for EV-TOU-2 (GF) Customers by Day of the Week



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



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

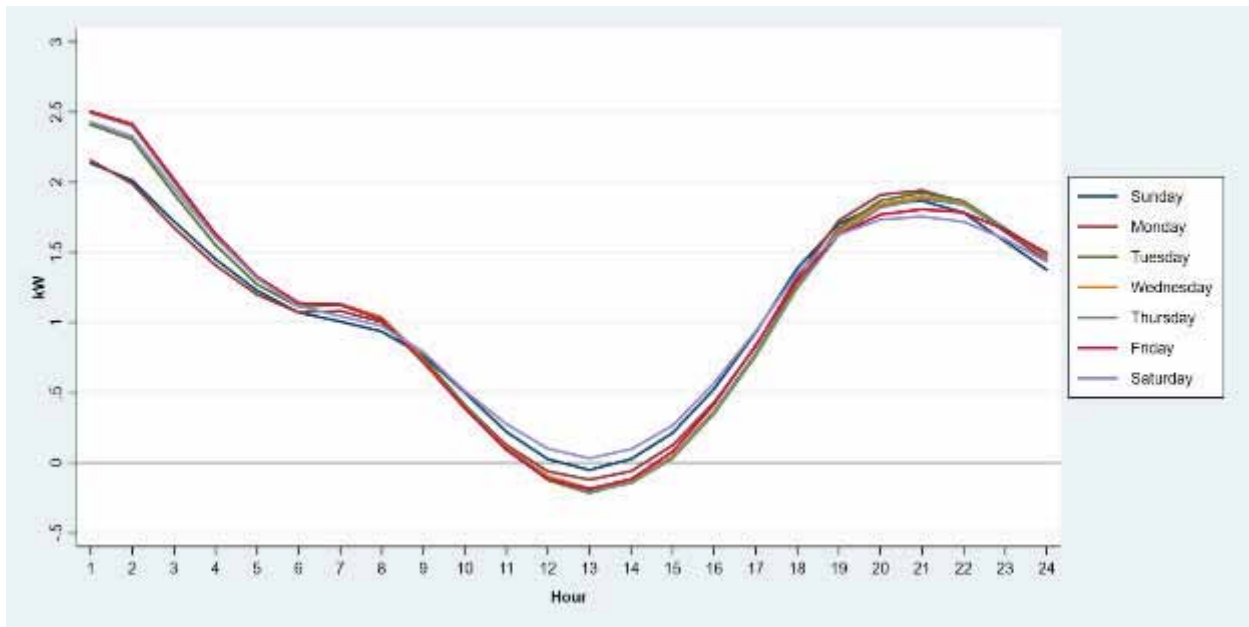


Chart 8 displays similar day of week patterns for separate-meter PEV customers. These accounts peak in the 01:00 – 02:00 hours and have virtually zero consumption during the rest of the day. This would indicate that the rate structure and enabling technology are extremely successful in encouraging charging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

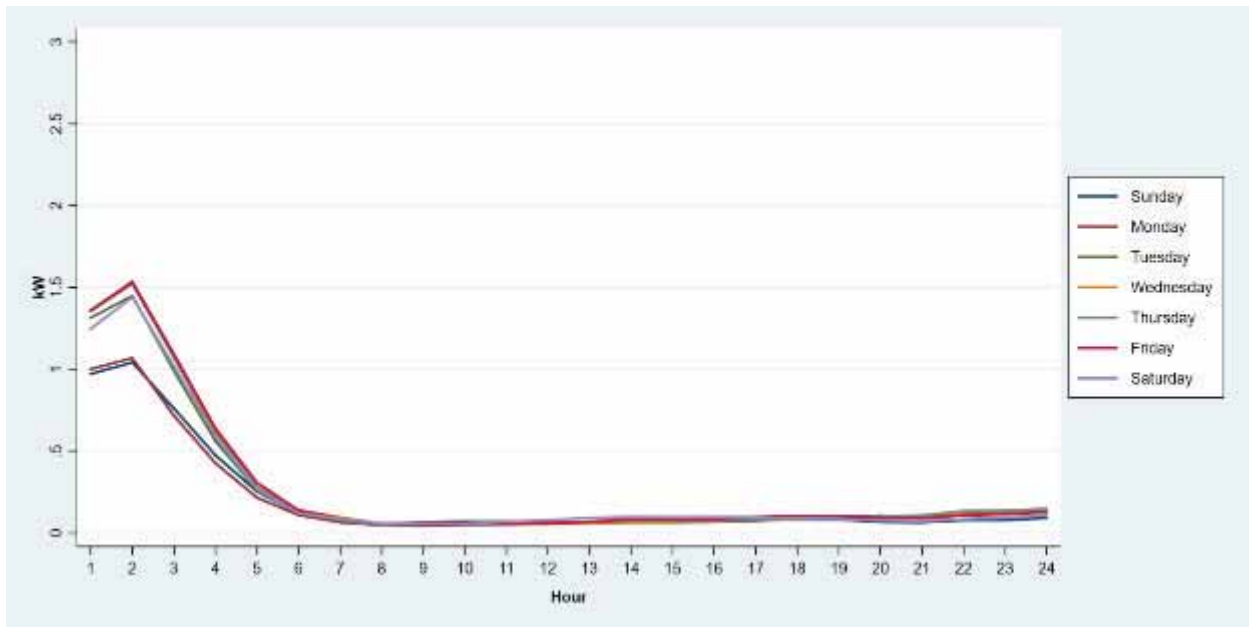
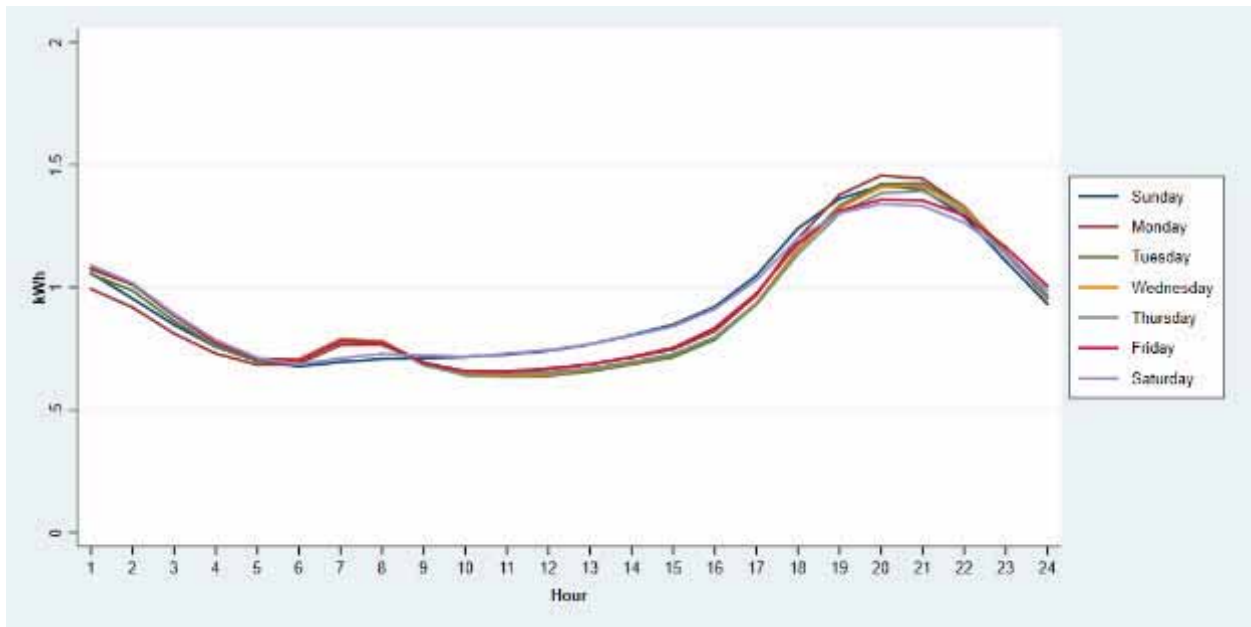
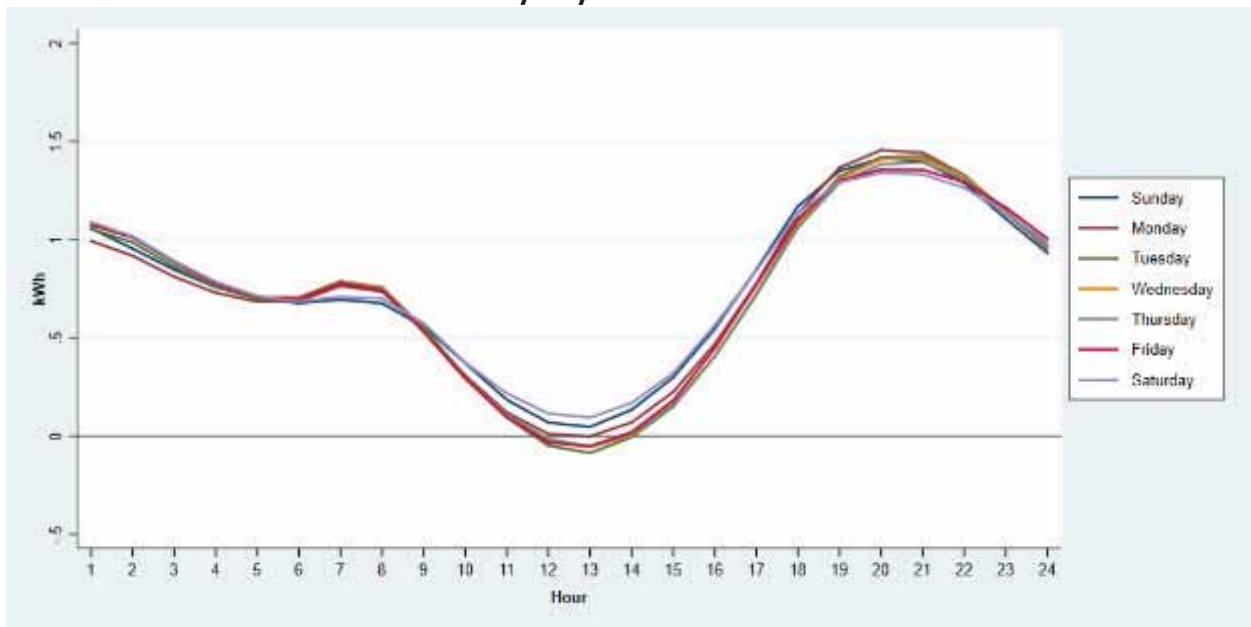


Chart 9a and 9b show the daily load profile and daily net load profile for customers who we believe own a PEV but are not currently on one of the previously mentioned PEV rates. These customers are either company employees who own EVs, or customers that received a climate credit for being an EV owner. 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. However, a couple observations worth noting are 1) because these customers are not incentivized to charge at a lower-priced off-peak time, charging occurs at various times during the day, and therefore charging peaks are not apparent in these average shapes. And 2) these customers peak in the evening, similar to the general residential population.

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



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



Average Maximum Peak Load

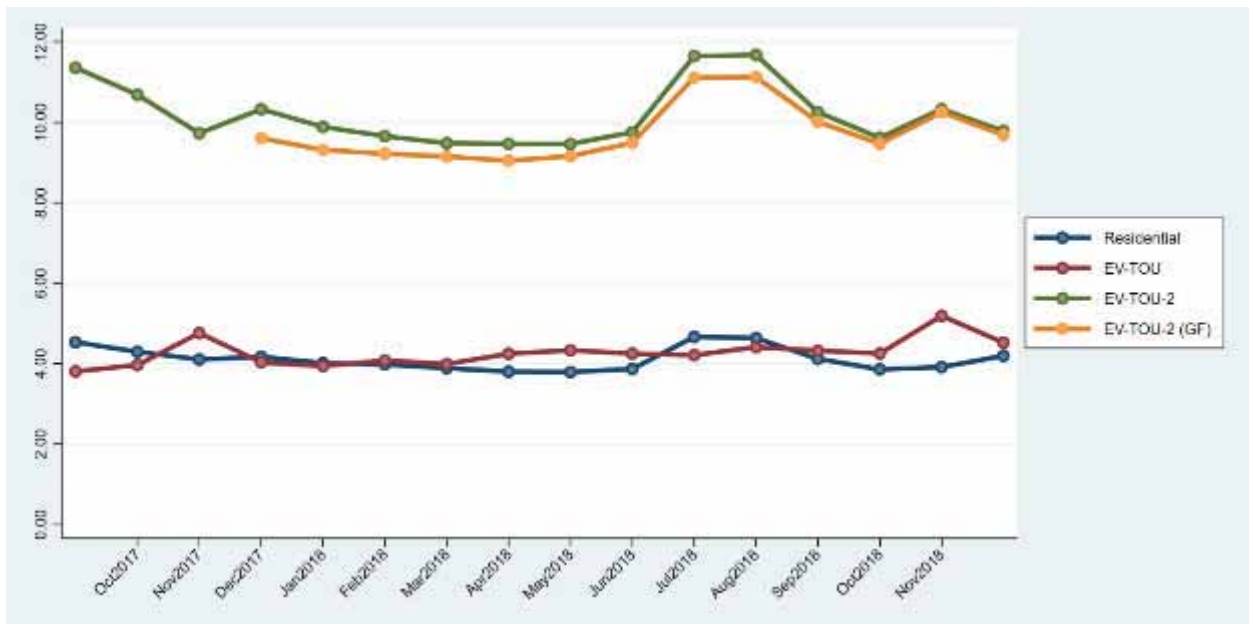
Table 9 shows that the average maximum (also referred to as Non-Coincident) peak load for separate-meter customers is slightly over 4 kW – for reference, this is roughly the max setting

on the Leaf EVSEs. Single-meter customers have a max demand more than twice that of the average residential customer, because of charging load added to base load.

SDG&E Table 9: Monthly Average Maximum Peak Load (kW)

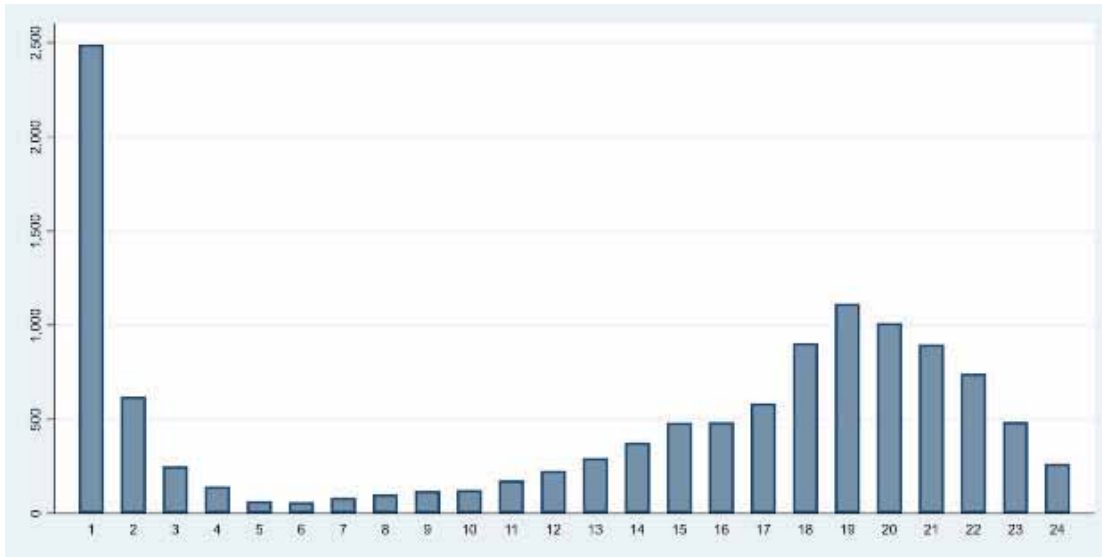
Month	Residential Pop.	Single-Meter		Separate-Meter
		EV-TOU-2	EV-TOU-2 (GF)	EV-TOU
Sep2017	4.53	11.36		3.81
Oct2017	4.30	10.68		3.97
Nov2017	4.10	10.17		4.76
Dec2017	4.17	10.33	9.61	4.03
Jan2018	4.01	9.89	9.32	3.94
Feb2018	3.98	9.66	9.22	4.08
Mar2018	3.89	9.48	9.15	3.99
Apr2018	3.80	9.47	9.05	4.25
May2018	3.79	9.46	9.16	4.33
Jun2018	3.87	9.75	9.49	4.25
Jul2018	4.67	11.65	11.11	4.21
Aug2018	4.63	11.68	11.13	4.41
Sep2018	4.12	10.25	10.01	4.32
Oct2018	3.86	9.62	9.47	4.25
Nov2018	3.91	10.33	10.25	5.19
Dec2018	4.20	9.78	9.69	4.52

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

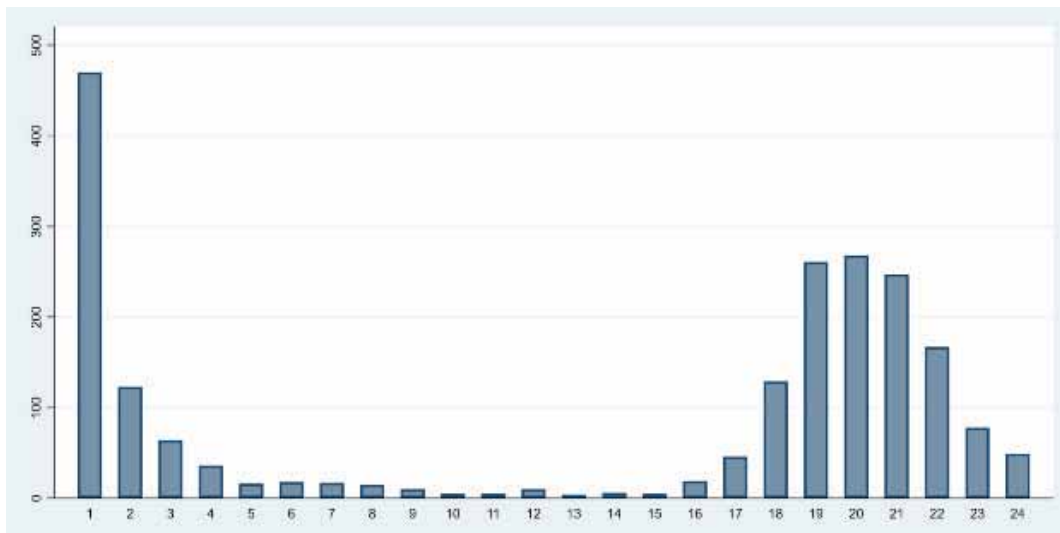


The histogram in Chart 11a provides a distribution of the hours in which EV-TOU-2 customers' maximum peak demand occurs. The majority of customers' peaks occur in the super off-peak TOU period, but 37% of the peaks still occur between hour-ending 18 and hour-ending 22. Chart 11b shows the same distribution for EV-TOU-2 (GF) customers. Most peaks occur in the off-peak TOU period, followed by the super off-peak TOU period.

SDG&E Chart 11a: Hourly Occurrence of Maximum Peak Load for EV-TOU-2 Customers



SDG&E Chart 11b: Hourly Occurrence of Maximum Peak Load for EV-TOU-2 (GF) 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	
			EV-TOU-2		EV-TOU-2 (GF)		EV-TOU	
	Time	kW	Time	kW	Time	kW	Time	kW
Sep2017	6:30PM	1.68	8:00PM	4.38			1:30AM	1.95
Oct2017	6:45PM	1.45	7:30PM	3.97			1:30AM	1.91
Nov2017	3:15PM	1.00	12:30AM	4.92			12:45AM	2.01
Dec2017	7:45PM	1.01	12:30AM	3.37	1:15AM	3.06	1:30AM	1.93
Jan2018	6:30PM	0.92	12:30AM	3.16	1:15AM	3.03	1:30AM	1.96
Feb2018	7:00PM	0.95	1:15AM	3.12	1:15AM	3.12	1:30AM	1.96
Mar2018	7:00PM	0.88	1:15AM	3.10	1:15AM	3.06	1:15AM	1.96
Apr2018	8:15PM	0.83	1:15AM	2.93	12:30AM	2.94	1:30AM	1.81
May2018	8:30PM	0.77	1:15AM	2.97	12:30AM	3.05	1:15AM	1.92
Jun2018	8:30PM	0.85	1:15AM	3.04	12:45AM	3.06	1:30AM	1.79
Jul2018	7:00PM	1.51	12:30AM	3.83	7:45PM	3.78	1:30AM	1.70
Aug2018	6:45PM	1.48	12:30AM	4.05	12:45AM	3.93	1:30AM	1.75
Sep2018	6:00PM	1.04	1:15AM	3.21	12:30AM	3.23	1:30AM	1.92
Oct2018	7:30PM	1.01	12:30AM	3.14	12:30AM	3.16	1:30AM	1.83
Nov2018	6:30PM	0.88	12:15AM	4.76	12:15AM	4.69	12:30AM	1.99
Dec2018	6:30PM	1.02	1:15AM	3.07	12:45AM	3.10	1:15AM	1.84

With the exception of EV-TOU-2 customers in September and October, and EV-TOU-2 (GF) customers in July, both single-meter and separate-meter customers peak around 12:30 AM and 01:30 AM driven by PEV charging behavior. The residential class peaks in the early evening hours.

As can be seen in Chart 12, for both single-meter and separate-meter, Hour 1 has the highest percentage of peak demand.

SDG&E Chart 12: Percentage of Peaks in Each Hour for Single-Meter

Hour	EV-TOU-2		EV-TOU-2 (GF)	
	Count	%	Count	%
1	2493	21%	468	23%
2	625	5%	125	6%
3	252	2%	64	3%
4	144	1%	37	2%
5	66	1%	15	1%
6	60	0%	17	1%
7	84	1%	17	1%
8	103	1%	15	1%
9	120	1%	10	0%
10	123	1%	5	0%
11	175	1%	5	0%
12	225	2%	10	0%
13	296	2%	4	0%
14	378	3%	6	0%
15	480	4%	5	0%
16	485	4%	19	1%
17	586	5%	46	2%
18	902	7%	129	6%
19	1112	9%	262	13%
20	1017	8%	268	13%
21	901	7%	246	12%
22	741	6%	166	8%
23	489	4%	78	4%
24	263	2%	49	2%

Average Load Coincident With System Peak

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

Month	Residential	Single-Meter		Separate-Meter
		EV-TOU-2	EV-TOU-2 (GF)	EV-TOU
Sep2017	1.46	2.85		0.08
Oct2017	1.35	3.18		0.08
Nov2017	0.90	2.57		0.10
Dec2017	0.90	2.61	2.11	0.12
Jan2018	0.94	2.52	2.05	0.13
Feb2018	0.94	2.44	2.06	0.08
Mar2018	0.85	2.30	1.97	0.06
Apr2018	0.77	1.97	1.71	0.07
May2018	0.68	1.82	1.60	0.08
Jun2018	0.80	1.90	1.66	0.01
Jul2018	1.40	3.14	2.02	0.11
Aug2018	1.28	2.83	1.74	0.07
Sep2018	0.82	1.85	0.91	0.11
Oct2018	0.86	1.94	1.73	0.06
Nov2018	0.87	2.11	2.00	0.05
Dec2018	0.96	2.28	2.17	0.14

Separate-meter customers have extremely low demand coincident with system peak because this is when their cost per kWh is the highest. EV-TOU-2, on the other hand, more than double the coincident demand of the average residential customers. One thing to note is that on average single-meter customers are mainly single-family homes, which tend to have higher usage than the general residential population.

Geographic Concentration of PEV Owners

Almost 70% of PEV owners are in the coastal climate zone with the remaining 30% located in the inland zone. The results presented in Table 12a show that PEV ownership is heavily concentrated in more affluent areas in the service territory (Carmel Valley, Encinitas, etc.)

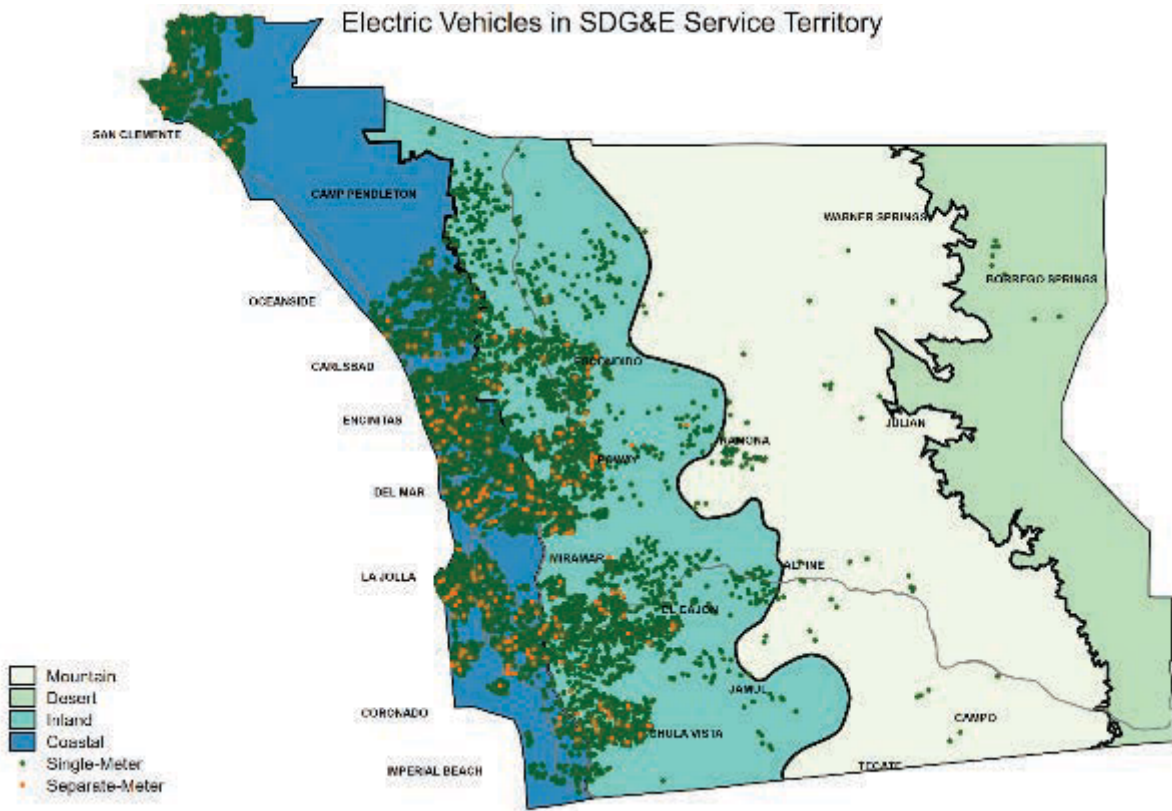
SDG&E Table 12a: Geographic Concentration of PEVs (Top Five Zip Codes by Meter Configuration)

Rate	Zip Code	Area	Number of Customers	Percent of Total
EV-TOU	92024	Encinitas	11	5%
	92130	Carmel Valley	10	5%
	92101	Downtown San Diego	10	5%
	92129	Rancho Peñasquitos	9	4%
	92128	Rancho Bernardo	8	4%
EV-TOU-2	92130	Carmel Valley	460	5%
	92037	La Jolla	393	4%
	92677	Laguna Niguel	386	4%
	92024	Encinitas	343	4%
	92127	Rancho Bernardo	306	3%
EV-TOU-2 (GF)	92130	Carmel Valley	142	5%
	92127	Rancho Bernardo	134	5%
	92024	Encinitas	127	5%
	92009	Carlsbad	117	4%
	92037	La Jolla	92	4%

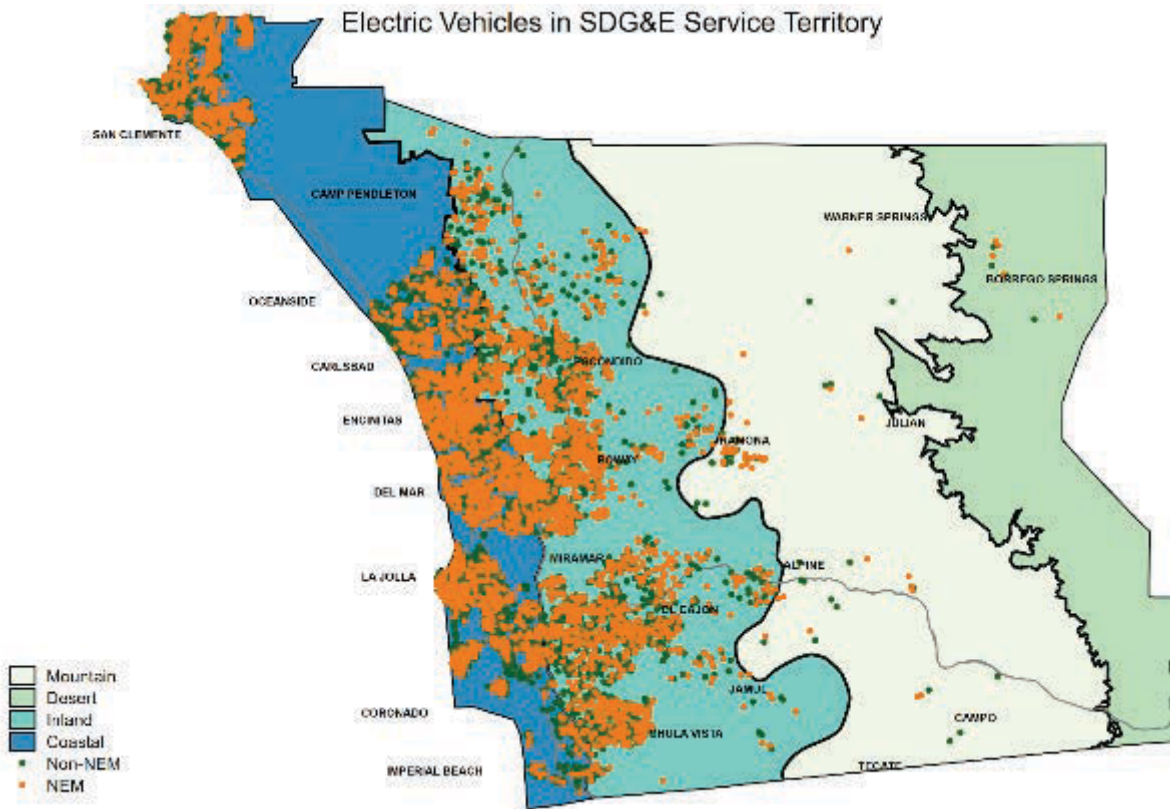
SDG&E Table 12b: Geographic Concentration of PEVs by Climate Zone and Meter Configuration

Climate Zone	Single-Meter		Separate-Meter	Total	Percent of Total
	EV-TOU-2	EVTU2 (GF)	EV-TOU		
Coastal	6,475	1,625	133	8,233	69.05%
Mountain	54	18	0	72	0.60%
Desert	4	3	0	7	0.06%
Inland	2,559	970	83	3,612	30.29%

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 been able identify a significant number of additional PEV.
- 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 22,959 accounts with a PEV charging under the single-meter TOU-D-A/B tariff have been identified as of the beginning of December 2018. However, as this rate is open to all residential customers, SCE must rely on self-identification. Therefore, account growth will likely not represent the actual numbers of PEVs on the single-metered TOU option or the broader PEV market growth.
- Separately metered PEV owners exhibited an increase in monthly average usage to 377 kWh during the last half of 2018 compared to the monthly average usage of 342 kWh over the preceding 10 months. This is perhaps the result of the composition of vehicle models changing due to the increased production of the Tesla Model 3.
- Non-coincident peak demand for the separately metered PEVs was 8.4 kW on average during the last six months of 2018. Average non-coincident demand was 7.2 kW in the 2014 report, 7.5 kW in the 2015 and 2016 reports and 7.7 kW in the 2017 report. Sixty-nine 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 three 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, Irvine has two zip codes that are in the top five under the single-metered tariff. It tops the list with 457 accounts and also has the fourth ranked zip code with 345 accounts. 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, about 35%, compared to 10% for the 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 on average are 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.
- This report only covers charging that takes place in the home, but there is EV charging that occurs outside of the home, either at work or other public locations.