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**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

Order Instituting Rulemaking Regarding
Transportation Electrification Policy and
Infrastructure.

Rulemaking 23-12-008

NOT CONSOLIDATED

Order Instituting Rulemaking to Continue
Development of Rates and Infrastructure for
Vehicle Electrification.

Rulemaking 18-12-006

**PACIFIC GAS AND ELECTRIC COMPANY'S (U 39 E) ANNUAL
VEHICLE-GRID INTEGRATION STRATEGIES REPORT FOR 2023**

PUBLIC VERSION

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Dated: March 15, 2024

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PUBLIC VERSION

Pursuant to Ordering Paragraph (OP) 1 of Decision (D.) 20-12-029, Pacific Gas and Electric Company (PG&E) hereby submits its Annual Report on Vehicle-Grid Integration (VGI) Strategies for 2024 (VGI Report). The Report outlines PG&E's VGI activities from January 1 to December 31, 2023.

Respectfully submitted,

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March 15, 2024

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Pacific Gas & Electric
Annual
Vehicle-Grid Integration Strategies
Report
Submitted on March 15, 2024

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Pacific Gas and Electric's Annual Report on Vehicle-Grid Integration Strategies, Programs and Pilots Metrics

March 15, 2024

Executive Summary

On December 21, 2020, the California Public Utilities Commission (CPUC or Commission) issued Decision (D.) 20-12-029, *Decision Concerning Implementation of Senate Bill 676 and Vehicle-Grid Integration Strategies* (the Decision), which among other things, orders the utilities to file annual and mid-term reports on metrics pertaining to pilots and programs related to Vehicle-Grid Integration (VGI).

Ordering Paragraph (OP) 1 directs utilities to file mid-term and annual VGI Reports on its Vehicle Grid Integration (VGI) activities.¹ Additionally, in accordance with the Decision,² this report uses the VGI reporting template that was developed in consultation with Energy Division staff and upon which stakeholders commented during the Joint Utilities' VGI Pilots and Reporting Template Workshop on March 16, 2021.³ The data collection template is provided as a separate excel document.

This report covers the period from January 1 through December 31, 2023, and includes any pilots, programs or activities that were active at any point during 2023.

VGI Definitions

Senate Bill 676 originally defined VGI and gave authority to the Commission to revise the definition. In D. 20-12-029, the Commission revised VGI's definition to the following:

"Electric vehicle grid integration" means any method of altering the time, charging level, or location at which grid-connected light-duty electric vehicles, medium-duty electric vehicles, heavy-duty electric vehicles, off-road electric vehicles, or off-road electric equipment charge or discharge, in a manner that optimizes plug-in electric vehicle or equipment interaction with the electrical grid and provides net benefits to ratepayers by doing any of the following:

- Increasing electrical grid asset utilization and operational flexibility.
- Avoiding otherwise necessary distribution infrastructure upgrades and supporting resiliency.

¹ D.20-12-029, OP 1.

² D.20-12-029, p. 61.

³ SCE, San Diego Gas & Electric Company (SDG&E), and Pacific Gas and Electric Company (PG&E) are collectively referred to as the Joint Utilities.

- Integrating renewable energy resources.
- Reducing the cost of electricity supply.
- Offering reliability services consistent with the resource adequacy requirements established by Section 380 or the Independent System Operator tariff.⁴

Based on this definition, VGI activities and programs can take many forms, broadly categorized as follows:

- V1G: Vehicle charging is managed to respond to grid requirements to improve reliability and reduce costs. Southern California Edison (SCE) in their definition further breaks this down into direct and indirect forms:
 - Indirect V1G uses price signals and/or other mechanisms to optimize charging, including Time of Use (TOU) rates and demand response
 - Direct V1G features the utility taking an active role in controlling timing and amount of vehicle charging, for example throttling charging load during peak periods
- Vehicle-to-building (V2B)/Vehicle-to-home (V2H): V2B or V2H integration, under which an EV may provide power directly to a home or building. In the United States, auto Original Equipment Manufacturers (OEMs) are using this term to refer to backup solutions in which the home or building is disconnected (islanded) from the grid.
- Vehicle-to-Grid (V2G): V2G bidirectional charging and discharging, under which EVs may discharge onto the grid in addition to characteristics offered by V1G.

VGI Reporting Template Structure

The Decision determines that “[r]obust VGI metrics and reporting are essential” for statutory compliance as well as determining progress toward goals and providing information to various parties and to help evaluate the VGI programs.⁵ Additionally, the Decision adopts the VGI staff paper proposal to establish 3 categories, with numerous corresponding metrics:

- (1) activity – track adoption of VGI policy actions
- (2) program – track the success of program implementation against program goals
- (3) outcome – track aggregate progress toward end goals across all programs and activities.⁶

For reporting purposes, the Decision directed the large electrical corporations to consult with the Commission’s Energy Division staff to create a VGI reporting template that incorporated

⁴ D.20-12-029, p. 12-13.

⁵ Decision, p. 52.

⁶ Id.

the required metrics.⁷ The utilities collaborated with Energy Division staff and also served a draft copy of the VGI reporting template to the service list and other stakeholders on February 28, 2021 in order to allow time for review prior to the Joint Utilities' workshop on March 16, 2021, in which stakeholders had an opportunity to provide feedback.

The VGI reporting template consists of two components: (1) a narrative section, which includes general utility and PG&E specific questions, to provide an overview of the utility's VGI efforts and qualitative information and (2) a spreadsheet for reporting quantifiable data, such as pilot/program participation, costs, and other data. PG&E's spreadsheet is provided as Attachment A.

Narrative Questions

The metrics reported below correspond to the row number in the VGI Reporting Template excel file, Narrative tab (starts with Row 3).

3. Customer program or pilot and incentives related to VGI -

Demand Response Emerging Tech Pilot – Technology Demonstration (Complete)

PG&E completed a study to understand the potential to incorporate EVs into Demand Response programs:

EV study for Automated Demand Response (ADR) incentive – This study evaluated if PG&E's ADR program should develop an ADR incentive for residential EV charging stations, and the following are the results of the study:

- a. Vehicle telematics and EV charger controls are both effective strategies for curtailing EV charging during DR events with minimal impact on participants.
- b. EV ADR charging controls technology holds promise for mitigating overnight peaks
- c. The maximum resource potential for EV ADR control technologies is 9 MW to 13 MW during the peak period from 4:00 p.m. to 9:00 p.m.
- d. The clustering analysis results reveal that 28% of EV owners are "overnight chargers," who could be targeted to mitigate distribution system impacts in areas with high EV adoption
- e. An additional 20% of EV owners are "peak period chargers" and would be good targets DR efforts designed to curtail consumption during the peak period 4:00 p.m. to 9:00 p.m. window

⁷ Decision, p. 60.

DRP DIDF and Partnership Pilot Aggregated Distribution Service (ongoing)

The existing Distribution Investment Deferral Framework (DIDF) currently provides opportunities for Distributed Energy Resources (DERs), including EVs, to defer distribution investments. Efforts include exploration of alternative sourcing methods to procure aggregated Behind-The-Meter (BTM) DERs to defer distribution investments. The program was amended in 2023 with recommended reforms with details published at: [509105421.PDF \(ca.gov\)](#).

Electric School Bus Renewables Integration – Infrastructure (complete)

PG&E deployed make-ready infrastructure to serve a fleet of electric school buses in a disadvantaged community. In addition to providing make-ready infrastructure for charging stations, PG&E tested how charge management software can be used to integrate onsite renewable generation. Charge management software was utilized to align the charging of the buses with excess renewable energy at midday and thereby reduced energy costs and GHG emissions. A report with results from this effort was filed by PG&E and is available [here](#).

Vehicle-to-Everything (V2X) Microgrid pilot – Infrastructure (Ongoing)

The V2X Microgrid Pilot was approved in Resolution E-5192. The Pilot will provide upfront and performance-based incentives to customers located in a multi-customer microgrid that has eligible EVs and Electric Vehicle Service Equipment (EVSEs). The microgrid pilot is focused on enabling bidirectional electric vehicles to charge/discharge in a microgrid to support community resiliency during a PSPS event with the goal of operational integration with multi-customer and critical infrastructure microgrids (i.e., front of the meter (FTM) microgrids with behind the meter (BTM) support)

- Phase 1 Testing Cohort – bidirectional chargers at selected microgrid site (Launched 2023)
- Phase 2 Incentive Cohort – expand pilot to up to 200 participants (Launch Q3 2024)

Residential V2X pilot – Infrastructure (Ongoing)

The V2XResidential Pilot was approved in Resolution E-5192. The Pilot will provide upfront and participation-based incentives to residential customers that have eligible EVs and EVSEs. The pilot is intended to study 1) the technical capability of achieving vehicle-to-home (V2H) resiliency during grid outages and 2) customer behavior and preferences for V2H and V2G participation. The following services will be enabled:

- EV backup power (2024)
- EV load shift (2024)
- EV export (2024)

Commercial V2X pilot – Infrastructure (Ongoing)

The V2X Commercial Pilot was approved in Resolution E-5192. The Pilot will provide upfront and participation-based incentives to commercial customers that have eligible EVs and EVSEs. The pilot is intended to study 1) the technical capability of achieving vehicle-to-building (V2B) resiliency during grid outages and 2) customer behavior and preferences for V2B and vehicle-to-grid V2G participation. The following services will be enabled:

- EV backup power (2024)
- EV load shift (2024)
- EV export (2024)

EV Submetering Protocol (active)

The CPUC approved the EV Submetering Protocol in 2022 to enable EV owners to measure an EV's energy use independently from the owner's main utility meter through submetering. The Investor Owned Utility (IOU) implementation plans were approved in June 2023 and PG&E opened up submetering to customer enrollment in August 2023. Submetering will enable more customers to enroll their EVs on specific EV rates, incentivizing off-peak charging.

Customers can currently enroll in submetering through a Meter Data Management Agent (MDMA) who has registered with PG&E. There are currently no registered MDMA's and therefore no customers enrolled on submetering.

V2G EVSE AC Pathway (completed)

The objective of this project was to develop a temporary interconnection pathway for pilots seeking V2G AC interconnection that will ensure the necessary safety precautions. Currently, one vehicle OEM, Lucid is taking advantage of this opportunity and is in the process of interconnecting several Lucid Air cars at their main office.

The Joint Investor Owned Utilities have requested to extend the V2G AC Pilot an additional two years via Advice Letter 7125-E and are waiting for Commission approval.

BMW ChargeForward Pilot (active)

The BMW ChargeForward Pilot⁸ is a smart charging program in partnership with PG&E. It has been running for more than eight years and is currently in its third phase. BMW and PG&E were the first to offer customers cash incentives for maximizing clean energy by optimizing their EV charging times to

⁸ <https://www.bmwchargeforward.com/>

periods of high renewable energy. It is available to all BMW battery and plug-in EV drivers in Northern and Central California who are also PG&E residential electric customers.

In March 2023, PG&E and BMW of North America expanded their collaboration through March 2026. They will be testing V2X technology that will improve grid reliability and help EV customers lower their electric bills. BMW and PG&E will test vehicle-to-grid applications in a field trial at a BMW facility in Mountain View, California, and V2X applications at PG&E's Applied Technology Services (ATS) Lab in San Ramon.

evPulse for PG&E (LCFS Resilient Charging Pilot) (completed)

evPulse for PG&E is a Low Carbon Fuel Standard (LCFS) funded pilot designed to provide resiliency for EV drivers in the face of increasing Public Safety Power Shutoffs (PSPS) due to wildfire risk. It was a two-phased pilot, with the following goals:

Phase One

- 1) Identify EV drivers in High Fire Threat Districts (HFTDs) and areas that have been affected by PSPS events.

Phase Two

- 2) Develop a baseline for EV driver charging behavior before a PSPS event.
- 3) Test customer experience and valuation of a third-party platform that provides proactive communication and managed charging of EVs as a resiliency service.

PG&E has concluded implementation of evPulse as of December of 2023. There was a total of 4,831 EVs participating in the pilot. A final evaluation report will be submitted to the CPUC in April 2024.

Emergency Load Reduction Program (ELRP)

The ELRP was created by the CPUC in 2021 to pilot a new Demand Response approach to help avoid rotating outages during peak summer electricity usage periods. Driven by the July 30, 2021 Emergency Proclamation from Governor Newsom “urging all state energy agencies to ensure there is adequate electricity to meet the needs of Californians in 2022,”⁹ the CPUC adopted changes to ELRP, “expand[ing] on electric vehicle potential by allowing aggregation of vehicle to grid managed charging and discharge to support the grid at net peak.”¹⁰ In 2023, the CPUC extended the pilot’s operating period through 2027 for most subgroups, including subgroup A.5 Vehicle-Grid Integration.

9 D.21-12-015, page 2

10 D. 21-12-015, page 3

Third-party aggregators managing a VGI aggregation consisting of any combination of EVs and charging stations, including V1G and V2G, are eligible to participate in ELRP provided the following criteria is met:

- The VGI aggregation or any customer site within the aggregation is not simultaneously enrolled in a market-integrated, supply-side DR program.
- All enrolled sites within the aggregation are located within PG&E's service territory.
- All enrolled sites within the aggregation have operational EVSE.
- All enrolled sites within the aggregation meet required UL 1741 certification requirements.
- The aggregation can contribute 25 kW or greater for a minimum of one hour during an ELRP event.

ELRP events can occur between May and October and are triggered in response to Energy Emergency Alert notices issued by California Independent System Operator (CAISO). ELRP A.5 VGI events are limited to 3 hours in duration with a maximum annual dispatch limit of 60 hours. A.5 VGI events may also be dispatched at PG&E's discretion to meet the 30 minimum dispatch hours per season guaranteed by the program, which is intended to encourage participation by providing level of certainty on the level of compensation. The ELRP A.5 VGI incentive rate is \$2 per kilowatt-hour (\$2/kWh) for incremental load reduction, calculated using a day-matching baseline.

In 2023, PG&E had one non-residential aggregator with three sites participating in ELRP A.5. PG&E does not have visibility into the number of EVs participating at each site.

PG&E-GM Vehicle-to-Home Pilot (terminated)

In the pilot, PG&E and GM planned to test a retrofit GM EV with a bidirectional charger made by dcbel at PG&E's ATS facility in San Ramon, California in Q2 of 2023. Due to delays in the development of the technology, PG&E and GM terminated the pilot at the end of 2023 without having completed any testing.

PG&E-Ford Vehicle-to-Home Pilot (active)

In the pilot, PG&E and Ford tested Ford's F-150 Lightning EV and bidirectional charging system in a field demonstration at two customers' homes beginning in Q2 2023. Sunrun performed the installations. PG&E will monitor system performance at the two participants' homes for 12 months.

4. Adoption of rates that encourage VGI and adoption of mechanism to provide credit for export

EV2-A – EV2-A is a time-of-use rate for customers with either an electric vehicle (EV), battery storage, or an electric heat pump. It combines home and EV loads on the same rate and off-peak hours extend from 12 midnight to 3 p.m., every day, including weekends and holidays. PG&E had approximately 124,000 customers enrolled on EV2-A at the end of 2023.

EV-B – EV-B is a time-of-use rate that requires the installation of a separate meter. Off-peak hours extend from 11 p.m. to 7 a.m. when energy demand is lowest. Peak periods are from 2 - 9 p.m. and partial-peak periods are from 7 a.m. - 2 p.m. and 9 - 11 p.m. PG&E had approximately 400 customers enrolled on EV-B at the end of 2023.

E-ELEC - E-ELEC is a time-of-use rate that is ideal for customers who have begun to electrify their home with either an EV, battery storage, or electric heat pump for water heating or climate control (space heating or cooling). It includes a Base Services Charge that lowers the price per unit of energy (kWh), on average, compared to other rate plans. Peak periods on E-ELEC extend from 4 - 9 p.m. and while off-peak periods extend from 12 a.m. – 3 p.m. PG&E had approximately 12,000 customers enrolled at the end of 2023.

BEV1 - Business Low Use EV Rate - For EV charging installations up to and including 100 kilowatts (kW). Best suited for smaller workplaces and multi-unit dwellings. This rate plan allows selection of a subscription level in 10 kW blocks, up to 100 kW with a price of \$12.41 per 10 kW block. The electricity is the most expensive during peak hours (4 - 9 p.m.), less expensive during off-peak hours (2 - 4 p.m. and 9 p.m. – 9 a.m.), and the least expensive during super off-peak hours (9 a.m. – 2 p.m.). BEV-2 TOU structure is year-round with no seasonality. There were 256 customer sites enrolled in BEV1 rate at the end of the 2023.

BEV2 - Business High Use EV Rate - For EV charging installations of 100 kilowatts (kW) and above. Best suited for sites with fleets and fast-charging stations. This rate plan allows selection of a subscription level in 50 kW blocks, starting at 100 kW (and over). For BEV2 (Secondary) customers, the price of each 50 kW block is \$95.56. For BEV2 (Primary) customers, the price of each 50 kW block is \$85.98. The electricity is the most expensive during peak hours (4 - 9 p.m.), less expensive during off-peak hours (2 - 4 p.m. and 9 p.m. – 9 a.m.), and the least expensive during super off-peak hours (9 a.m. – 2 p.m.). BEV-2 TOU structure is year-round with no seasonality. There were 467 customer sites enrolled in BEV2 rate at the end of 2023.

Day Ahead Hourly Real Time Pricing Business Electric Vehicle (DAHRTP-BEV) Rate – Due to the dependency on a billing system modernization upgrade which has been delayed, PG&E has delayed the launch of the DAHRTP-BEV Rate and Export Compensation Pilot and is working on a solution to offer real-time pricing rates to BEV customer class as soon as possible. In February 2024, PG&E received an extension for implementation of the DAHRTP-CEV rate to February 2025.

VGI Dynamic Rate – This rate will be tested in Phase 2 of both the residential and commercial V2X pilots that PG&E launched in April 2023 and will send price signals to incentivize EV load shifting and export. Phase 2 of the V2X pilots is targeted for the Q4 2024.

For further information on the electric vehicle rates, please refer to the following reports filed annually. EV Cost and Load Report examines EV customer charging behavior and service and distribution system upgrade costs related to EV load and contains the impact EV rates have on driver charging

behavior, among other relevant information.¹¹ BEV Performance Report contains information on the BEV rate class.¹²

5. Efforts to collaborate with CAISO to design wholesale market rules and access that support VGI

PG&E proposed a pilot in Advice Letter (AL) 6259-E that was intended to investigate the potential for V2G participation in the CAISO wholesale market. The proposal was rejected because the CPUC determined that it was not sufficiently explicit in how it would achieve those goals, and instead, instructed PG&E to implement a VGI Dynamic Rate as described in a in the prior section. Thusly, PG&E is working with CPUC to use Real Time Pricing (RTP) rates in lieu of direct CAISO participation in the V2X pilots and is also incorporating day-ahead CAISO pricing into the DAH RTP-BEV rate and the DAH RTP BEV Export Compensation pilot as mentioned above.

6. Leveraging or supplementing EPIC and/or other sources of funding for VGI technology demonstration projects

PG&E is currently coordinating with EPIC 3 Pilot 3.11.B in phase 1 of the V2X Microgrid Pilot. The V2X Microgrid Pilot expands upon the existing EPIC 3.11B program (which is validating BTM real time resiliency controls for solar and storage) to include EVs. Phase 1 of the pilot is working with EVSE suppliers to demonstrate the capability for EVs to participate in multi-customer microgrid generation and load balancing support utilizing the EPIC 3.11B control scheme.

PG&E hosted its first Innovation Summit in July 2023 which brought together stakeholders from around the world both in person and virtually. The focus of the summit was increased collaboration between PG&E and innovators to meet key challenges to meeting the following goals, as identified by PG&E subject-matter experts:

- Connecting our customers to the grid (timely and cost-efficiently)
 - Residential (Single and Multifamily)
 - Commercial & Fleet
- Leveraging these connected assets to serve the grid
- Helping decarbonize the grid by achieving the following by 2030:
 - Customer adoption of 3 million EVs across our system
 - 2 million of those vehicles participate in VGI (managed charging and/or vehicle to grid)
 - A result of a reduction of 58+ Million Metric Tons (MMT) of carbon emissions

¹¹ Annual reports are filled on April 1 and available <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/resources-and-reporting>

¹² 2022 BEV Performance Report available at https://www.pge.com/tariffs/assets/pdf/adviceletter/ELEC_6906-E.pdf. 2023 BEV Performance Report will be published on April 1, 2024.

Following the summit, PG&E hosted a “pitchfest” in which companies proposed solutions to meet these challenges. EPIC funds will be used to help realize the solutions that are identified and prioritized. PG&E is currently going through the pilot development process and internal approval for EPIC pilots to be launched in 2024.

7. Efforts to accelerate the use of VGI for Resiliency

All three of the PG&E V2X pilots specified in approved AL 6259-E include efforts to support resiliency by incentivizing the installation of V2X technology capable of backup power and then testing that capability in the pilots. Given delays in equipment availability, there has been limited participation as of now. Participation is expected to increase in 2024 and subsequent years as the market evolves.

The evPulse for PG&E Pilot, funded by the Low Carbon Fuel Standard revenue, was designed to provide managed charging services to ensure customers’ vehicles are charged prior to a potential public safety power shutoff (PSPS) events. This pilot concluded in December 2023.

8. Progress to reform interconnection rules to advance VGI

PG&E AL 6209-E (SCE AL 4510-E and SDG&E AL 3774-E) was approved with modifications in Resolution E-5165, reforming the interconnection rules to advance VGI.

In recognition of the importance of interconnection to scaling VGI, PG&E will focus increasingly on efforts to reform interconnection rules in 2024.

9. Support and adoption of non-interconnection technical standards to advance VGI -

ISO 15118-20	Has been finalized by the International Standards Organization (ISO) and we are now waiting for additional standards including the standards for testing the implementation to be published.
IEEE 2030.5	While not yet supported by many parties, it will be a supported protocol for the VGI Pilots and for PG&E’s Distributed Energy Resource Management System (DERMS) in the future.
OpenADR 2.0.b	Currently being used for the ChargeForward pilot program and will be supported in phase 2 of the V2X Pilots.
OpenADR 3.0	Currently being considered as an option for interaction with the dynamic pricing engine that will be used by the PG&E VGI Pilots. OpenADR 3.0 offers functionality that provides additional flexibility in working with DERs that will provide benefits for VGI programs. This functionality includes the ability to subscribe to dynamic prices and the ability to directly control customer equipment.

Vehicle telematics (4G network rules)	Currently being used by the BMW ChargeForward pilot and was used for evPulse.
UL 9741	The Underwriter's Laboratory (UL) Standard 9741 covers both unidirectional and bidirectional equipment that is connected to an electric vehicle. Unidirectional equipment exports power from the vehicle to off board loads including an electric power system such as the electric utility grid. Bidirectional equipment serves the same function but additionally provides power to the electric vehicle for recharging of the on-board electric vehicle battery.

10. Summary on efforts to fund and launch VGI customer education

PG&E has begun these efforts with the launch of our V2X Pilots. Some basic resources have been provided on our website www.pge.com/vgi. This education will be further developed as details of the implementation are finalized via an expected supplementary resolution from the Energy Division of the California Public Utilities Commission.

PG&E will also include information on VGI as part of the Technical Assistance (TA) Program of the Transportation Electrification Framework as directed by the CPUC and in the Transportation Electrification Advisory Services Near Term Priority pilot proposal submitted to the CPUC in June 2023. The minimum TA Service requirements (from D.22-11-040) include:

- Basic technical assistance
- Planning load management and other VGI considerations
- Help with choosing rates
- Support with walking through the IOU energization and interconnection process
- Support and advisory services during planning, installation, and post-deployment
- Operations post-deployment, like route optimization, load management, and future fleet electrification
- Available Automated Load Management (ALM) & Distributed Energy Resource (DER) options to lower deployment costs

The general education efforts will include a self-service webpage, links to tools and resources, and webinar and workshop materials, along with tailored information from a dedicated Transportation Electrification (TE) Advisor.

11. Summary on efforts to develop and support complementary policies needed to support Automated Load Management (ALM) technology

PG&E understands the definition of ALM to be the use of software or other BTM technologies to strategically share charging capacity across multiple charging ports at the same charging site, helping to safely connect multiple charging ports whose total nameplate load would otherwise exceed the rated capacity of the customer connection.

The technology for ALM exists today and PG&E customers have deployed it in a few of its EV Programs such as Electric Vehicle Charge Network (EVCN) and EV Fleet. PG&E is also considering additional ways to educate customers about ALM both before and after energization to help customers maximize the benefit of EV charging as noted above via its various technical assistance programs.

12. ALM deployment in the utility territory in the context of both existing and future transportation electrification programs, rules, and tariffs to the extent practical; including estimates on the number of ALM

PG&E is planning a Flexible Service Connection pilot program which is anticipated to launch in 2024 and will enable customers with eligible loads to connect with a new electric service prior to the completion of necessary capacity upgrades by dynamically managing consumption based on near real-time grid availability until infrastructure projects are completed. Ten sites will be initially targeted followed by offering this capability to a broader audience.

PG&E is also considering ways to provide additional education on ALM to customers participating in the various EV programs.

13. ALM systems Installed for passenger vehicles and any medium and heavy-duty vehicle segment(s) under currently approved transportation electrification programs as well as estimates on the potentially expected avoided distribution and customer-side cost savings attributable to such ALM installations –

Within the EVCN program, over 1,300 ports were deployed with ALM. The benefits of using ALM include cost savings, space savings, and enables a project to overcome physical constraints on the site. In the EVCN program, ALM produced cost savings ranging from \$30,000 to \$200,000 per project.

PG&E also uses ALM for a few customers in the EV Fleet program where the site has capacity restrictions. PG&E does not currently have data on avoided distribution costs or customer cost savings and may do that analysis upon the conclusion of the program.

14. Customer VGI participation in utility demand response programs, including customer retention and efforts to reduce churn and data requested from 3rd party providers as needed.

PG&E had one non-residential aggregator participating with three sites in the Emergency Load Reduction Program A.5 VGI subgroup as of the end of the 2023 season. This aggregator was dispatched for 30 event hours across nine event days, providing incremental load reduction of up to 12 kW.

15. Implementation of VGI pilots, lessons learned and potential future efforts

Enrollment in PG&E's VGI pilots launched in April of 2023. Learnings to date have been limited by the lack of available compatible equipment. Additionally, the lack of fully implemented open standards has necessitated the inclusion of a requirement that vehicle and EVSE OEMs must agree that their equipment is interoperable prior to being eligible to participate in the pilot. As of the end of 2023, the only solution that is approved for installation for the residential VGI pilot is the Ford F-150 Lightning with the Ford/Sunrun Pro charger and home integration system. A few of these have been installed in PG&E service territory and such customers are expected to begin enrolling in the pilots in Q1 2024. Other OEM products should follow soon after once UL testing and certification is complete.

Enrollment in the commercial pilot is expected to begin in early 2024 as agreements are signed.

16. Integration of VGI across the utility relevant business activities

PG&E has integrated VGI options into the Emergency Load Response Program. PG&E has also integrated V2X adoption forecasts into its electric load forecasting process which informs multiple utility planning processes such as the Integrated Energy Policy Report, the Integrated Resources Plan, and internal capacity and distribution planning.

Looking forwards, PG&E is committed to using VGI to decarbonize society at the lowest societal cost with flexible use of EVs. Using a combination of managed charging (V1G) and vehicle to grid (V2G) energy can be stored into vehicles during times of peak renewable generation and made available to supply energy during period of peak demand. This can lower our reliance on fossil fuels which are burned in Peaker Plants used to quickly supply energy during peak demands at the cost of lower efficiency and greater greenhouse gas emissions.

17. Pilots underway with a discussion on the results and next steps including cost, lessons learned

Pilot	Description	Budget	Learnings
Residential V2X pilot – Infrastructure (active)	Give residential customers access to V2X technology, determine pathways to scale and enable the following services: - EV backup power (2024) - EV load shift (2024) - EV export (2024)	\$7.5M	Enrollment in the pilot was launched in April 2023, and participation has been delayed due to lack of capable vehicles and EVSE. PG&E is currently working with OEMs to establish agreements around participation and has added one equipment option to the approved list by the end of 2023, allowing customers to begin to enroll.
Commercial V2X pilot – Infrastructure (active)	Give commercial customers access to V2X technology, determine pathways to scale and enable the following services: - EV backup power (2023) - EV load shift (2024) - EV export (2024)	\$2.7M	Enrollment in the pilot was launched in April 2023, and participation has been delayed due to lack of capable vehicles and EVSE. PG&E is currently working with OEMs to establish agreements around participation and expects to have equipment added to an approved list by early 2024, allowing customers to begin to enroll.
Microgrid pilot – Infrastructure (active)	Pilot will provide incentives to customers located in a multi-customer microgrid that has eligible EVs and EVSEs. The microgrid pilot is focused on enabling bidirectional electric vehicles to charge/discharge in a microgrid to support community resiliency during a PSPS event with the goal of operational integration with multi-customer and critical infrastructure microgrids (i.e., front of the meter (FTM) microgrids with behind the meter (BTM) support)	\$1.5M	A location has been selected as the primary site for Phase 1 of the Microgrid Pilot. Significant progress has been made in the testing and design of the testing cohort which will consist of multiple bidirectional chargers supporting a multi-customer microgrid. Testing is being performed to determine capability of frequency controls to regulate charging/discharging in a microgrid Over the past two years there has been a significant decrease in the number of Public Safety Power System (PSPS) shutoffs that have been required due to upgrades to the PG&E grid that automatically shut off circuits to avoid dangerous situations. As a result, options to broaden the scope of the pilot and expand customer eligibility are being explored. This will allow for additional participation in Phase 2 of the Microgrid Pilot which is expected to launch in line with Phase 2 of the Residential and Commercial Pilots
evPulse Pilot (complete)	PG&E partnered with WeaveGrid to communicate actively manage customer EV charging prior to PSPS event Two participation options: Monitored Charge Customers receive messaging prior to PSPS event Managed Charge Home EV charging actively controlled by WeaveGrid	\$4.8M	Customer Overview As of December 31, 2023, a total of 4,831 EVs associated with 3,403 PG&E customers were enrolled in the pilot program and considered in scope for the report. Eighty-nine percent (89%) of the vehicles enrolled were actively sending data to evPulse as of December 31, 2023. Enrollment for the pilot program began in August 2022 and formally closed in late October 2022. However, at PG&E's discretion, there were a small number of customers allowed to enroll in November and December At the end of the year, 75% of enrolled customers elected to stay in the Resilient Charging - Managed Charge option, where their home EV charging was actively controlled by WeaveGrid and PG&E

	Customers receive \$50 upfront incentive and possible additional incentives of up to \$100	Eligibility Customers had to reside in a High Fire Threat District (HFTD) or had to have been impacted by a PSPS event in the last five years. Objectives • Increase resiliency for EV customers during PSPS events • Improve data on EV customers and their valuation of Vehicle-to-Home solutions • Test customer interest and valuation of a direct load control service • Identify lessons learned on managed charging to inform future program design While notifications for two PSPS events were sent in 2023, the target audience was only one participant for each event. Due to the lack of statistically significant data, PG&E and WeaveGrid implemented a test outage event to evaluate the effectiveness of proactive messaging leading up to PSPS events To further data richness in the pilot, three operational cohorts were launched in Fall 2023 that tested additional grid signals including a self-balancing signal, renewables energy abundance, and a behavioral SMS. Key Findings • 74% of home charging occurs between midnight and 6am • Only 10-20% of plugged in vehicles are actively charging during daytime hours ○ Participants charge their vehicles about 1/4 to 1/3 of the plug session ○ Potential for EVs to respond to utility/grid signals • In the simulated outage event, an SMS message was sent asking participants to charge as if they were preparing for an outage the following day. Compared to the other weekdays, the four hours immediately following the SMS send had between 32% and 63% more energy consumption, suggesting that some drivers heeded the message. Participants' charging duration and state of charge also increased following the message. This suggests that additional EV-specific messaging may help increase driver preparedness ahead of an actual PSPS event • The Self-Balancing cohort utilized WeaveGrid's Distribution Integrated Smart Charging Orchestration (DISCO) algorithm with the goal of flattening the overall load curve of the cohort participants. The observed peak load reduction from self-balancing was very consistent. A peak load reduction greater than 20% was achieved on 96% of weekdays and
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			75% of weekend days. - The Automatic Charging to Renewables cohort utilized a signal derived from CAISO's renewable forecast and was configured to prioritize charging during periods of abundant wind and solar energy. Participants in this cohort had 10% of their home charging energy consumed during high renewable hours compared to 7% for managed charge participants outside of the group. - Across all participants, only 10-20% of plugged-in vehicles are actively charging during daytime hours suggesting there is an opportunity to encourage further energy consumption when renewables are more abundant - The behavioral SMS cohort utilized the same renewable signal; however, instead of configuring their charging, participants received an SMS message to plug in their EV in times of high renewable abundance. An increase in charging over the baseline days was observed on six out of seven Behavioral SMS event days. On these six days, the observed increase in energy consumption ranged from 32% to 203% - Top three self-reported reasons for joining pilot were insights on charge costs, financial incentives, and contributing to reduced strain in that order
Electric School Bus Renewables Integration (completed)	PG&E partnered with Olivine Inc. and Liberty Access Technologies for this pilot project to provide Pittsburg Unified School District (PUSD) with a low-cost, configurable electric fleet management system The main goals of this pilot were: 1. Reduce the Total Cost of Ownership (TCO) of electric buses for school districts by: a. Minimizing infrastructure costs; b. Minimizing fuel costs - Managing charging to reduce electric usage during expensive, peak times 2. Inform how medium and heavy-duty fleet vehicles can act as distributed energy resources during periods of high renewable penetration by testing	\$1.4M	- Contracting, construction, and implementing test protocols with schools may require planning for extra time to reflect their unique contracting processes and seasonal operational patterns - Fleet electrification projects do not occur in a vacuum and are subject to broader risks that site hosts face. For example, projects that implement networked systems or virtual charge management controls are exposed to cybersecurity threats. These internet-enabled capabilities are only as durable as the site host system is secure - School districts and other early fleet adopters may not be able to adjust operations to optimize the use of new electric buses. The suitability of selected electric buses to serve as 1:1 replacement for existing fleet vehicles should be carefully considered during procurement (including passenger capacity and range), or expectations for usage (number of days in use and overall mileage) should be appropriately tempered - The electric school bus industry is experiencing growing pains, which affects equipment O&M. PRP activities brought to light new barriers and accelerated conversations between key industry actors to identify issues and search for solutions

	incentive mechanisms for compensating fleet operators to adapt charging schedules to align with renewable generation.		- When upfront cost support is available, electric school buses have strong potential to reduce fleet TCO relative to the fleet baseline due to the large fuel and O&M savings anticipated under normal operating patterns; lacking support in the form of grants and infrastructure, the cost of electric school buses relative to conventional vehicles does not pencil out - Managed charging with low-cost, non-networked chargers is feasible and can yield operational cost savings for the fleet compared to uncontrolled charging - PG&E was insightful in scheduling a significant block of time after commissioning during which project operators could iron out issues with project hardware and software integration. The challenge of identifying the cause of issues can be compounded when there are several distinct systems integrated in a single project - The use of dynamic signaling to optimize for grid services, renewables, and GHG reductions is feasible. These opportunities can be better realized with high, consistent utilization of the buses - PG&E's Commercial BEV rate design is effective in motivating desired charging behavior and consumption patterns but does not align well with XSP participation
Medium/Heavy-duty Fleet Customer Demonstration (completed)	PG&E partnered with San Joaquin Regional Transit District (SJRTD) to install five depot chargers for overnight charging, demand management software to reduce demand charges associated with overhead fast chargers, and a battery energy storage system (BESS) to further reduce demand charges. The goals of this pilot were: 1. Reduce the Total Cost of Ownership (TCO) using three unique charging models a. Overnight charging at the Regional Transportation Center (RTC) depot location using direct current (DC) fast chargers b. Extreme fast charging at SJRTD's Union Transfer Station (UTS) paired with energy storage	\$1.7M	- The process of deploying energy storage in relatively new applications like transit transfer stations may be more complex and time consuming than expected because local contractors and customers like transit agencies may still have uncertainty about what is required for the install, cost of components, and cost of labor. This issue may or may not be resolved if a turnkey solution is procured from product manufacturers - Early partnership and regular coordinated discussions between the utility, transit agencies, and relevant vendors will provide opportunities for transfer of knowledge and best practices. The utility brings unique insights and can support agencies with expertise developed through implementing programs and projects throughout the territory - Direct access to vehicle manufacturer's online portal with electric bus and charger operational data expedited the data collection process and analysis. It provided transparency into RTD's operations and enabled the evaluation team to react quickly to operational changes - The complexity of managing the charging protocol of multiple generations of buses with a mix of

	c. Extreme fast charging at SJRTD's Downtown Transit Center (DTC) paired with demand management software 2. Inform how transit agencies can best implement transportation electrification and electrify their fleet 3. Identify how non-electrification resources could be used to evaluate other opportunities for cost savings and energy management.		overhead fast charging and depot charging warrants extensive guidance from the bus manufacturer and requires sophisticated management from the transit agency
EV Charge Network Program (completed)	Make-ready and utility-owned charging infrastructure for workplaces and multi-family dwellings. Includes incentives for charger purchase in some customer segments. Up to 7500 level 2 chargers deployed over 3 years. www.pge.com/evcharge	\$113.6M	• Offering turnkey support drives participation and strong demand from Disadvantaged Community (DAC) customers in EVCN and is generally preferred by most customers • Customers seek further support beyond what was offered in EVCN • Costs can be effectively managed through a variety of criteria- • It is efficient and effective to create sophisticated applications to prioritize sites quantitatively before conducting site walks, preliminary designs, and offering contracts • Application sophistication can increase when EVSPs play a larger role in application submission on behalf of sites • Utilizing automated load management (ALM) whenever possible is an effective way to keep costs low • Customer willingness to pay can be maximized through custom-tailored incentives and capping PG&E's cost exposure • Utilization of ports can be increased by prioritizing key indicative criteria • Alignment with other funding entities increases likelihood of project success- • Coordination with community-based organizations can increase site acquisition and customer awareness of EV programs- • There are low-cost opportunities for futureproofing that PG&E can support when they fit within program cost thresholds

18. Metrics on interconnection reform (in conjunction with item 7)

PG&E does not currently track metrics related to interconnection reform.

19. Effectiveness of credit-for-export availability, lessons learned and potential next steps to increase availability

This will be tested as part of phase 2 of the V2X pilots which will allow credit for export based on the VGI Dynamic Rate and is anticipated to launch in 2024.

20. Participants in credit for export and discussion to increase participation –

This will be determined when phase 2 of one of the V2X pilot projects is open to customer enrollment which, as described above, is anticipated in late 2024.

21. Annual energy exported (kWh) and report out on potential efforts to increase participation

PG&E did not have any energy exported from EVs in 2023. PG&E anticipates this to increase via increased availability of V2G technology and new compensation mechanisms for export from EVs such as ELRP and the V2X Pilots.

22. Overall barriers removed in V2B

PG&E is actively engaged in an effort to remove barriers to V2H as part of a pre-pilot effort with two EV OEMs and plans to extend this to commercial V2B as part of the V2X commercial pilot. For V2H we have established an option to bypass interconnection for solutions that are configured to not allow operation parallel to the grid as in the example of solutions that only support islanded backup.

Customers can also receive incentives as part of the V2X pilots for installation V2H and V2B capable infrastructure to help lower the total cost of adoption.

23. Number of EVs enrolled in DR programs

In 2023, PG&E has one non-residential aggregator participating in the Emergency Load Reduction

Program A.5 Vehicle-Grid Integration subgroup. PG&E does not currently have the ability to track into the number of EVs participating in other subgroups contributing to load reduction.

It is also possible that customers with EVs are participating in other aggregator programs that PG&E does not have visibility into.

24. Rate of change of EV DR enrollment and potential steps to increase enrollment

Before the start of each ELRP season, workshops are held to educate and inform prospective aggregators about the program and participation options.

25. EV DR enrollment capacity (MW)

In 2023, PG&E had one aggregator participating in the ELRP A.5 Vehicle-Grid Integration subgroup that provided up to 0.012 MW of load reduction during events.

26. EV DR enrollment load shift (MWh)

In 2023, PG&E had one aggregator participating in the ELRP A.5 Vehicle-Grid Integration subgroup that provided up to 0.079 MWh of load reduction across the 9 events called.

27. Estimated aggregated GHG reduction attributable to VGI

This is not currently tracked within PG&E.

28. Site Participation in rate-to-driver and discussion on how to increase participation –

PG&E does not have rate-to-driver programs.

29. Sites participating in DR, lesson learned and next steps to increase participation –

In 2023, one aggregator participated in ELRP A.5 VGI across three sites. PG&E will continue to hold workshops to educate prospective aggregators on their options to participate in ELRP.

30. Barriers to data collection and potential solutions

Barriers include not having previously tracked the data and in certain cases, PG&E doesn't have direct access to that data and would only be able to collect it through a customer survey process which would require additional funding to conduct. This is particularly true for EVs participating in ELRP outside of the A.5 subgroup since they do not have to report on the type of DER they are participating with.

31. Load shift for EV rate customers

Data on the customer load impacts on TOU rates, including residential EV rates, were included in PG&E's 2022 Load Impact Evaluation of Residential TOU Rates Report filed to CPUC and posted publicly on 4/3/2023 on PG&E's site:

<http://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=734214>

A separate report on EV Infrastructure Cost and Load can be found on the CPUC website within the documents section found at: [Proceeding Details \(ca.gov\)](https://www.cpuc.ca.gov/Proceedings/Details/2023-04-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000). The updated report for 2023 will also be posted in April of 2024.

32. Rate-to-driver enrollment by sites

PG&E does not have rate-to-driver programs

33. Dynamic rate load shift (MWh)

PG&E does not currently have any EVs on a dynamic rate. This will be evaluated based on the data from the phase 2 of the V2X pilots targeted to launch in late 2024.

34. Aggregate unmanaged load profiles within programs (kWh)

PG&E does not have a way to identify EV users that are on unmanaged load profiles.

35. Aggregate unmanaged load profiles within programs (kW)

PG&E does not have a way to identify EV users that are on unmanaged load profiles.

36. Aggregate unmanaged load profiles outside of programs (kWh, Misc.)

Data on the customer load impacts on TOU rates, including residential EV rates, were included in

PG&E's 2022 Load Impact Evaluation of Residential TOU Rates Report filed to CPUC and posted publicly on 4/3/2023 on PG&E's site:

<http://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=734214>

A separate report on EV Infrastructure Cost and Load can be found on the CPUC website within the documents section found at: [Proceeding Details \(ca.gov\)](#). The updated report for 2023 will also be posted in April of 2024.

37. Aggregate unmanaged load profiles outside of programs (kW, Misc.)

Data on the customer load impacts on TOU rates, including residential EV rates, were included in PG&E's 2022 Load Impact Evaluation of Residential TOU Rates Report filed to CPUC and posted publicly on 4/3/2023 on PG&E's site:

<http://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=734214>. A report for 2023 will be posted in April of 2024 and can be found on the same website by selecting "Demand Response OIR 2013" from the dropdown menu, select "PGE" from party dropdown menu and enter 04/23 in the "from" and "to" dates.

A separate report on EV Infrastructure Cost and Load can be found on the CPUC website within the documents section found at: [Proceeding Details \(ca.gov\)](#). The updated report for 2023 will also be posted in April of 2024.

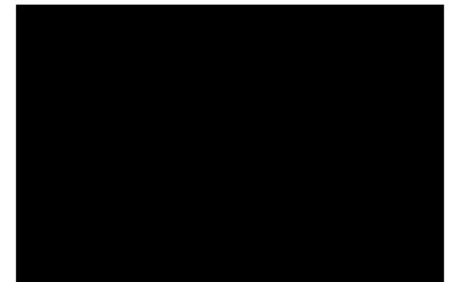
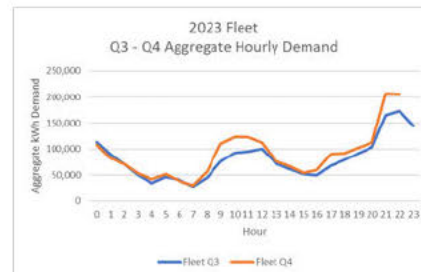
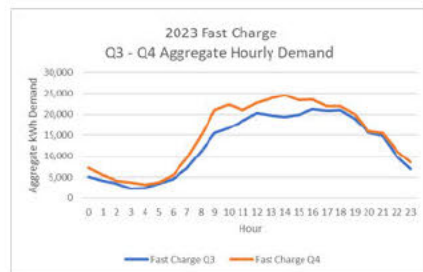
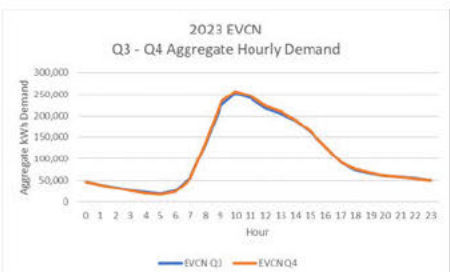
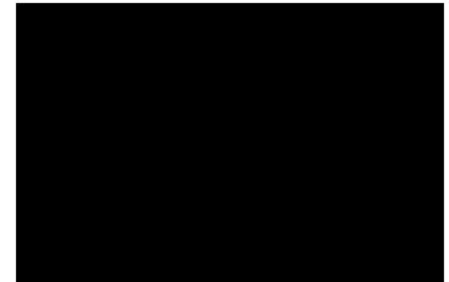
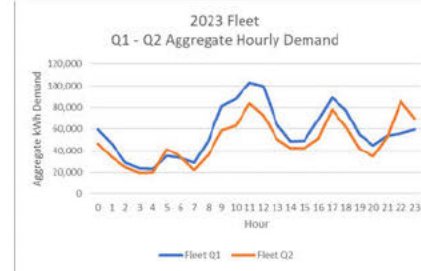
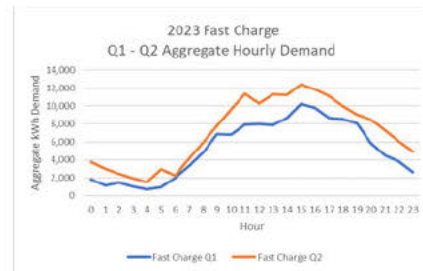
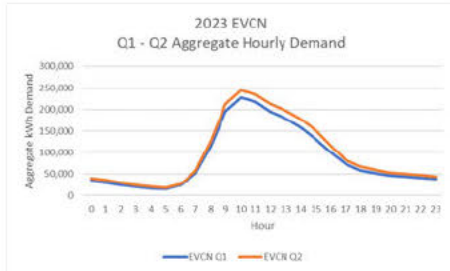
38. Net Avoided Costs from Avoided Upgrades

PG&E does not track avoided costs from avoided upgrades at this time.

The redacted portions below contain Confidential, Customer-specific data, which may include demand, loads, names, addresses, and billing data.
Protected under PUC § 8380; Civ. Code §§ 1798 et seq.; Govt. Code § 6254; Public Util. Code § 8380; Decisions (D.) 14-05-016, 04-08-055, 06-12-029

39. Aggregate Load Profiles for EV TOU Rates Within Programs (kWh)

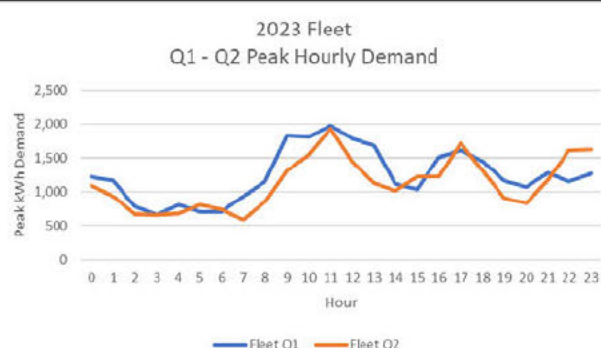
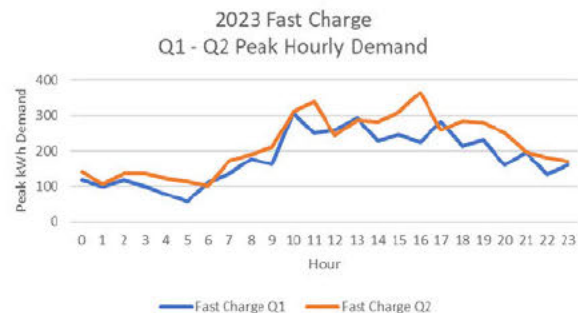
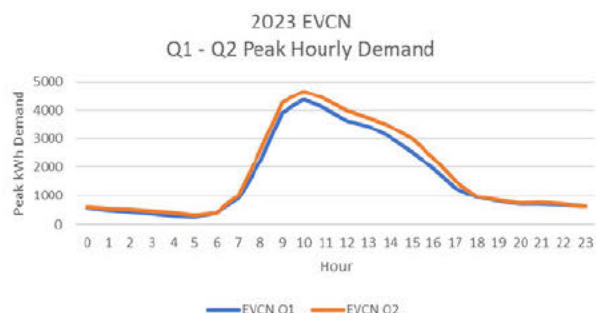
Metric			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Aggregate hourly demand	EVCN	Q1	34,312	29,952	24,379	20,442	16,947	15,668	23,823	51,559	114,024	196,857	226,999	217,775	195,077	179,440	158,979	130,840	101,179	73,215	58,572	51,473	46,075	43,983	41,822	38,093
Aggregate hourly demand	EVCN	Q2	40,113	35,477	29,921	24,660	20,318	18,262	26,717	56,495	126,306	213,314	244,431	234,861	212,892	197,361	178,421	151,565	117,336	83,527	67,579	59,346	52,856	50,019	47,727	43,761
Aggregate hourly demand	EVCN	Q3	46,492	39,944	33,152	26,717	21,216	17,885	25,070	56,988	133,258	223,308	252,335	242,293	218,077	205,744	189,108	162,370	128,909	91,485	73,415	65,877	60,080	57,467	54,996	50,461
Aggregate hourly demand	EVCN	Q4	46,655	39,824	32,424	25,182	19,591	16,638	23,198	54,030	136,118	231,397	257,958	246,538	223,672	209,816	190,547	162,942	128,266	92,056	76,787	67,810	60,902	57,824	54,645	50,722
Aggregate hourly demand	Fast Charge	Q1	1,801	1,129	1,433	998	712	951	1,990	3,316	4,803	6,873	6,813	7,958	8,002	7,897	8,653	10,257	9,803	8,676	8,583	8,054	5,871	4,502	3,851	2,660
Aggregate hourly demand	Fast Charge	Q2	3,754	3,032	2,434	1,936	1,531	2,924	2,236	4,119	5,954	7,804	9,607	11,360	10,312	11,277	11,259	12,408	11,844	11,127	9,971	9,050	8,494	7,292	6,051	4,930
Aggregate hourly demand	Fast Charge	Q3	5,171	4,215	3,546	2,282	2,489	3,456	4,537	7,116	11,173	15,536	16,754	18,482	20,310	19,736	19,328	19,942	21,317	20,813	21,030	18,944	15,702	14,853	9,998	7,042
Aggregate hourly demand	Fast Charge	Q4	7,221	5,502	4,250	3,790	3,233	3,841	5,512	9,454	14,806	20,927	22,280	20,980	22,703	23,792	24,547	23,423	23,497	21,991	21,946	20,026	15,975	15,571	11,372	8,614
Aggregate hourly demand	Fleet	Q1	59,130	46,042	28,801	23,472	23,333	34,935	33,047	28,758	49,614	80,996	87,880	102,951	99,781	63,833	48,251	49,123	68,885	88,947	77,239	54,562	44,644	53,573	55,915	59,517
Aggregate hourly demand	Fleet	Q2	46,189	33,458	24,796	19,624	20,174	41,183	34,131	21,946	36,279	58,582	63,136	83,599	72,991	50,364	42,236	42,181	51,149	78,172	62,050	41,637	34,733	52,674	85,798	69,745
Aggregate hourly demand	Fleet	Q3	113,501	89,442	71,017	49,290	34,567	46,197	40,927	28,534	45,680	75,943	92,772	94,734	100,264	72,074	61,833	52,180	49,458	68,361	78,687	91,642	103,707	165,147	173,746	144,638
Aggregate hourly demand	Fleet	Q4	108,098	81,622	70,814	53,188	42,278	51,316	39,056	30,273	57,246	110,467	122,972	122,416	111,956	76,219	66,723	53,846	59,326	90,356	91,690	102,866	112,501	207,439	206,292	159,018



The redacted portions below contain Confidential, Customer-specific data, which may include demand, loads, names, addresses, and billing data.
Protected under PUC § 8380; Civ. Code §§ 1798 et seq.; Govt. Code § 6254; Public Util. Code § 8380; Decisions (D.) 14-05-016, 04-08-055, 06-12-029

40. Aggregate Peak Load of EV TOU Rates within Programs (kW)

Metric			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Peak hourly demand	EVCN	Q1	568	485	434	367	292	264	406	897	2182	3923	4390	4091	3638	3441	3062	2550	1978	1285	954	805	708	694	679	619
Peak hourly demand	EVCN	Q2	608	554	509	459	397	315	412	1002	2562	4259	4671	4406	3998	3750	3457	3022	2346	1524	990	844	739	754	703	626
Peak hourly demand	EVCN	Q3	763	687	590	480	405	313	412	965	2,597	4,399	4,646	4,264	3,813	3,722	3,516	3,069	2,436	1,480	1,072	977	945	882	824	823
Peak hourly demand	EVCN	Q4	750	675	598	537	441	341	371	994	2,827	4,546	4,801	4,434	4,014	3,775	3,451	3,061	2,327	1,512	1,099	968	905	898	781	788
Peak hourly demand	Fast Charge	Q1	118	100	117	100	78	55	110	136	176	161	308	250	259	294	227	245	224	283	212	230	159	197	133	159
Peak hourly demand	Fast Charge	Q2	140	106	136	134	120	114	102	172	189	209	309	337	243	288	283	309	364	258	285	280	249	197	180	171
Peak hourly demand	Fast Charge	Q3	206	172	206	142	129	137	187	234	293	357	410	469	455	510	477	503	477	470	433	440	422	324	250	252
Peak hourly demand	Fast Charge	Q4	188	177	134	254	132	130	194	242	344	504	484	467	487	459	468	495	514	594	491	564	362	366	311	242
Peak hourly demand	Fleet	Q1	1,216	1,164	785	655	803	705	699	928	1,157	1,835	1,812	1,983	1,786	1,679	1,116	1,032	1,514	1,608	1,455	1,160	1,069	1,278	1,158	1,270
Peak hourly demand	Fleet	Q2	1,092	929	670	661	685	812	734	584	852	1,315	1,549	1,939	1,443	1,129	1,014	1,216	1,224	1,717	1,319	912	836	1,178	1,609	1,623
Peak hourly demand	Fleet	Q3	43,811	34,856	27,605	19,279	13,687	15,608	14,394	9,670	18,074	31,090	36,919	39,815	38,089	24,975	22,644	19,265	18,314	26,307	31,982	34,062	41,061	64,986	66,019	55,584
Peak hourly demand	Fleet	Q4	41,876	32,022	26,589	19,357	14,962	17,447	13,324	11,429	21,192	38,394	41,317	42,357	40,059	26,245	23,303	19,207	20,770	31,772	34,141	38,503	42,710	75,851	75,630	60,968



41. Rate-to-host

PG&E does not have a rate-to-host program.

42. Rate-to-driver

PG&E does not have a rate-to-driver program nor is PG&E aware of what drivers are charged by third parties. Collecting this data would require a separately funded survey process.

43. Aggregate load profiles for EV TOU rates outside of programs (kWh)

Commercial

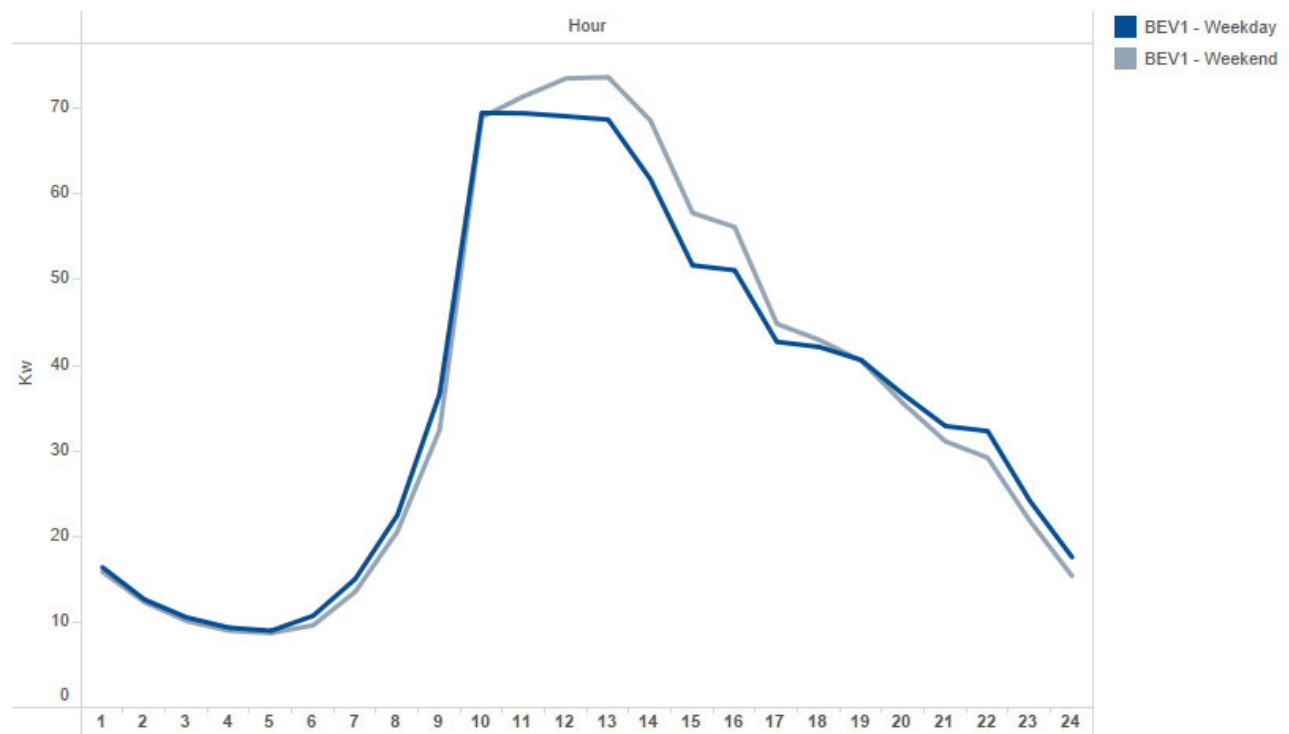


Figure 1. Average Load Profile for BEV-1 Customer by Weekday and Weekend (2023)

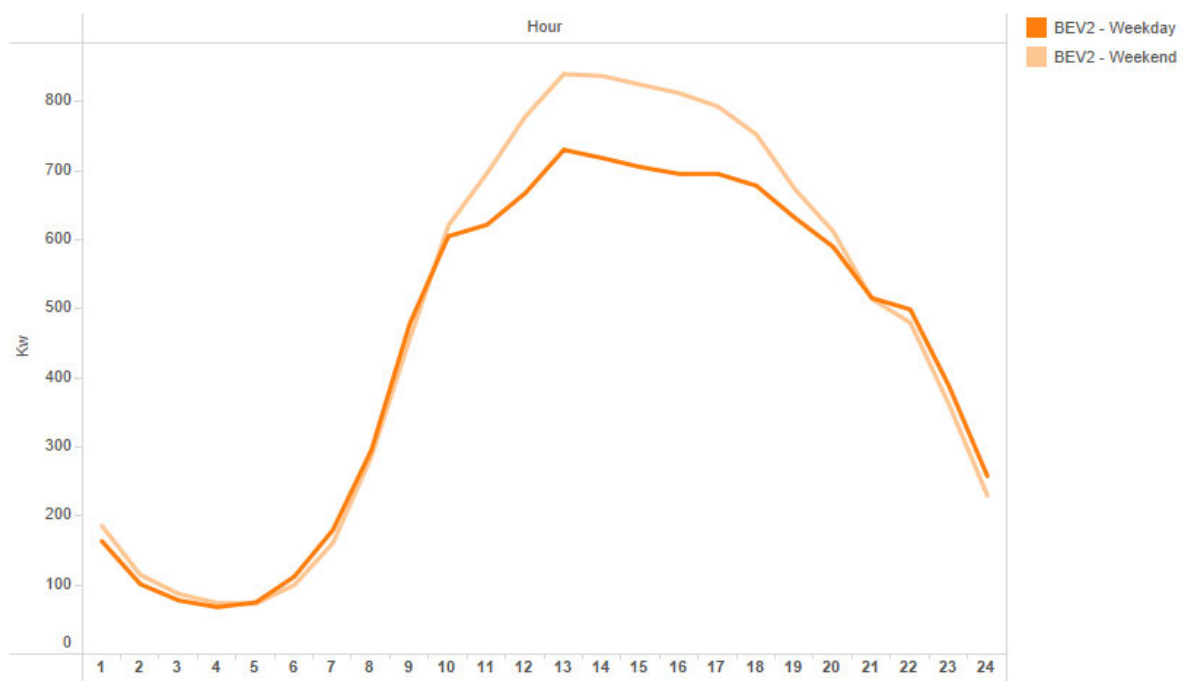


Figure 2. Average Load Profile for BEV-2 Customer by Weekday and Weekend (2023)

Residential

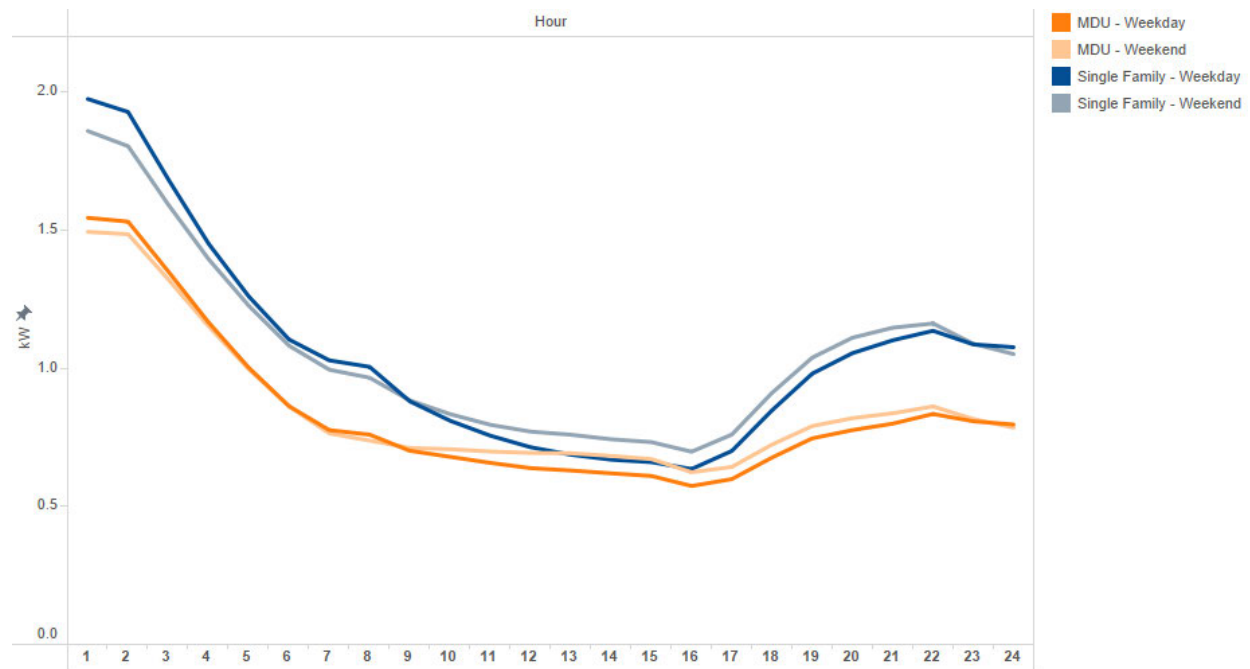


Figure 3. Average Load Profile for SF and MDU Single-Metered by Weekday and Weekend (2023)

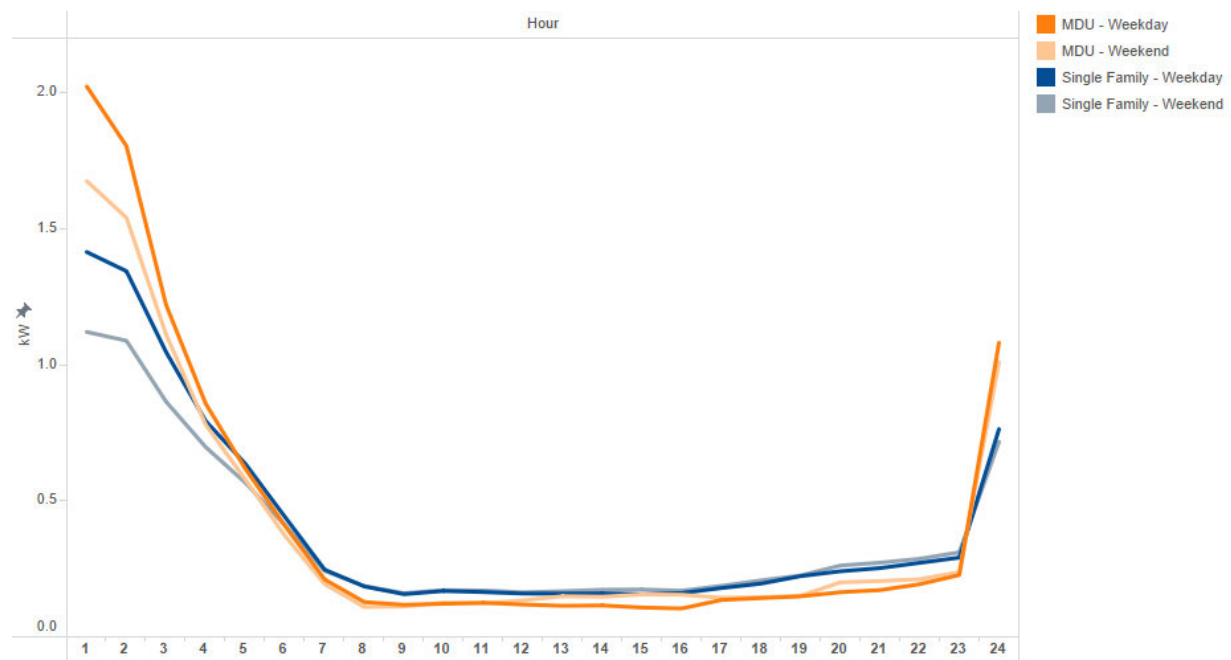


Figure 4. Average Load Profile for SF and MDU Separately Metered by Weekday and Weekend (2023)

44. Aggregate peak load of EV TOU rates outside of programs (kW)

Commercial

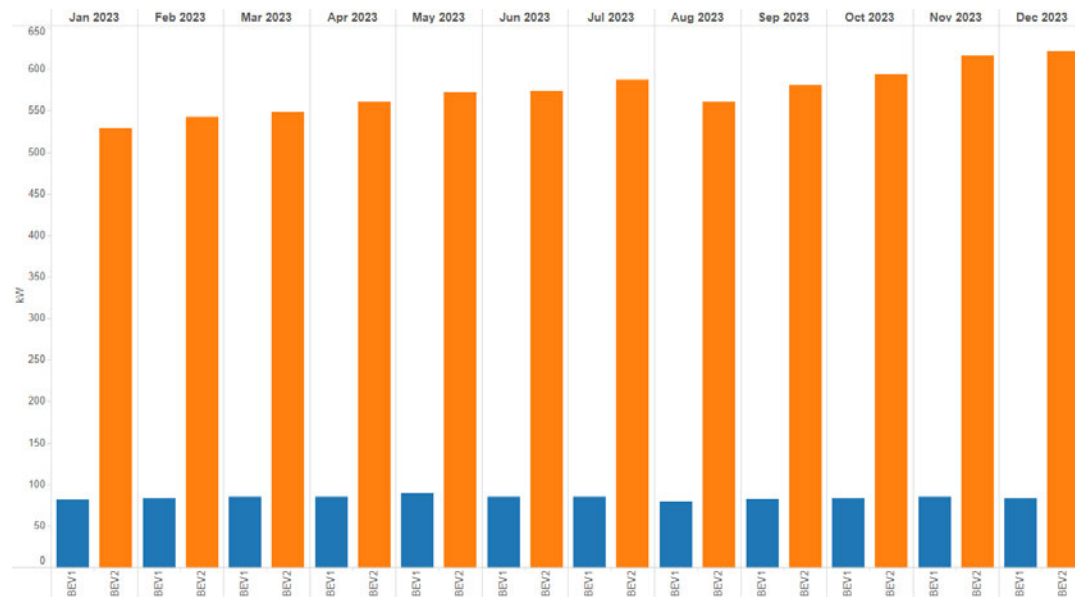


Figure 55. Average Non-Coincident Peak Load (kW) by Customer Type by Month (2023)

Residential

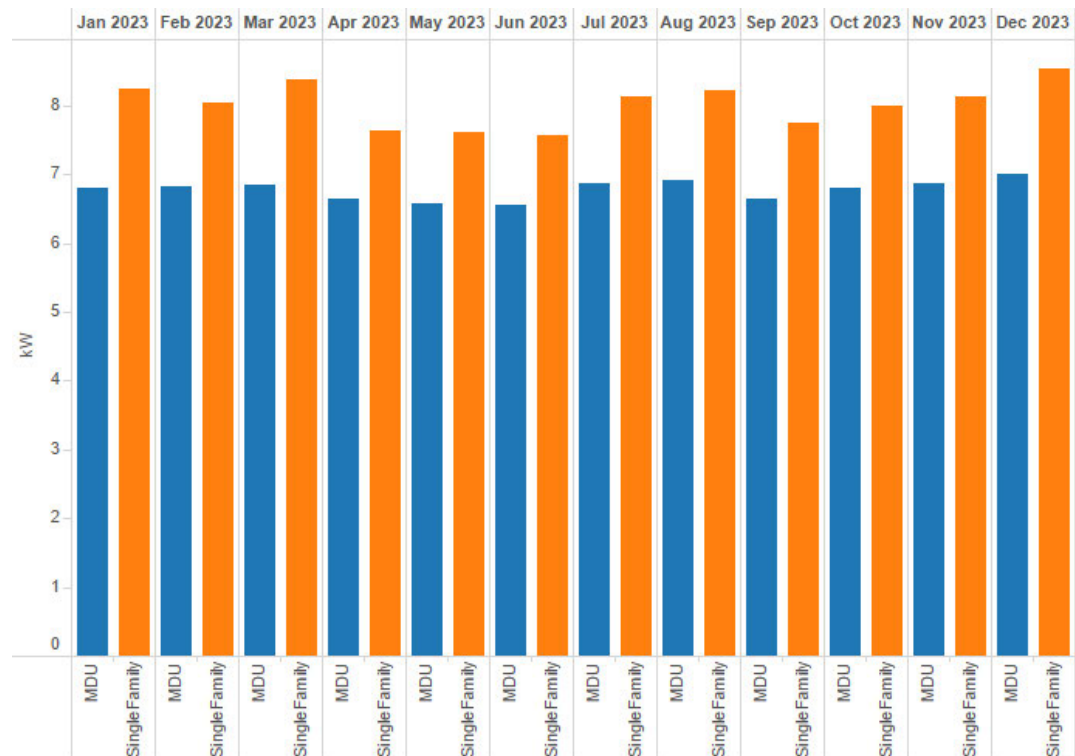


Figure 6. Average Non-Coincident Peak Load (kW) for Single-Metered by Customer Type by Month 2023

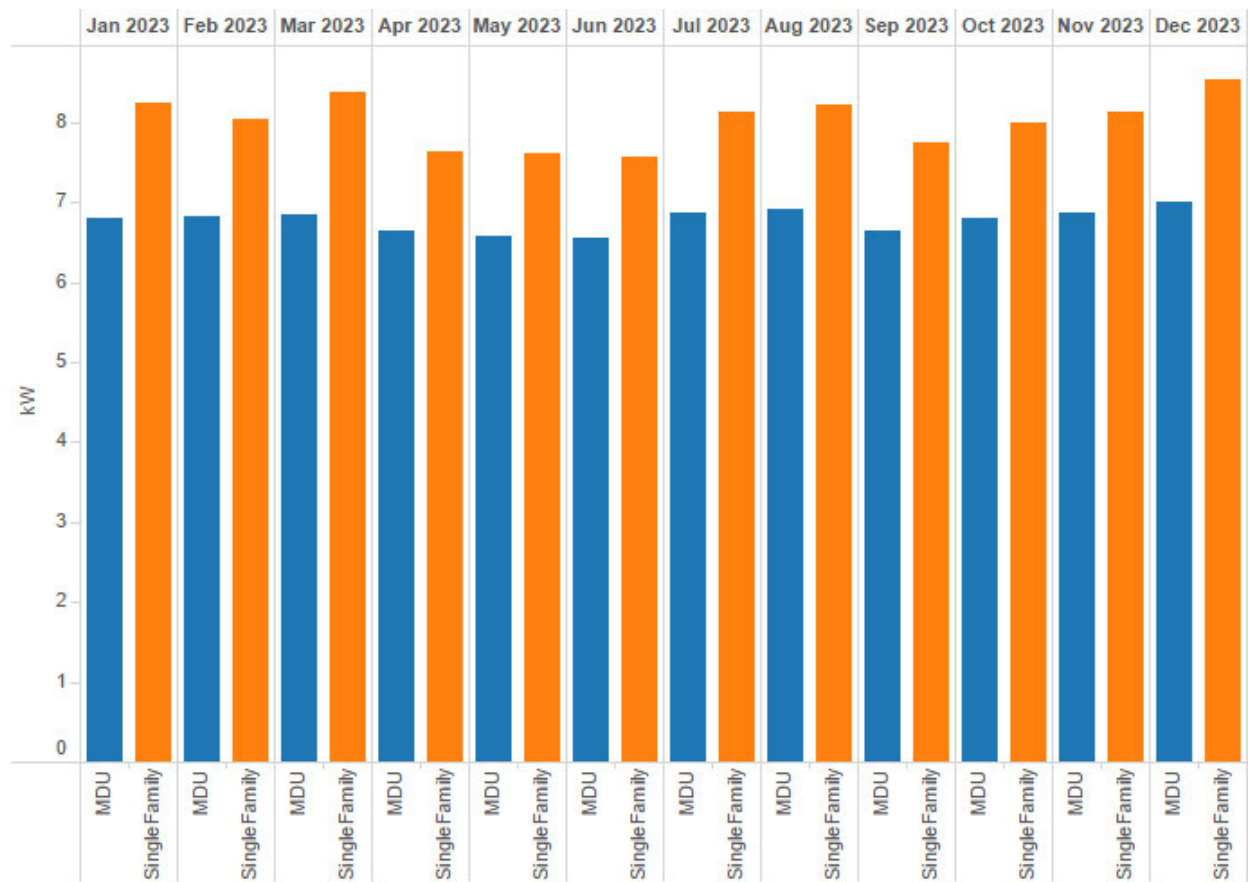


Figure 7. Average Non-Coincident Peak Load (kW) for Separately Metered by Customer Type by Month 2023

Appendix A - VGI Reporting Template

Program and Pilot Metrics

				Totals:	1364	20	20	N/A	N/A	N/A	N/A	N/A	N/A	\$ 388.70	\$ 180.40
Program/Pilot(1)	Market Segment - Residential or Commercial	Market Segment - Subcategory	ESJ subcategory	Implementation Status	Number of ports participating in ALM	Number of sites participating in ALM	Number of sites participating in dynamic rates	Number of EV drivers participating in dynamic rates	Total number of V2G EVSE customers	Distribution-side cost savings	Customer-side cost savings (related to panel and similar equipment)	Upgrade avoided by ALM	Savings of upgrades avoided by ALM	Authorized Budget (Millions)	Budget expended (Millions)
EVCN (Program)	Commercial	Workplace	DAC	Active	50	1	1	N/A	N/A	N/A	N/A	N/A	N/A		
EVCN (Program)	Commercial	Workplace	Non DAC	Active	468	10	10	N/A	N/A	N/A	N/A	N/A	N/A	130	117
EVCN (Program)	Commercial	Multi Unit Dwelling	DAC	Active	713	5	5	N/A	N/A	N/A	N/A	N/A	N/A		
EVCN (Program)	Commercial	Multi Unit Dwelling	Non DAC	Active	133	4	4	N/A	N/A	N/A	N/A	N/A	N/A		
Fleet Ready Program	Commercial	All	All	Active	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	236.3	49.5
Fast Charge Program	Commercial	All	All	Active	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22.4	13.9
Schools Program	Commercial	Workplace	All	Active	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.7	4.1
Parks Program	Commercial	All	All	Active	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.5	0.53

Appendix B - Interim V2X Pilots Report

This interim evaluation report on the V2X Pilots addresses the reporting required by Section 17 of Resolution E-5192.

PG&E has only launched Phase 1 of Pilots 1 and 2 and therefore will only report out on the proposed metrics for Phase 1.

- PG&E proposed metrics from Tables 1-4 in Resolution E-5192:
 - Pilot 1: Residential
 - **Customer enrollment and attrition rates**
No enrollment yet.
 - **V2X incremental deployments costs**
Cannot be ascertained without enrollment data.
 - **Influence of the pilot incentives to motivate V2X purchase decisions**
Cannot be ascertained without enrollment data.
 - **Value (revenue and other benefits) to customers and to the electricity grid for each V2X application tested in the pilot**
Phase 1 will test the emergency backup power use case, which refers to providing power to the home in the event of an outage. No revenue is expected to accrue to either the customer or the grid in this use case. The benefit is purely one of resiliency for the customer.
Phase 2 value cannot be determined until Phase 2 launch, estimated in Q4 2024.
 - **Total cost of ownership savings due to V2X**
Phase 1 will not generate revenue for the customer, resulting in no total cost of ownership savings.
 - **Pathways (existing rules and regulations) that currently inhibit V2X value creation for customers and/or the electricity grid**
PG&E has worked directly with the approved equipment providers to enable a pathway to energize systems that are capable of participation in Phase 1 but not Phase 2 (grid-connected use cases) that avoids interconnection, thus removing this barrier in cost and time.
 - Pilot 2: Commercial
 - **Customer enrollment (number of vehicles) and attrition rates**
No enrollment yet.
 - **V2X incremental deployments costs**
Cannot be ascertained without enrollment data.
 - **Influence of the pilot incentives to motivate V2X purchase decisions**
Cannot be ascertained without enrollment data.
 - **Value (revenue and other benefits) to customers and to the electricity grid for each V2X application tested in the pilot**
Phase 1 will test the emergency backup power use case, which refers to providing power to on-site loads in the event of an outage. No revenue

accrues to the grid in this use case. The benefit is purely one of resiliency for the customer, but without enrollment data, this cannot yet be quantified.

Phase 2 value cannot be determined until Phase 2 launch, estimated in Q4 2024.

Total cost of ownership savings due to V2X

Cannot be ascertained without enrollment data.

- **Pathways (existing rules and regulations) that currently inhibit V2X value creation for customers and/or the electricity grid**

PG&E will work directly with the approved equipment providers (no commercial equipment has yet been approved) to enable a pathway to energize systems that are capable of participation in Phase 1 but not Phase 2 (grid-connected use cases) that avoids interconnection, thus removing this barrier in cost and time.

- o **Pilot 3: Microgrid**

- **Number of customers who enroll in the pilot and attrition rate**

- Phase 1 will test four bidirectional EVs at a single customer site.

- **Incentives required (value and structure) to induce participation**

- Phase 1 will cover the full cost of installation and testing. These costs have not yet been finalized.

- **Reduction in greenhouse gas emissions and fuel costs within the Public Safety Power Shutoff microgrid**

- Phase 1 testing has not yet begun.

- **Reduction in equipment or nameplate capacity required to serve the microgrid**

- Phase 1 testing has not yet begun.

- **Cost to serve the microgrid using conventional generation versus incentives and compensation to EV participants**

- These costs have not yet been finalized.

- **Operational time and complexity**

- Phase 1 testing has not yet begun.

- **Reliability and consistency of bi-directional EVs and potential to scale bidirectional EVs as a community micro-grid resource**

- Phase 1 testing has not yet begun.

- **Additional metrics added by Section 17.1.**

- o **Adoption of communication standards by technology providers participating in the pilots.**

- PG&E is requiring the following technical requirements for EVSE Providers to participate in the pilots:

- The Eligible EVSE is able to (1) measure and communicate demand (kW) and energy (kWh) at an accuracy of +/-2%, (2) communicate energy and demand usage via WIFI and/or cellular connections, (3) use Open Charge Point Protocol ("OCPP") 1.6 or later to communicate data and signals; and (4) respond to

demand response signals via IEEE 2030.5 or the OpenADR 2.0b protocol using either its integrated software or through its cloud platform.

- Pilots 1 and 2:
 - **Consumer understanding & participation in response to rate tariffs, ELRP, and/or other pricing structures**
New pricing structures are not yet available for testing as part of pilot participation.
 - **Data for ESJ and non-ESJ customers on both participation levels, kWh delivered, and incentives paid for each value stream. For the commercial fleets pilot, PG&E must disaggregate data for EVs with different battery capacities and EVs with different operational cycles**
No enrollment yet.
 - **Customer participation by zip code or other geographic regions; and by number of EVs that a residential or commercial customer operates**
No enrollment yet.
 - **Cost data for up-front and any on-going incremental costs for bi-directional EVSE of different power levels and, if available, costs for AC bi-directional EVSE compared to DC bi-directional EVSE**
No enrollment yet.
 - **Round-trip electrical losses for bi-directional charging by power level and type (DC and, if applicable, AC) and vehicle segment**
No enrollment yet.
 - **Maturity of business models for deployment of the use cases developed in the pilots**
Phase 1 testing has not yet begun.
 - **Number of customers reached, and number of customers enrolled by market actor partners developing & deploying customer education and key lessons learned.**
Marketing materials are still under development; No enrollment yet.
- **Progress and any additional efforts that will be needed to resolve barriers noted in PG&E's October 15, 2021, data response.**

Pilot	Practical & Policy Barriers	Progress and additional efforts needed
Pilot 1: Residential V2X	□ Bidirectional EVs and/or equipment cannot obtain the same value and compensation for grid services as other distributed energy resources (DERs) (such as battery storage or solar) that are eligible to participate in the Net Energy Metering (NEM) tariff and/or the Self-Generation Incentive Program (SGIP) incentives □ Disincentives exist to participate in demand response (DR) programs, such as the capacity bidding program (CBP) due to a limitation on compensation against a baseline □ Lack of compensation for export capability □ EV ownership costs prohibitory for ESJ communities □ Higher cost for residential bidirectional DC chargers over residential AC Level 2 chargers □ Single replicable communication (digital) platform that aggregates multiple OEM and EVSE brands □ Lack of cost data and quantification of benefits for a robust cost-benefit analysis □ Lack of market signals to increase private-industry technology development, production and customer adoption □ Low-power bidirectional DC chargers are not considered in existing utility make-ready infrastructure programs	- NEM/NBT and SGIP eligibility requirements are unlikely to ever permit EVs - DR programs that measure compensation against a baseline exhibit a disincentive due to the misalignment of typical charging hours with event hours. This is overcome by use of V2G capabilities, which are forthcoming from automakers. - Phase 2 of the pilot will provide export compensation via a dynamic rate - The upfront incentive for this pilot is higher for customers located in disadvantaged communities (as defined by AB 841) - The upfront incentive for this pilot was originally designed to cover the expected difference in cost between a bidirectional charger and a unidirectional charger. This delta is larger than anticipated, making the incentives less effective until manufacturers can bring costs down or financial benefits (incentives and/or compensation) can be proven to improve payback - PG&E is conducting an RFP for a cloud platform vendor that will be capable of aggregating across EV and EVSE brands - Phase 2 will enable a more robust cost-benefit analysis - The objective of this pilot is to inform large-scale programs that would help to accelerate the V2G market by providing value to both customers and the utility - As more technologies become eligible for this pilot, PG&E will be able to assess their fit for make-ready infrastructure programs
Pilot 2: Commercial V2X	□ Bidirectional EVs and/or equipment cannot obtain the same value and compensation for grid services as other distributed energy resources (DERs) (such as battery storage or solar) that are eligible to participate in the Net Energy Metering (NEM) tariff and/or the Self-Generation Incentive Program (SGIP) incentives □ Disincentives exist to participate in demand response (DR) programs, such as the capacity bidding program (CBP) due to a limitation on compensation against a baseline □ Lack of compensation for export capability	- NEM/NBT and SGIP eligibility requirements are unlikely to ever permit EVs - DR programs that measure compensation against a baseline exhibit a disincentive due to the misalignment of typical charging hours with event hours. This is overcome by use of V2G capabilities, which are forthcoming from automakers - Phase 2 of the pilot will provide export compensation via a dynamic rate - The upfront incentive for this pilot is higher for customers located in disadvantaged communities (as defined by AB 841) - The upfront incentive for this pilot was originally designed to cover the expected difference in cost between a bidirectional charger and a unidirectional charger. This

	□ EV ownership costs prohibitory for ESJ communities □ Higher cost for 3-phase bidirectional DC chargers over 3-phase unidirectional DC chargers □ Single replicable communication (digital) platform that aggregates multiple OEM and EVSE brands □ Lack of cost data and quantification of benefits for a robust cost-benefit analysis □ Lack of market signals to increase private-industry technology development, production and customer adoption □ 3-phase bidirectional DC chargers do not receive additional rebates for the incremental cost or additional functionality in existing utility make-ready infrastructure programs	delta is larger than anticipated, making the incentives less effective until manufacturers can bring costs down or financial benefits (incentives and/or compensation) can be proven to improve payback - PG&E is conducting an RFP for a cloud platform vendor that will be capable of aggregating across EV and EVSE brands - Phase 2 will enable a more robust cost-benefit analysis - The objective of this pilot is to inform large-scale programs that would help to accelerate the V2G market by providing value to both customers and the utility - As more technologies become eligible for this pilot, PG&E will be able to assess their fit for make-ready infrastructure programs
Pilot 3: V2M (Microgrid)	□ Lack of participation of behind-the-meter (BTM) DERs in coordination with front-of-the-meter (FTM) generation for resiliency □ Scalable real-time controls for managing the balance of generation and load within a multi-customer microgrid □ Protection schemes that support high penetration distributed generation □ Lack of validation of bidirectional inverter hardware, in combination with vehicles operating in multi-customer microgrids □ Lack of integration to operations and planning to effectively include BTM DER capacity when operating a multi-customer microgrid □ Lack of BTM DERs that can accurately and reliably detect a utility-formed microgrid □ Lack of BTM DERs that are able to respond in real time to generation and load balance within the microgrid □ Logistical challenges to implement direct connectivity to each individual DER, replacement of hardware or additional communication equipment, and other site level device upgrades across the entire network □ Limited solutions that are low cost, require low to no customer involvement, and are universally applicable	- Phase 1 of this pilot will test coordination between BTM and FTM generation - Phase 1 of this pilot will work with a multi-customer microgrid - This pilot is designed to test more advanced inverter functionality that should allow for higher penetration of distributed generation within a microgrid - Phase 1 of this pilot will test bidirectional inverter hardware in combination with EVs - Phase 1 of this pilot will work with a multi-customer microgrid and may be able to assess the benefits of increased consideration of BTM DER capacity in operations and planning - Phase 1 of this pilot will test the ability of the technology to detect a utility-formed microgrid - Phase 1 of this pilot will test the ability of the technology to respond in real-time to the balance of load and generation on the microgrid - Phase 1 of this pilot will test a passive approach to grid support that may remove the need for direct connectivity involving replacing or adding hardware. - This pilot will result in industry learnings regarding customer experience as part of a microgrid - This pilot will explore methods of compensating customers for participation in a microgrid to inform future utility programs - This pilot leverages incentives that can be stacked on those provided by either pilot 1 or

	□ Customer performance logging and renumeration for participation are not considered by utility programs □ High cost of interconnection studies for customers without NEM □ Customer concerns around mobility during a PSPS emergency □ Higher cost of charging from the grid during times that customers may not normally have to prepare for PSPS events	2 - This pilot will inform industry understanding of customer concerns regarding their mobility during a PSPS event - Our evPulse managed charging program is exploring how to optimize charging in preparation for PSPS events
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- **Customer convenience as noted in AL 6259-E, including whether participation conflicts with other priorities such as transportation needs.**
Use case testing has not yet begun.