BEFORE THE PUBLIC UTILITIES COMMISSION OF THE

STATE OF CALIFORNIA

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SOUTHERN CALIFORNIA EDISON COMPANY'S (U 338-E) VEHICLE-GRID INTEGRATION STRATEGIES ANNUAL REPORT FOR 2022

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Dated: **March 15, 2023**

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VEHICLE-GRID INTEGRATION STRATEGIES
ANNUAL REPORT FOR 2022

Pursuant to Ordering Paragraph (OP) 1 of Decision (D.) 20-12-029 (Decision), Southern California Edison Company hereby submits its 2022 annual report on Vehicle-Grid Integration Strategies for 2022. The Report outlines SCE's VGI activities from January 1 through December 31, 2022.

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Attachment A

Annual VGI Strategies

SCE Annual VGI Strategies Report for 2022

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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 mid-term and annual reports on metrics pertainingto pilots and programs related to Vehicle-Grid Integration (VGI).

Ordering Paragraph (OP) 1 directs utilities to "file mid-term reports annually starting on September 15, 2021, and annual reports starting on March 2021 and ending March 15, 2031."[1] On February 1, 2021, Executive Director Peterson issued an *Order Correcting Error*, to correct the date for the first annual report to March 15, 2022.

Southern California Edison (SCE) submitted its first mid-term report on VGI Activities on September 15, 2021. The mid-term report covered the period of January 1 through June 30, 2021. SCE subsequently filed its first annual report on March 15, 2022.

This annual report covers the period from January 1 through December 31, 2022. In accordance with the Decision, the 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.[2] The data collection template is provided as a separate Excel document.

In this report, SCE provides information on existing transportation electrification (TE) pilots and programs, some of which may have been implemented for a year or longer. SCE routinely tracks data, including costs and customer enrollment, for its TE pilot and program reports. SCE's program managers, internal experts, and TE staff were also engaged to provide narrative updates on the latest program and activity metrics.

The VGI template establishes some additional data requirements that SCE was not tracking as part of its existing reporting. Some of these data elements are not available for this report as they pertain to programs or projects which SCE has not launched as of this report's timeframe covered, or SCE does not have access to those data elements. Additionally, SCE's TE programs are in various stages of

1 D.20-12-029, OP 1.

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

implementation. As a result, some programs may have limited data. SCE discusses these areas in the Narrative Questions section, response to question 30 on "Barriers to data collection and potential solutions."

A. VGI Definitions

SB 676 originally defined VGI and gave authority to the Commission to revise thedefinition. In the Decision, VGI's definition is revised 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 thatoptimizes plug-in electric vehicle or equipment interaction with the electrical grid and provides net benefits to ratepayers by doing any of the following:
>
> A. Increasing electrical grid asset utilization and operational flexibility.
> B. Avoiding otherwise necessary distribution infrastructure upgrades andsupporting resiliency.
> C. Integrating renewable energy resources.
> D. Reducing the cost of electricity supply.
> E. Offering reliability services consistent with the resource adequacy requirements established by Section 380 or the Independent System Operator tariff.[3]

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

- Methods, including TOU tariffs and programs, autonomous or automatic settingson electric vehicles (EVs) or charging systems that position charging times and rates to increase grid asset utilization.

- V1G: Vehicle charging is managed to respond to grid requirements to improve reliability and reduce costs. SCE further breaks this down into direct and indirect forms:
    - Indirect V1G uses EVs or Electric Vehicle Supply Equipment (EVSE) that can adjust according to price signals or periods and/or other mechanisms to optimize charging that benefits both the grid and the customer.

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[3] D.20-12-029, pp. 12-13.

    - Direct V1G features the utility taking an active role in controlling timingand amount of vehicle charging, for example throttling charging load during peak periods using a demand response (DR) mechanism.
- V2G: Vehicle-to-grid bidirectional charging and discharging, under which EVs may discharge in parallel with the grid, or to an isolated microgrid or home, providing potential added value in addition to that offeredby V1G.
- V2B: Vehicle to building parallel interconnection with the grid for non-export demand support.

B. 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.[4] Additionally, theDecision adopts the VGI staff proposal to establish 3 categories, with numerouscorresponding 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.[5]

For reporting purposes, the Decision directed the large electrical corporations to consultwith the Commission's Energy Division staff to create a VGI reporting template that incorporated the required metrics.[6] 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 SCE specific questions, to provide an overview of the utility'sVGI efforts and qualitative information, and (2) a spreadsheet for reporting quantifiable data, such as pilot/program participation, costs, and other data.

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4 D.20-12-029, p. 52.

5 Id.; *see also id.*, OP 1 (listing VGI activities to be reported on).

6 Id., p. 60.

C. Narrative - General Questions

1. <u>Customer program or pilot and incentives related to VGI</u>

In 2022, SCE had three active VGI pilots: Charge Ready DR Pilot, Emergency Load Reduction Program (ELRP), and Integrated Distributed Energy Resources (IDER) Partnership Pilot.

SCE Charge Ready DR Pilot:[7] SCE sends control signals to the EV Service Provider (EVSP) that throttles charging capacity by 50%. Customers who reduce load from a calculated baseline during event hours receive incentives. When the Charge Ready DR Pilot launched, anincentive of $0.10 per kWh reduced was provided. The incentive amount was later increased to $0.15 per kWh reduced.

SCE ELRP Pilot:[8] As part of Rulemaking (R.) 20-11-003, on March 26, 2021, the CPUC issued D.21-03-056 that (among other measures) approved the ELRP Pilot, which is an out-of-market (*i.e.*, not integrated into the CAISO's market), voluntary, non-penalty DR resource. The ELRP currently consists of eight participant sub-groups.[9] On December 6, 2021, the CPUC issued D.21-12-015, which directs SCE, Pacific Gas and Electric Company (PG&E), and San Diego Gas & Electric (SDG&E) to take additional actions toprepare for potential extreme weather in the summers of 2022 and 2023, including the addition of a VGI Aggregator[10] option (Sub-Group A.5.) to the ELRP pilot.

IDER Partnership Pilot: SCE launched the IDER Partnership Pilot in January 2022, whichallows customers to enroll with energy solutions providers to implement distributedenergy resources (DER) solutions to help meet grid needs in specific geographicalareas. VGI opportunities are a potential option available to participants.

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7 Charge Ready DR Pilot approved in D.17-12-003, OP 40.

8 ELRP Pilot approved in D.21-03-056; The VGI ELRP Sub-Group (Sub-Group A.5.) was established in D.21-12-015.

9 ELRP Pilot sub-groups include: A.1. (Directly Enrolled Non-Residential Customers); A.2. (Base Interruptible Program (BIP) and Non-BIP Aggregators); A.3. (Non-Residential Customers with Rule 21 Exporting Distributed Energy Resources (DERs)); A.4. (Virtual Power Plant (VPP) Aggregators); A.5. (Vehicle Grid Integration (VGI) Aggregators); A.6. (Residential Customers); B.1. (Third-Party Demand Response Providers (DRPs) Participating in the CAISO Energy Market as a Proxy Demand Resource (PDR)); and B.1. (Capacity Bidding Program (CBP) Aggregators).

10 A VGI Aggregator is a third-party that manages an aggregation consisting of any combination of electric vehicles and/or charging stations – including those that are capable ofone-way charging (V1G) and/or bi-directional charging and discharging (V2G) deployed with residential (bundled or unbundled) or non-residential (bundled or unbundled) customers that meet specified criteria.

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

SCE interprets this metric to cover rates that encourage both VGI *and* adoption of mechanisms for credit for export—not simply rates that encourage VGI, which arecovered elsewhere.

The VGI Aggregator ELRP sub-group allows for the compensation of exported energy,as long as the customer has a Rule 21 interconnected device/equipment with export capability and permit. The ELRP baseline is modified to account for exported energy during non-event days and count exported energy in their ELRP Incremental Load Reduction (ILR) calculation. No VGI Aggregators elected to participate in the ELRP VGI Sub-Group (A.5.) in 2022.

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

SCE is not currently involved in, nor is it aware of, any CAISO efforts to revise or reform its market design rules in order to facilitate VGI's participation in wholesale markets.

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

SCE has three Electric Program Investment Charge (EPIC) III projects under way which include electric transportation and VGI elements. In addition, there are several other EPIC projects which involve DER integration and controls which in general support VGIuse cases and may include electric vehicles. The EPIC electric transportation-focused projects are:

- Distributed Plug-In Electric Vehicle Resources (DPIEV Resources)
- Vehicle to Grid Integration with On-Board Inverter (V2G OBI)
- Service and Distribution Center of the Future (SCOF)

DPIEV Resources: This project studies the integration of energy storage systems with high-power, high-impact EV charging systems. This project demonstrates the use of batteries to support customer bill management as well as several utility VGI grid supportuse cases, including renewables integration, grid infrastructure deferrals, and energy market services.

This project has proceeded to procure and receive a dedicated 150 kW DC charger and associated electrical gear. A microgrid test bed has been designed and is being constructed using existing facilities at the EV Technical Center in Pomona. An existing Li-ion energy storage system is in place in the test bed for project testing. A testing instrumentation and EV simulator system has been received for project testing. Testing will be completed by the 4th quarter of 2023.

V2G OBI: This project advances Vehicle to Grid Alternating Current (V2G AC), or on-board inverter, based architecture function and standards in partnership with automotive and EV charging original equipment manufacturers (OEMs). In addition, it provides the first demonstration of distributed energy resource management system (DERMS)-based IEEE 2030.5 controls from the SCE Grid Management System with both AC and DC (off-board inverter) systems. With three sets of partners, involving two light-duty OEMs automakers and an electric school bus, all with dedicated EVSE and aggregator control elements, the project operates the systems in the lab while demonstrating Rule 21 interconnection requirements, control functionality with SCE's distribution operating system functions, and resulting effects on the electrical system. Six VGI use cases are demonstrated with the partners, which sets the stage for future field demonstrations and V2G interconnections and operations. All three sets of systems are subject to power off resiliency use case testing. SCE participates in SAE J3072, IEEE (Institute of Electrical and Electronics Engineers) 2030.13, and UL 1741 SC committees, among others, in conjunction with this project. Included as part of the project is the V2G Technical Advisory Board, which provides a forum for industry technical experts on V2G to review and advises on V2G and VGI aspects of the EPIC project and on the technology in general. The project runs through 2024.

In 2023, V2G EVs and charging systems are to be assembled in the EV Technical Center lab for testing, including a Stellantis EV and Blue Bird school bus. Another OEM is working within the project at the computer control system level, progressing to hardware in the loop testing. SCE continues to work on the cited standards, and UL 1741 SC is nearing completion.

In parallel, SCE's DERMS continues to advance. The project team is working to align project testing facilities and DERMS system access with project physical scheduling. The V2G Technical Advisory Board (TAB) continues informing and collaborating, with the leading experts in V2G participating. In conjunction, SCE planned to host the first V2G Forum in its Irwindale Energy Education Center (the V2G Forum took place in February 2023, outside the scope of this report). Last year the TAB advanced topics such as the ISO 15118 V2G gap analysis effort.

SCOF: The Service Center of the Future project is a broad-scale project that brings microgrid control strategies together with facility modernization of a heavy-duty vehicle operations center. It involves building electrification and controls, energy storage, PV generation, EV charging controls, EV charging submetering, and utility operations, all managed through a utility operated microgrid control system. Multiple VGI use cases are demonstrated here, including power-off grid resiliency and local grid balancing andrenewables integration. The project runs through 2025.

SCE has procured a microgrid control system (MCS) from a leading supplier. It is in lab design phase and has completed project architectural designs and received MCS panels and completed factory acceptance tests of control systems. The initial MCS test bed is complete, facilitating further Hardware-in- the-Loop studies of the system with DERs in the EV Technical Center (EVTC) microgrid test lab. Beyond lab activities, the pilot site has been determined, and design work is underway on electrical infrastructure, which should be completed by the end of 2023.

SCE filed its EPIC IV Investment Plan in October 2022. Unique to this tranche, SCE did not file specific project requests but rather Strategic Objectives and Initiatives. Under Strategic Objective B, SCE identified the research topic Customer Load Flexibility. Three areas are described that relate to VGI:

1. Direct Current (DC) Service and Solid State Transformers
2. Improving DER Aggregation Utilization
3. VGI Valuation in a Commercial Context

Topics in this area include managed charging, demand response, advanced metering and submetering, tariffs and their application, bidirectional charging, and vehicle-to-grid resiliency and backup power. As customers adopt EVs, it will be crucial to demonstrate new methods, equipment and technical controls to integrate these EVs onto the electric grid. Integration of the vehicles to provide grid services will provide benefits to utility operators and customers.

In 2023, SCE is formulating project concepts to support this investment plan while the commission considers this application.[11]

5. <u>Efforts to accelerate the use of VGI for resiliency</u>

SCE continues work to accelerate VGI for resiliency through various TE efforts, including through (1) its EPIC pilots discussed in response to question 4, and (2) the pending School Bus V2G project and VGI pilots detailed below, as well as other projects and pilots still in their planning phases.

SCE was one of the original signatories to the "DOE V2X MOU", which seeks to validate and demonstrate the commercial viability of Vehicle to Everything (V2X) technologies, identify and resolve barriers to commercialization and customer adoption, and improve coordination between the electric and automotive sectors, and participated in the signing event and in the V2X technical

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[11] *See* https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/energy-research-development-and-deployment.

roundtable. SCE continues to collaborate on V2X and looks for potential projects and partnership opportunities and expects several potential project formulations in 2023.

On June 15, 2021, SCE filed advice letter (AL) 4518-E outlining its Low Carbon Fuel Standard (LCFS) Holdback Implementation Plan. This proposal included a School Bus VGI Project with Baldwin Park Unified School District focused on providing resiliency power for emergency energy backup.[12] Though this project was not authorized by Resolution E-5236 due to, among other reasons, the need for more detailed scoping budget information, SCE will continue to work with Energy Division to identify opportunities to support energy resiliency through TE with LCFS funding. This may include proposing different school bus VGI projects. SCE has observed its school district customers facing barriers in unlocking this functionality on their own. SCE may also propose LCFS projects that manage light-duty EV charging to facilitate customer EV charging around grid emergencies (wildfire, Public Safety Power Shutoffs (PSPS), CAISO events, etc.) and mitigating grid congestion.

Additionally, on July 15, 2021, SCE filed AL 4542-E seeking approval of proposed VGI Pilots in response to D.20-12-029. AL 4542-E is currently pending approval from the Commission. SCE proposed three VGI pilots in this advice letter, two of which are beneficial for resiliency. First, the Medium-Duty and Heavy-Duty (MD/HD) VGI Pilot,[13] explores options for behind the meter (BTM) storage services, in support of V2B functionality. Second, the DER VGI Pilot[14] explores integration with municipal fleets and provides nanogrid services. SCE is actively working with ED staff to augment and expand this proposal to more accurately address current market needs and may file a supplemental advice letter with proposed changes in 2023.

6. <u>Progress to reform interconnection rules to advance VGI</u>

Under R.17-07-007, the Commission issued D.20-09-035 on September 24, 2020. D.20-09-035 adopted the following proposals, of which 23a-e had consensus:

- 23b. Rule 21 applies to the interconnection of both stationary and mobile storagesystems.
- 23c. V2G direct current (DC) EVSE may be interconnected under the existingRule 21 tariff so long as it meets all requirements.
- 23d. V2G DC EVSE may connect as V1G and operate as load-only upon certification that it will not discharge to the grid, will not

[12] AL-4517-E, Appendix A, p. 64.

[13] AL-4542-E, Appendix B, p. 7.

[14] *Id*., Appendix C, p. 8.

inadvertently switch tobidirectional mode, and factory default settings are set to unidirectional mode.

- 23e. V2G DC EVSE connected as V1G may switch to bidirectional mode uponcompleting the Rule 21 interconnection process and receiving permission to operate (PTO).
- 23f. The Utilities' interconnection portals should be modified to enable the simpletracking of V2G interconnections.
- 23i. The Utilities must clarify a temporary pathway to interconnect vehicle-to-gridalternating current (V2G AC) EVSE systems.

As required by D.20-09-035, SCE participates on committees that update theV2G-AC interconnection standards, such as the Vehicle-to-Grid Alternating Current Subgroup.[15]

On March 25, 2022, SCE/PG&E/SDG&E provided the following update to parties of R.17-07-007 and R.18-12-006 on the status of V2G AC interconnections.

- **SAE -J3072 – Interconnection Requirements for Onboard, Grid SupportInverter Systems**
  - Status: **Approved**
  - Published on 3/10/2021 – https://www.sae.org/standards/content/j3072_202103/[nam10.safelinks.protection.outlook.com]
  - Establishes requirements for a grid support inverter system function which is integrated into a plug-in electric vehicle (PEV) which connects in parallelwith an electric power system (EPS) by way of conductively coupled, electric vehicle supply equipment (EVSE)
  - Conforms with IEEE1547-2018 and IEEE1547.1-2020 requirements
- **UL 1741 SC – Standard for Interconnection System Equipment (ISE)/EVSE**
  - Taskforce working group has been coordinated by UL
  - Kickoff meeting held 2/26/2021 followed by weekly re-occurring meetings
  - Development of standard continues, with an expected publication date in 2023
  - Anticipated to define EVSE-PEV communication requirements, safety requirements, certification confirmation requirements, PEV performanceoperations verification, among other requirements
- **SunSpec J3072-2030.5 profile standard and certification**
  - Taskforce working group has been coordinated by SunSpec
  - Final version has been published
    - Testing and certification are now underway
  - Anticipated to define sequence of operations between the EVSE and PEV such as registration, handshake, and authorization

15 *Id*., OP, 53 and 54, p. 225.

While outside the timeline of this report, SCE also notes that on July 27, 2022, SCE filed with the Commission AL 4836-E to revise Rule 21 to provide information regarding certification requirements for interconnection applicants with EVSE with stationary inverter for direct current charging of vehicles (V2G DC EVSE).

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

SCE actively supports the industry in development and adoption of VGI and EV charging technical standards through SAE, IEEE, CSA, UL, SunSpec, and others. SCE experts helped develop the SAE J2894 power quality of PEV chargers recommended practice and continue participating in revision efforts today. SCE staff participate as an original member of the CSA (CSA Group, Canadian Standards) task force on EVEMS (EV Energy Management Systems, also known as ALM), which is the first attempt in North America on comprehensive standards for network-controlled EV charging energy management systems. This supports a critical need for a certifiable safety standard and implementation process for Type II EVEMS. The CSA effort supports harmonizationefforts with U.S. standards bodies to create the first US/Canada standard on network-connected EV charging management systems. In addition, SCE membership is maintained on the IEEE 2030.13 committee on network-managed EV charging facilities.SCE staff participates and maintains expertise in VGI communications and controls protocols, such as IEEE 2030.5, demonstrated in SCE's EPIC projects and utilized by SCE's Distributed Energy Resource Management System. These are all standards and systems that will ultimately be used to effectively utilize VGI for grid and customereffect. The IEEE 2030.13 Guide was published at the end of 2022. CSA published the reference guide for Electric Vehicle Energy Management System (EVEMS) and the safety standard is in process.

Additionally, SCE continues to work with industry on advancing adoption of new technical standards and capabilities. For example, SCE is part of a California Energy Commission (CEC)-funded project under the BESTFIT program to demonstrate innovative utility-connected charging methods, partnering with cities to deploy low-cost EVSE in needed areas and increase utilization of utility grid equipment, using V1G smart charging methods to manage grid impact and support customers. SCE is also a partner in the CEC-funded RHETTA program (eTRUC project) working to demonstrate advanced high-power charging systems for heavy-dutytrucks, siting of public truck charging stations, and the integration of DERs with those systems. SCE continues to work with partners and associations such as the Electric Power Research Institute (EPRI) and maintains membership in the National Infrastructure Working Council to support these objectives.

In 2023, SCE with eTRUC participants, will open the first phase of the eTRUC lab facility that will be open to EV charger testing at medium power levels; high power megawatt facilities will open in 2024. This facility will be available to test EV charging systems, including power, communications, and cybersecurity.

On June 15, 2021, pursuant to OP 19 of D. 20-12-029, SCE submitted AL 4521- E, detailing its end-to-end workplan and work schedule to conduct a cybersecurity gap analysis to identify potential gaps in existing cybersecurity protocols and EV charging equipment products used for TE programs, and to provide recommendations on how to address those gaps. AL 4521-E was approved via Energy Division Disposition on December 1, 2022 without direction or funding to advance the topic. In conjunction with D.22-11-040 (Decision on Transportation Electrification Policy and Investment[16]), the Commission authorized SCE to proceed with its cybersecurity workplan and to record costs in the memo account. In accordance with D.22-11-040, SCE is proceeding with an RFP to select a consulting firm to complete the cybersecurity gap analysis plan. SCE continues to collaborate with cybersecurity experts and organizations such as EPRI, the National Labs, and the DOE Vehicle Technology Office on advancing EV charging cybersecurity.

SCE maintains membership in U.S. Driving Research and Innovation for Vehicle efficiency and Energy sustainability (US DRIVE) and the Grid Integration Technical Team andis on the DOE's EVs at Scale Steering Committee.

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

D.20-12-049 does not establish funding to support VGI customer education and outreach but directs SCE in OP 6 to provide customer education. SCE provides VGI customer education through its Charge Ready Light-Duty, Charge Ready Transport, Business Customer Division Account Managers, and TE Advisory Services programs.[17]

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[16] R.18-12-006, Order Instituting Rulemaking to Continue the Development of Rates and Infrastructure for Vehicle Electrification.

[17] *See for example* CHARGE READY PROGRAM (sce.com), For Medium- and Heavy- Duty Vehicle Fleets (sce.com), Energy Management: Charge Ready Rate Training - YouTube.

Below is an overview of the VGI customer education offerings currently offered:

- As part of SCE's TE Advisory Services, SCE offers education, outreach, and one-on-one consultations to customers and third parties to help them understand rate and grid impacts to their transportation electrification projects, and how they can better manage cost through energy management strategies.
- SCE's Charge Ready programs offer quarterly educational webinars for multi-family, commercial, and medium- and heavy-duty fleet customers, which cover an array of topics such as, site planning, right-sizing their EVSE infrastructure, managed charging, EV Time of Use (TOU) rates, among others.
- To help customers prepare and better manage electricity cost, SCE is providing a review of TOU-EV Rates with Charge Ready applicants during consultation reviews and completing Customized EV Rate Analysis as requested. The result of the analysis provides estimated annual energy cost, best rate options based on assumptions provided by the customer such as KW rating, charging station usage pattern and number of ports being installed. The following Energy Management training video was created in 2022 by SCE to provide further education. https://www.youtube.com/watch?v=r2dD7P6PtGg
- In 2020, SCE launched a simple, user-friendly, Fleet Fuel Calculator tool, which provides fleet operators with information on electric vs. diesel fueling costs, EVSE charging level recommendations, managed vs. unmanaged electric fuel savings comparison, and GHG emissions saved. The TE Advisory Services - EV Readiness Services program offers qualified customers a one-on-one consultation with a TE advisor, who will go over various topics, including but not limited to, managed charging, EV TOU rates, and recommended EVSE level charging.

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

SCE described two separate architectures for ALM (or EV Energy ManagementSystems (EMS)) in 2019 at the National Infrastructure Working Council:

- Type I: Electrical infrastructure has full capacity for all stations; EMS is used tomanage energy costs or respond to time- and location-based grid conditions.
- Type II: Electrical infrastructure has less capacity than would be needed for allstations without EMS; EMS is needed as a critical safety element. Uses can also include economic or grid service.

All EVSE (EVSE or charging stations) installed in SCE's Charge Ready programs (except for Charge Ready Transport and Level 1 applications in all programs) are Type I ALM capable, with network connection and EVSP operator in place. Type I capable systems can be configured by the customer to reduce electricity costs, for example, by changing price or capability according to time and utility tariff. These systems, when also configured to connect to SCE's DR system, as demonstrated in the Charge Ready DR Pilot, can be signaled to perform a grid support function when such action is needed based on grid conditions. In this manner, generation, transmission, anddistribution impacts are reduced, utilization is increased, and upgrades could be deferred.

Type II ALM is designed, installed, and configured in the case where a customer or the utility is adding load to an electrical system which is greater than the existing physical capacity of that system (wires, connectors, etc.). In other words, an electrical overload ispresent without some control. The deficit of capacity can occur on the customer's system, the utility's system, or both. The normal course in this situation is to design and construct the needed (Code based) electrical infrastructure to serve the load. In the anticipation of certified and capable energy management systems, it is helpful to start planning to assess the two alternatives (build out or controller) and determine which is more economic and useful to all customers.

In 2017, California's Title 24 adopted the version of the National Electrical Code which gave provisions for listed and suitable EV EMS to configure and manage load up to the nameplate rating of the EV EMS. This standard, CSA SPE-343:21, was published at the end of 2021. As of this date, there is not a Nationally Recognized Testing Laboratory(NRTL) listed network-controlled EV EMS available. SCE looks forward to the availability of listed Type II ALM systems for further opportunities.

SCE remains open to pursuing and investigating Type II ALM opportunities in the Charge Ready programs. In anticipation of coming standards, in 2017, SCE developedprocedures to evaluate and approve such systems in support of SCE's responsibilities to evaluate and qualify EVSE systems for its Charge Ready programs. SCE worked with two vendors in lab safety evaluations to approve and list their products on SCE's Approved Product List (APL) for its Charge Ready programs. For business reasons onthe customer side, the two initial projects for Type II ALM requested by customers ultimately did not proceed.

Because the two projects did not proceed, SCE did not gain experience with the next part of ALM deployment, which is the implementation and commissioning procedure. AsSCE is not the permitting authority, SCE would have had to demonstrate its due diligence in each project to the authority having jurisdiction (AHJ), but it would be up to the AHJ to approve the installation and energization of the devices. The AHJ may require an NRTL field evaluation. Another important aspect of Type II ALM deployment is field commissioning. Each site must be properly configured with all of the EVSE types, their numbers, the infrastructure characteristics, protection settings, interface withutility systems, and fail-safe operating parameters, along with cybersecurity protections to prevent changes or takeovers which could immediately result in unsafe conditions.

Each project at each site has uncertainty on the customer side with the AHJ and on the utility side with utility service design standards. This last component also requires further advancement due to the nature of unlisted electronic and network-controlled devices used in a critical fashion.

Subsequently, SCE in its Charge Ready Bridge program installed Type II capable systems in response to customer requests based on economics, but the Type II capabilities were not implemented because the electrical infrastructure was capable ofhandling full load. The systems are still useful for providing customer and grid benefitsas Type I systems.

SCE continues to work to advance the deployment and use of Type I ALM and to address the issues and gaps with Type II implementation. SCE continues to serve onthe CSA (CSA Group, Canadian Standards) and Institute of Electrical and ElectronicsEngineers' (IEEE) boards working on EV controls and EMS.

In 2023, SCE will also take an active role in hosting an annual VGI Forum, in conjunction with the Investor-Owned Utilities (IOUs) and Energy Division staff, as required in D.22-11-040. The VGI Forum will focus on (1) rates and demand flexibility programs; (2) technology enablement; and (3) planning. SCE anticipates parties will discuss ALM opportunities at the VGI Forum.

10. 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

Current ALM deployment covers Type I systems, referenced above, which apply to all Charge Ready programs with the exception of Charge Ready Transport and Level 1 chargers.

As of 12/31/2022 SCE has 148 sites and 2,757 ports participating in Type I ALM within our territory. Thecurrent list of sites is made up of customer participants from our Charge Ready Pilot, Bridge and Schools programs participating in Demand Response.

For future TE programs and installations, SCE will evaluate the needs, costs andbenefits of Type I and Type II ALM as directed by D.20-12-029 and report out accordingly.

11. 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

Currently, there are no sites in the Charge Ready Transport, Charge Ready Schools, or Charge Ready Parks programs that have deployed Type II ALM systems to date (i.e., where a customer or the utility is adding load to an electrical system which is greater than the existing capacity of that system). Two sites participating in SCE's Charge Ready Pilot and Bridge programs installed Type II capable ALM systems with their Level 2 EVSEs. However, because thecustomers indicated that they were not sure if or when they would implement the capabilities, and SCE did not have service capacity constraints, SCE proceeded to design the sites based on 100% load capabilities. Therefore, as installed, the systems are Type I ALM. Type I ALM can still have system benefits, depending on how they are utilized and coordinated with the utility system, but there is currently no information to calculate those benefits.

12. 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

All Charge Ready Pilot and Bridge customers are required to participate in the Charge Ready DR Pilot, which is a direct V1G DR pilot. Customer retention and efforts to reduce churn have not been needed since participation is required. Charge Ready LightDuty has a similar requirement for customers to enroll in the Charge Ready DR pilot or an eligible DR program. Since the Charge Ready DR Pilot is a utility run pilot, data has not been requested from third party providers.

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

SCE has not received approval for its VGI Pilots (AL 4542-E/E-A). SCE is coordinating with the Energy Division to assess if supplemental information may be necessary prior to approval. Following CPUC approval and implementation of Advice Letter 4542-E or its supplemental, SCE will begin to report on the implementation and lessons learned associated with its authorized VGI pilots.

On October 21, 2022, the CPUC issued Resolution E-5224, which rejected the VGI Emerging Markets and Technology (EMT) Program submitted by SCE, SDG&E and PG&E (ALs 6365-E, 3872-E, and 4610-E) that was jointly filed on October 13, 2021 pursuant to D.20-12-029.

14. Integration of VGI across the utility relevant business activities

As described in the VGI Definitions section above, VGI activities and programs can take many forms – including direct and indirect V1G and V2G applications. SCE has worked to accommodate VGI in its TE programs, for example customers participating in SCE's Charge Ready Light Duty and Charge Ready Transport programs are required to enroll in TOU rates, which support V1G and customers in Charge Ready Light Duty are also required to participate in a demand response program, which requires installation of charging equipment that can respond to demand response signals.

SCE collaborates with VGI market actors and TE program site hosts to understand and address concerns when they arise. SCE also provides verbal and written clarification to stakeholders regarding the ability to install customer-load monitoring equipment in Charge Ready Transport (CRT) Program via the customer-build path and has created internal reference guides to ensure SCE staff are aware and of the support and flexibility afforded to customers through customerownership.

Additionally, SCE is including VGI in utility discussions on relevant business activities, including the development of potential new rates, exploring changes to SCE forms and procedures, and how to address operational challenges. This will become more relevant as VGI Aggregators enroll and participate inthe ELRP Pilot.

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

SCE has multiple pilots underway, not including the VGI Pilots for which it requested approval in AL 4542-E, which was submitted on July 15, 2021. Below is an overview of the pilots underway:

- The Charge Ready DR Pilot began in 2018 and concluded at the end of 2022. Results have been generally positive through 2022 in reducing load between 4:00 pm and 9:00pm by using a combination of control signals and incentives. Next steps include transitioning these customers to other DR programs or pilots, including ELRP, so they may continue their DR participation. Costs for the Charge Ready DR Pilot are included in the Program and Pilot Metrics spreadsheet found in Appendix A. Lessons learned include the difficulty in shifting EV charging to specific times and problems with using baselines to determine DR performance. To date, there has been minimal negative feedback fromcustomers throughout the pilot relating to DR events.

- SCE's EPIC project, V2G Integration will use new interconnection requirements, V2G-related technologies (as well as smart charging or V1G) and standards, andutility and third-party controls to demonstrate how V2G direct current (V2G-DC) and V2G alternating current (V2G-AC) capable EVs and EV chargers can connect and charge/discharge to the grid. The demonstrations will consist of bothcustomer support and grid support use cases. Next steps are to complete the labnetwork environment, move the systems into the lab, and execute the test plans. This EPIC IOU administered project, including cost, schedule, and deliverables, is managed and reported out annually in the EPIC administrative process.
- SCE EPIC project, Service Center of the Future will demonstrate a fleet service center supporting large EV charging demands, while also integrating elements such as ESS, PV, and controllable loads such as electrified space and water heating - all controlled by a utility-owned MCS to maintain safe and reliable operation and minimize costs. The EPIC project will assimilate with an existing Charge Ready Transport project site to inform beyondinitial phase distribution and charging infrastructure deployment. The MCS will also aggregate customer controllable resources and integrate with SCE's Grid Management Systems (GMS) to demonstrate distribution system operator (DSO)use cases, as well as power-out resiliency use cases. Next steps are to carry outthe MCS design and production processes in anticipation of MCS testing, SCE lab testing, and field deployment. This EPIC IOU-administered project, including cost, schedule, and deliverables, is managed and reported out annually in the EPIC administrative process.
- SCE EPIC project, Distributed Plug-In Resources will demonstrate technology and techniques to leverage energy storage systems (ESS) in order to alleviate fast-charging impacts to the grid and address the potential to reduce customer demand charges. Next steps are to acquire the high-power charging system and assemble in the SCE microgrid test bed lab to integrate with a battery system and test use cases. This EPIC IOU-administered project, including cost, schedule, and deliverables, is managed and reported out annually in the EPIC administrative process.

Additionally, SCE partnered with industry and research partners Flo, Arup, LACI, and EPRI to win a CEC-funded project under the BESTFIT program to demonstrate innovative utility-connected charging methods. EVSP/EVSE maker, Flo, is the contracted entity with CEC, with EPRI and ARUP providing project management. SCE is a team member, focused on designing new methods for attaching EVSE to utility equipment in a low cost and time efficient manner. Two cities are participating, Santa Monica and Huntington Park, and seven different types of installations are planned.

Studies will be conducted on costs, energy utilization, grid impact, driver utilization, city satisfaction and utility, and other important factors. Final reporting will provide a guide to other utilities. New standards may emerge for utility infrastructure. Demand management of the EVSEs through pricecontrol is expected.

SCE is also a partner in the CEC-funded RHETTA program working to demonstrate advanced high-power charging systems, siting of public truck charging stations, and theintegration of DERs with those systems to manage grid impact and increase utilization. EPRI is the awardee and is co-leading with CALSTART. SCE is a project partner and will work on lab technical evaluations and technical studies on DER integration with charging systems. The two initial truck charging pilot sites will apply to the Charge Ready Transport program. The program includes comprehensive studies of truck goodsmovement needs, electric energy fueling needs, and grid impact assessment.

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

SCE does not have metrics on interconnection reform for V2G to report 2022, because V2G systems have not been interconnected on the system.

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

SCE did not realize any V2G participation in ELRP during the 2022 season and event period for ELRP. Therefore, SCE is not yet able to determine and assess the effectiveness of compensating V2G exports. SCE is working with service providers to grow EV enrollment in ELRP in preparation for 2023.

18. Participants in credit for export and discussion to increase participation

See response to Question #16 above.

19. Annual energy exported (kWh) and report out on potential efforts to increaseparticipation

This metric is not applicable, because there are no V2G enrolled participants exporting energy to our grid at this time.

20. Overall barriers removed in V2B

SCE takes V2B in this context to mean vehicle to building parallel interconnection with the grid for non-export demand support. In SCE’s V2G EPIC project, SCE is working with three major automakers or OEMs and one medium-duty OEM to demonstrate V2G interconnection and controls. One included area of focus is on V2G resiliency use cases, including V2G- backup power. One objective is to remove barriers that could arise from automakers not complying with safe and legal interconnection requirements. Lacking compliance with interconnection safety requirements, these systems would be denied interconnection, and they could cause safety issues if interconnection requirements were not followed. With this project, SCE can work with OEMs to implement technical measures that will be successful and work to prevent unsafe or unauthorized use of such devices to discharge to a grid-connected premise inviolation of California Health and Safety codes. SCE works with industry and organizations to broaden the effectiveness of these measures. In addition, in conjunction with this project the team works with stakeholders in the grid interconnections field to better incorporate V2G in the web-based grid interconnection application tools.

21. Number of EVs enrolled in DR programs

The Charge Ready DR Pilot does not enroll specific EVs, but rather it enrolls the EVSE through the EVSP. As noted above, all Charge Ready Pilot and Bridge customers are required to participate in the Charge Ready DR Pilot. The DR pilot sends control signalsfrom the utility to the EVSP, who can then communicate with the EVSEs to stop or start charging or to throttle charging current. The number of sites and charging ports participating are listed on the Program and Pilot Metrics spreadsheet (Appendix A).

For the reporting period, SCE does not have any VGI Aggregators enrolled in the ELRP Pilot.

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

Since participation in DR is a condition for all Charge Ready Pilot and Bridge customers and these customers were enrolled onto the Charge Ready DR Pilot, efforts to increase enrollment were not needed. The rate of change in participation in DR events can be attributed to additional Charge Ready Pilot and Bridge sites being completed throughout the Charge Ready DR Pilot, increased utilization of charging ports over time, and variability in when drivers choose to charge their EVs.

23. EV DR enrollment capacity (MW)

Charge Ready Pilot, Bridge and Schools include a total of 2,757 charging ports currently active. Based on the active charging ports, 100% utilization at an average of 7.2 kW (previously 6.6 kW was used as the average, but more current data estimates an average of 7.2 kW) is almost 20 MW. The Charge Ready DR Pilot control signals reduce charging capacity by 50% during events, so the maximum DR potential capacity of the Charge Ready DR Pilot is approximately 10 MW.

24. EV DR enrollment load shift (MWh)

Assuming load shift is simply the amount of MWh reduced during a DR event that will be shifted to a different time, 100% utilization of charging ports with DR MW potential of10 MW over a 5-hour event (Charge Ready DR Pilot Load Reduction events are from 4:00 pm to 9:00 pm) would result in a maximum DR potential load shift of 50 MWh.

However, the Charge Ready DR Pilot through 2022 averaged less than 1 MWh of load shift per event based on much lower than 100% utilization of charging ports and the variability of EV charging during baseline and event time periods.

25. Estimated aggregated GHG reduction attributable to VGI

SCE does not have a complete accounting of all aggregated greenhouse gas (GHG) reduction attributable to VGI (e.g., TOU rates are considered V1G and shift a significantamount of load thus potentially contributing significant GHG reduction to a non-TOU scenario). Consequently, SCE interprets this question to only cover the VGI pilots and programs addressed through D.20-12-029.

SCE will have a more accurate accounting for VGI attributable GHG reductions following the approval and implementation of its VGI Pilots, proposed in AL 4542-E. As mentioned above, the EMT Program, proposed in AL 4610-E, was not approved and therefore no GHG accounting or learning will be initiated through that program.

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

SCE interprets this section as being specific to EVSEs (EV chargers) that are installed and owned by the utility, as part of a utility TE program, and for which the utility bills theEV driver directly. SCE does not currently have any EVSEs that fall into this category.

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

All active Charge Ready Pilot, Bridge and School sites participate in the Charge Ready DR Pilot, which began in 2018. A total of 145 EV charging sites installed as part of the Charge Ready Pilot and Bridge phases are currently active. An additional 3 sites installed as part of Charge Ready Schools are also now active. Lessons learned include the difficulty in shifting EV charging to specific times and problems with using baselines to determine DR performance. Since participation in DR was required for Charge ReadyPilot, Bridge and School customers and will also be required for Charge Ready Light Duty, steps to increase participation are unnecessary as participation will increase organically as more sites go live and utilization of charging stations improves. To date, there has been minimal negative feedback from customers relating to DR events.

28. Barriers to data collection and potential solutions

Below are barriers to data collection and potential solutions:

- **Existing TE Programs are not able to separate O&M Costs by MarketSegment**

SCE tracks costs by program and pilot through Capital and O&M expense categories. While SCE is able to separate Capital expenses by market segment, weare not able to separate O&M costs by market segment, and therefore budget and spend figures are presented as consolidated.

- **Certain Metrics Require Baselines that have yet to be Established**

Columns O-R of the Program and Pilot Metrics tab in Appendix A, cover savings and avoided upgrades as a result of VGI measures, require an estimated baseline or a level of granular visibility and tracking that SCE has not yet deployed.At this time SCE is not operating any programs or projects that are relevant to columns O-R. SCE will assess how to collect, track and best present this data for future reporting if such programs or projects begin operation.

- **Metrics SCE cannot Directly Gather**

Several metrics include customer-side data and behind the meter load dynamicsthat are not available to SCE. Without surveys or other customer reports, these metrics cannot be reported concretely.

- **Electric Vehicle Service Provider (EVSP) data collection and qualitychallenges**

As per our program requirements, SCE and its partners collect interval and session level data from EVSPs. SCE continues to see data collection and quality challenges. On a monthly basis, we are actively engaging withEVSPs to help identify these challenges and work toward streamlining data collection.

29. Load shift for EV rate customers

SCE offers a TOU-D-PRIME rate for residential customers who either own or lease an electric vehicle or plug-in hybrid or have a residential battery or electric heat pump system for water or space heating.[18] SCE's findings show that the TOU-D-PRIME rate option is effective in shifting peak

[18] *See e.g.,* https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans for details.

period demand during summer weekdays from 4:00 to9:00 PM to off-peak periods, when the rate is lowest.

SCE evaluated load impacts from Residential EV customers enrolled in its TOU-D-PRIME rate option in 2019, 2020, and 2021. SCE reported on 2019 and 2020 in previous VGI reports. The analysis of 2022 data is ongoing and will be provided in the next VGI report.

For Summer 2021, EV customers who attested to owning an EV before Oct 2019 and joined TOU-D-PRIME prior to March 2021 exhibited peak-period demand reduction of 0.47 kW/customer or 20.4% along with an **increase** in daily electricity usage of 1.08 kWh or 3.2%.[19] EV customers who attested to owning an EV before Oct 2019 and joined either TOU-4-9PM or TOU-5-8PM prior to March 2021 exhibited peak-period demand reduction of 0.09 kW/customer or 7.1% and 0.14 kW/customer or 10.3%, respectively. They exhibited a **decrease** in daily electricity usage by 0.8 kWh/customeror 4.0% and 0.71 kWh/customer or 2.8%, respectively. Note that the TOU-D-PRIME rate option has the largest peak-to-off-peak differential and the lowest off-peak period price compared to that of TOU-5-8PM and TOU-4-9PM. EV customers on the TOU-D- PRIME rate option opt into the rate option and are likely aware of the steep peak to off-peak differential, and shift most of their usage to the off-peak period with low energy rates ($/kWh). EV customers on either TOU-4-9PM or TOU-5-8PM are likely defaulted onto the rate and can either be unaware that they were defaulted or not know the exactpeak hours. The smaller peak to off-peak differential of the default rates also provides less incentive for load shifting than that of TOU-D-PRIME.

30. Rate-to-driver enrollment by sites

SCE interprets this section as being specific to EVSEs (EV chargers) that are installed and owned by the utility, as part of a utility TE program, and for which the utility bills the EV driver directly. SCE does not currently have any EVSEs that fall into this category.

31. Dynamic rate load shift (MWh)

"Dynamic rate" is interpreted to mean retail rates that adjust to day-ahead or day-of prices based on the supply and demand of capacity for each hour. SCE is currently conducting a

[19] For the PY 2021 TOU-D-PRIME load impact evaluation, results were not disaggregated by NEM and non-NEM EV owners on TOU-D-PRIME. The reduction of increase in daily electricity usage between PY 2020 and PY 2021 TOU-D-PRIME load impact evaluation is likely due to behaviors of NEM customers or residential rooftop solar customers with battery storage.

dynamic rate pilot (known to customers as SCE's Flexible Rate Pilot[20]) thatis expecting to enroll customers with electric vehicles within the next few months. The evaluation to assess load shift resulting from EV customers on the Dynamic Rate Pilot is still being scoped. A first draft of the evaluation will become available in the December 2023 "Dynamic Rate Pilot Mid-term Report." SCE notes that on July 22, 2022,the Commission initiated a new proceeding, the Rulemaking to Advance Demand Flexibility through Electric Rates (R.22-07-005), which will address dynamic rates in greater depth.

32. Aggregate unmanaged load profiles within programs (kWh)

SCE does not currently have any customers within our TE programs with unmanaged load, as all programs employ TOU rates, which SCE defines as managed load for thepurposes of this report.

33. Aggregate unmanaged load profiles within programs (kW)

SCE does not currently have any customers within our TE programs with unmanaged load, as all programs employ TOU rates, which SCE defines as managed load for thepurposes of this report.

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

All non-residential rate schedules are TOU. For residential customers, Schedule D is an optional, tiered rate structure which applies to all household's load, including load from EVs. SCE has identified a limited number of customers on Schedule D believed to have EVs. The average load profile for these customers is presented in Chart 1. The values for Chart 1 are presented in Appendix B.

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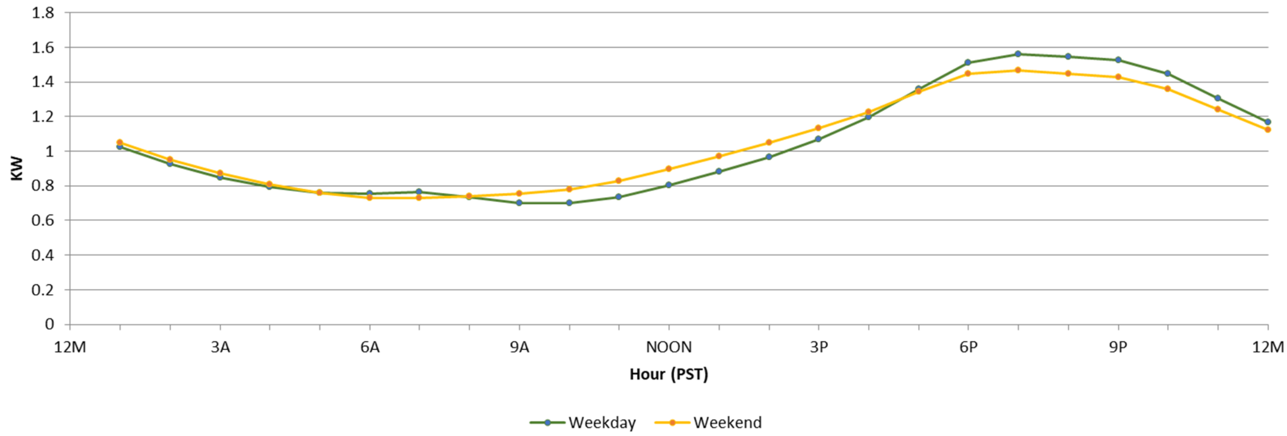
[20] D. 21-12-015.

Chart 1 – Aggregate Average Load Profile for Schedule D (kWh)



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

The peak load for these Schedule D customers is 1.6 kW on weekdays and 1.5 kW on weekends. This includes all household load.

36. Net Avoided Costs from Avoided Upgrades

Not applicable, as SCE has not identified any avoided upgrades at this time.

37. Aggregate load profiles for EV TOU rates within programs (kWh)

Program Customers from TOU-EV-1 are identified through our Charge Ready Home Installation Rebate program and our LCFS programs. As of December 31, 2022, all TOU-EV-1 program customers identified through Charge Ready Home Installation Rebate program had changed rate categories. As there is only one TOU-EV-1 customer identified through California Clean Fuel Reward program, SCE will not be providing an analysis or an aggregate hourly load profile for TOU-EV-1 within our programs.

Chart 2 provides average weekday and weekend hourly load profiles for program customers on separately metered TOU-EV-7 between January 1, 2022, and December 31, 2022. The average weekday demand begins to rise around 4:00 AM where it is 0.56 kW and peaks around 8:00 AM with an average demand of 1.57 kW. For the rest of the day, charging within our program customers tapers off after the 8:00 AM peak. Although overall usage had slightly increased, the 2022 annual average hourly charging behavior is similar in profile to the mid-term report analyzing load data from January 1 through June 30, 2022.

The weekend profile almost overlaps with the weekday profile between 9:00 PM and 4:00 AM. Weekend load gradually increases from 6:00 AM where it is 0.44 kW and peaks around 10:00 PM with an average demand of 1.08 kW.

Chart 2: Average hourly load profiles for TOU-EV-7 within programs (kWh)

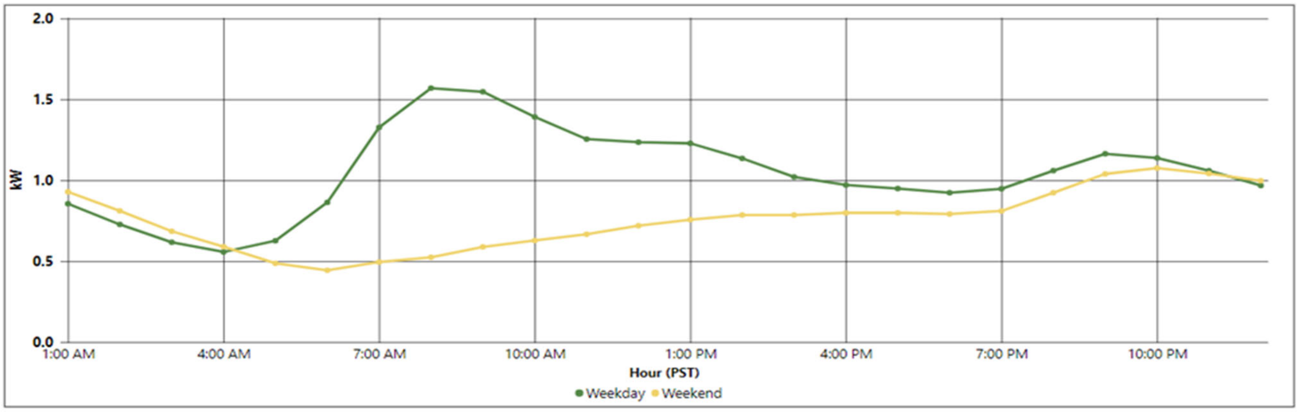
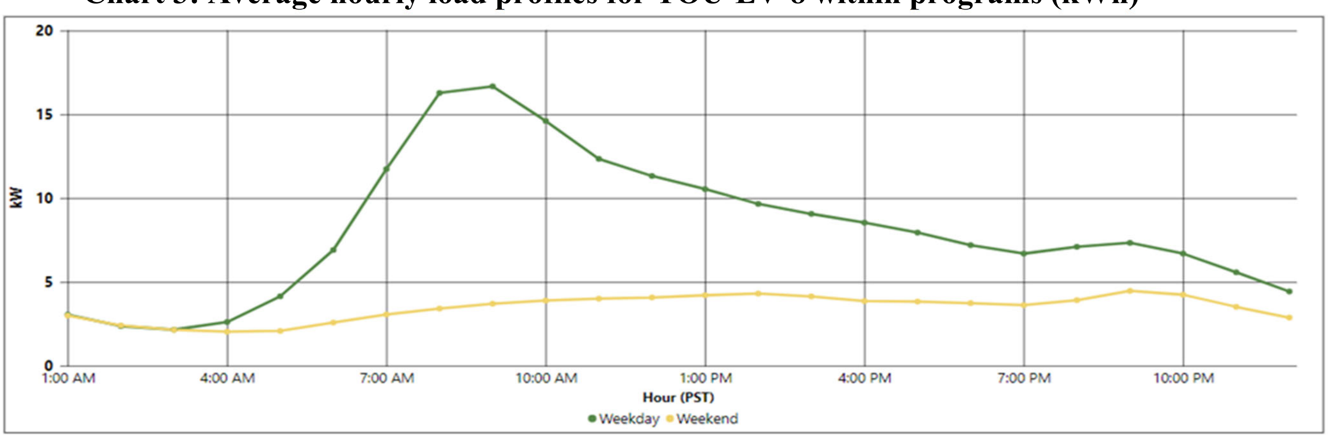


Chart 3 provides average weekday/weekend hourly load profiles for program customers on separately metered TOU-EV-8 between January 1, 2022, and December 31, 2022. The average weekday demand begins to rise beginning at 3:00 AM where it is 2.16 kW and peaks at 9:00 AM with an average demand of 16.68 kW. Charging demand noticeably dips starting at 10:00 AM and begins to slowly taper off beginning at 12:00 PM. After this, the load shape tapers off until 2:00 AM at 2.37 kW. The weekend profile displays a slow increase from 5:00 AM at 2.08 kW and peaks at 9:00 PM where it is 4.47 kW. Although overall usage had slightly increased, the 2022 annual average hourly charging behavior is similar in profile to the mid-term report analyzing load data from January 1 through June 30, 2022.

Chart 3: Average hourly load profiles for TOU-EV-8 within programs (kWh)



As of December 31, 2022, there were only ten program customers participating on TOU-EV-9, representing large commercial customers. There are not enough customers and load to report this shape publicly. Also, the data is not representative of the broader trends on the rate. Therefore, SCE will not be providing an analysis or an aggregate hourly load profile for TOU-EV-9 within our programs.

The supporting data for Charts 2 and 3 can be found in Appendix B.

38. Aggregate peak load of EV TOU rates within programs (kW)

Average weekday usage within the TOU-EV-7 rate category peaks at 1.57 kW and average weekend usage peaks at 1.08 kW.

Average weekday usage within the TOU-EV-8 rate category peaks at 16.68 kW and average weekend usage peaks at 4.47 kW.

39. Rate-to-host

SCE interprets this section as asking for information on rates charged to hosts as distinguished from rates charged directly to drivers on utility-owned chargers.

SCE charges site hosts one of three TOU-EV rates based on metered monthly maximum demand. TOU-EV-7, TOU-EV-8, and TOU-EV-9 rates are applicable tocommercial EV customers whose metered monthly max demand is 20 kW or less,greater than 20 kW to 500 kW, and above 500 kW, respectively.

Charging infrastructure must be separately metered to qualify for these rates. In D.22-08-001 (Phase 2 of SCE’s 2021 General Rate Case), the Commission adopted SCE’s proposal to extend the energy-only rate structure for TOU-EV-8 and TOU-EV-9 beyond the timeline established in D.18-05-040 until the implementation of the next GRC Phase 2, or when rates consistent with guidance in the Transportation Electrification Framework[21] can be implemented either in a Rate Design Window, or in a separate rate design proceeding as determined by the Commission, whichever occurs first.

40. Rate-to-driver

SCE interprets this section as being specific to EVSEs (EV chargers) that are installed and owned by the utility, as part of a utility TE program, and for which the utility bills theEV driver directly. SCE does not currently have any EVSEs that fall into this category. However, through the Charge Ready programs, SCE communicates and educates customers (host) on rate-to-driver structures, grid impacts, rate levels and conversions to dollars per gallon equivalence so that they can make an informed decision on the impact their decisions make on drivers as well as the grid.

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[21] D.22-08-001, p.36.

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

The average load profiles for all TOU-EV customers not participating in an EV program are presented below. Non-residential TOU-EV rates include TOU-EV-7, TOU-EV-8, and TOU-EV-9 as described above. All average load profiles are for metered data between January 1, 2022, and December 31, 2022. The values for all average load profiles are provided in Appendix B.

As of December 31, 2022, almost all TOU-EV-1 customers had changed rate categories. Therefore, SCE will not be providing an analysis or an aggregate hourly load profile for TOU-EV-1 outside of programs.

Chart 4 provides average weekday and weekend hourly load profiles for customers outside of programs on separately metered TOU-EV-7. The average weekday demandbegins to rise around 5:00 AM where it is 0.4 kW and peaks around 10:00 AM with an average demand of 1.7 kW. Charging for customers not participating in EV programs begins tapering off for the rest of the day at 6:00 PM. The weekend profile almost overlaps with the weekday profile between midnight and 5:00 AM. Weekend load gradually increases from 6:00 AM where it is 0.4 kW and peaks around noontime withan average demand of 1.3 kW. Although overall usage had slightly increased, the 2022 annual average hourly charging behavior is similar in profile to the mid-term report analyzing load data from January 1 through June 30, 2022.

Chart 4 – Aggregate Average Load Profile for TOU-EV-7 (kWh)

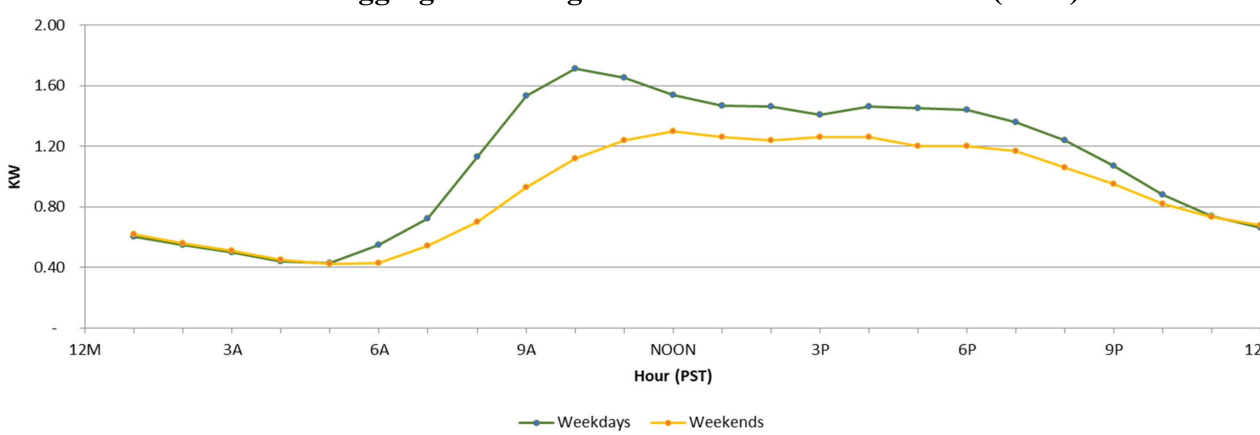


Chart 5 provides average weekday and weekend hourly load profiles for customers outside of programs on separately metered TOU-EV-8. The average weekday demandbegins to rise around 5:00 AM where it is about 4.7 kW and peaks around noon with an average demand of 21.9 kW before it tapers off for the rest of the day. The charging load profile for customers on TOU-EV-8 not participating in EV programs has a higher weekend usage during midday. It has a peak demand also around noon with an average demand of 24.3 kW. Similar to the trend of customers on TOU-EV-7, although overall usage had slightly increased, the 2022 annual average hourly charging behavior is similar in profile to the mid-term report analyzing load data from January 1 through June 30, 2022.

Chart 5 – Aggregate Average Load Profile for TOU-EV-8 (kWh)

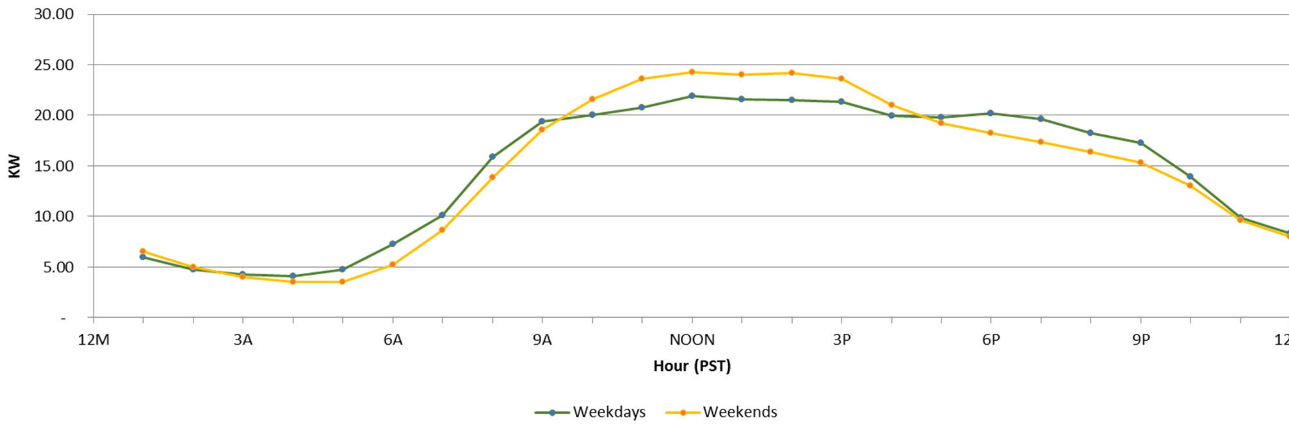
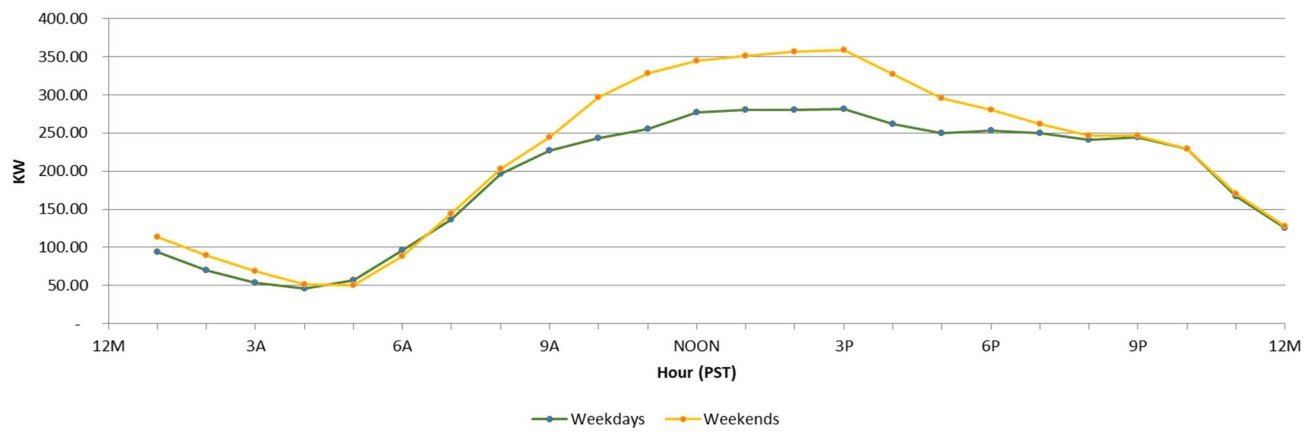


Chart 6 provides average weekday and weekend hourly load profiles for customers outside of programs on separately metered TOU-EV-9. The average weekday demand begins to rise around 5:00 AM where it is 57 kW and peaks around 3:00 PM with an average demand of 281 kW before tapering off for the rest of the day. The weekend profile shows a similar load shape but a higher usage during midday, with peak demandof 359 kW around 3:00 PM.

Chart 6 – Aggregate Average Load Profile for TOU-EV-9 (kWh)



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

The average peak load for all non-residential TOU-EV customers not participating in an EV program is: 1.7 kW on weekdays and 1.3 kW on weekends for TOU-EV-7, 21.9 kW on weekdays and 24.3 on weekends for TOU-EV-8, 281 kW on weekdays and 359 kW on weekends for TOU-EV-9.

Appendix A

VGI Reporting Template

Program and Pilot Metrics

The Program and Pilot Metrics tab includes metrics in the VGI Decision by program or pilot. This tab plans to list the utilities VGI programs and pilots and their associated aggregated metrics. Definitions of each metric are provided in the Descriptions tab. For draft purposes, illustrative program examples are provided.

Aggregated totals:					**Totals(2):**	**148**	**0**	**148**	**2757**	**148**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$871,504,765**	**$95,797,743**
						Counts By Program or Pilot								Cost By Program or Pilot					
Program/Pilot	**Market Segment - Residential or Commercial**	**Market Segment - Subcategory**	**ESJ subcategory**	**Launch Date**	**Implementation Status**	**Enrolled**	**Dropped out**	**Currently Participating**	**Number of ports participating in ALM**	**Number of sites participating in ALM**	**Number of sites participating in dynamic rates (if known)**	**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)**	**Sites with Upgrade avoided by ALM**	**Avoided utilty-side costs (where known) avoided by ALM**	**Authorized Budget**	**Budget expended(1)**
Charge Ready Pilot & Bridge	Commercial	Destination Center, Distribution Center Warehouse, Government facility, Multi-Unit Dwelling, Retail Business Center/Retail parking lot, School facility, and Transit agency	DAC/NonDAC	5/27/2016	Completed	145	0	145	2733	145	0	0	0	0	0	0	0	$43,855,000	$41,432,898
Charge Ready Demand Response Pilot(3)	Commercial	Destination Center, Distribution Center Warehouse, Government facility, Multi-Unit Dwelling, Retail Business Center/Retail parking lot, School facility, and Transit agency	DAC/NonDAC	12/27/2017	Completed	145	0	145	2733	145	0	0	0	0	0	0	0	$429,953	$210,322
Charge Ready Transport	Commercial	TRU, Medium-Duty Vehicles, Heavy Duty - Vehicles, School Bus, Transit Bus	DAC/Non-DAC	5/20/2018	Active	0	0	0	0	0	0	0	0	0	0	0	0	$356,362,471	$22,706,123
Charge Ready Light Duty	Commercial	N/A	DAC/Non-DAC	7/12/2021	Active	0	0	0	0	0	0	0	0	0	0	0	0	$436,343,669	$17,906,491
Charge Ready Schools	Commercial	Schools	DAC/Non-DAC	11/2/2020	Active	3	0	3	24	3	0	0	0	0	0	0	0	$9,890,000	$4,304,791
Charge Ready Parks	Commercial	Parks	DAC/Non-DAC	2/1/2021	Active	0	0	0	0	0	0	0	0	0	0	0	0	$9,890,000	$775,653
PRP-Charge Ready DCFC	Commercial	Transit agency	DAC/NonDAC	6/29/2018	Completed	0	0	0	0	0	0	0	0	0	0	0	0	$3,980,000	$1,666,444
PRP-Charge Ready Transit	Commercial	Transit agency	DAC/NonDAC	6/4/2018	Completed	0	0	0	0	0	0	0	0	0	0	0	0	$3,978,000	$2,019,295
PRP -Charge Ready Home Install Rebate	Residential	Residential	DAC/NonDAC	5/30/2018	Completed	0	0	0	0	0	0	0	0	0	0	0	0	$3,999,000	$2,067,538
PRP -Charge Ready POLB - Gantry Crane	Commercial	Gantry Crane	DAC	Q1 2018	Completed	0	0	0	0	0	0	0	0	0	0	0	0	$2,326,672	$2,261,429
PRP -Charge Ready POLB - Yard Tractors	Commercial	Yard Tractors	DAC	Q1 2018	Completed	0	0	0	0	0	0	0	0	0	0	0	0	$450,000	$446,759

(1) Charge Ready Pilot & Bridge,Transport, Light Duty, Schools, Parks, PRPs, and Demand Response Pilot budget expended are deflated for price inflation.

(2) Total number of ports and sites participating in ALM does not include Charge Ready Demand Response Pilot. Inclusion will duplicate total number of ports and sites in which all Charge Ready customers with installed level 2 electricle vehicle supply equipment (EVSE) are required to participate.

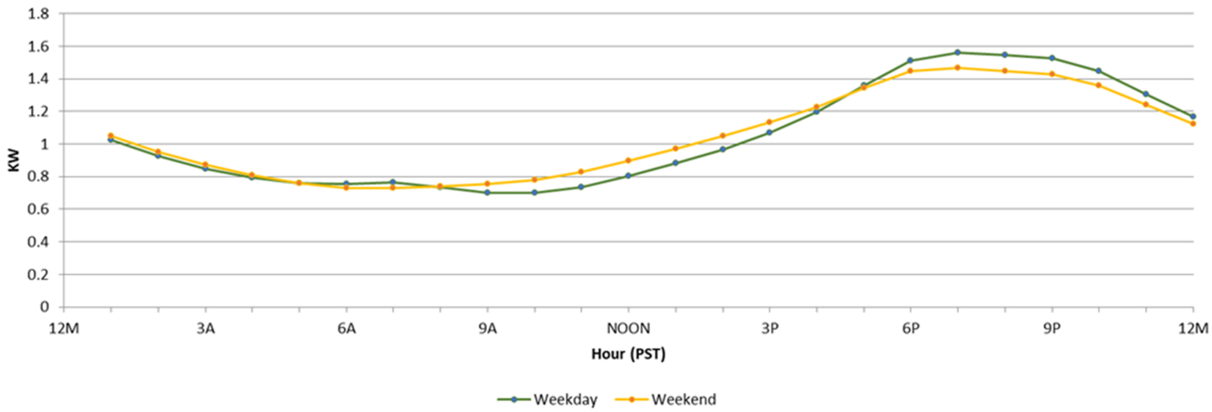
(3) The enrolled sites participating in the Charge Ready Demand Response Pilot are all of the Charge Ready Pilot and Bridge sites. In addition there are three Charge Ready School sites participating in the Demand Response Pilot.

Appendix B

VGI Annual Report

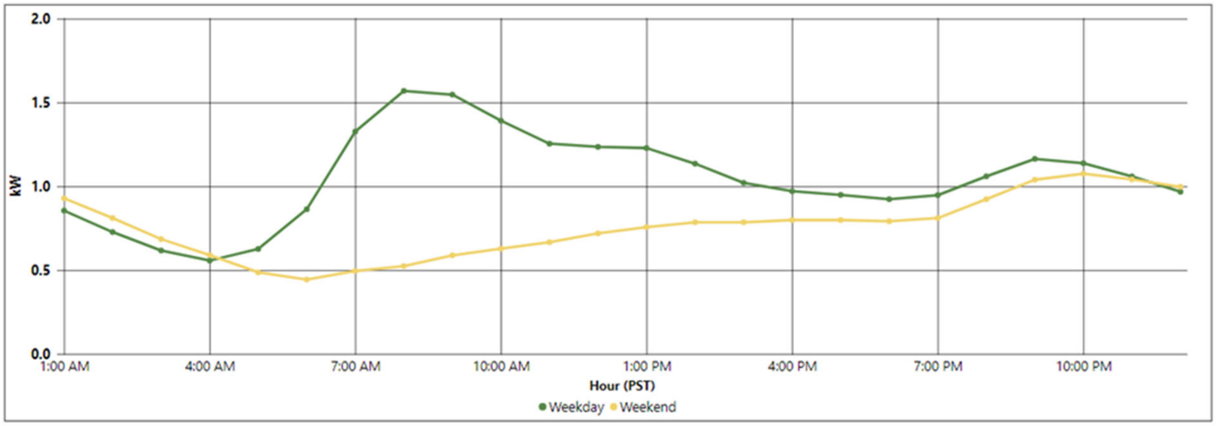
Chart Data

Chart 1 – Aggregate Average Load Profile for Schedule D (kWh)



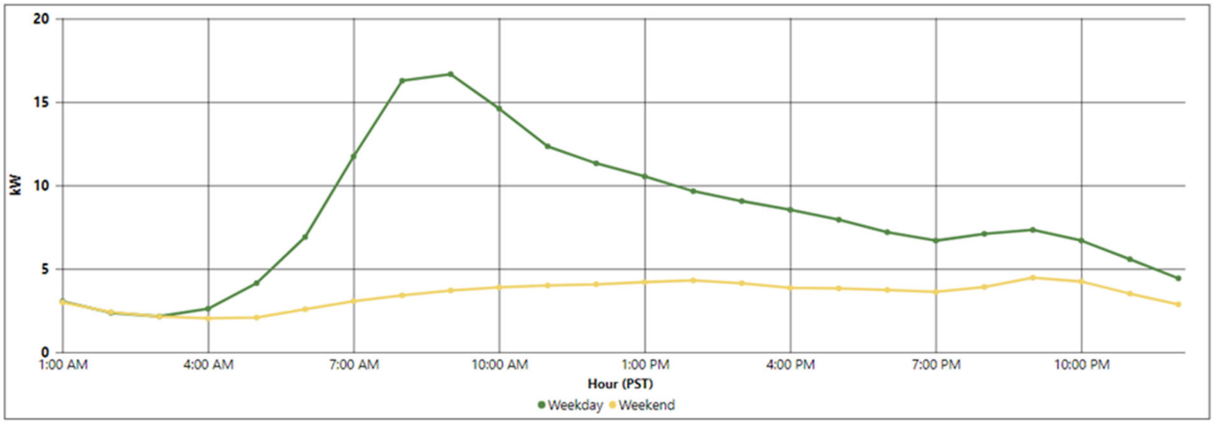
Hours	Weekday (kW)	Weekend (kW)
1	1.03	1.05
2	0.93	0.95
3	0.85	0.87
4	0.79	0.81
5	0.76	0.76
6	0.75	0.73
7	0.76	0.73
8	0.73	0.74
9	0.70	0.75
10	0.70	0.78
11	0.74	0.83
12	0.80	0.90
13	0.88	0.97
14	0.97	1.05
15	1.07	1.13
16	1.19	1.23
17	1.36	1.34
18	1.51	1.45
19	1.56	1.46
20	1.55	1.45
21	1.53	1.43
22	1.45	1.36
23	1.30	1.24
24	1.17	1.12

Chart 2 – Aggregate average hourly load profiles for TOU-EV-7 within programs (kWh)



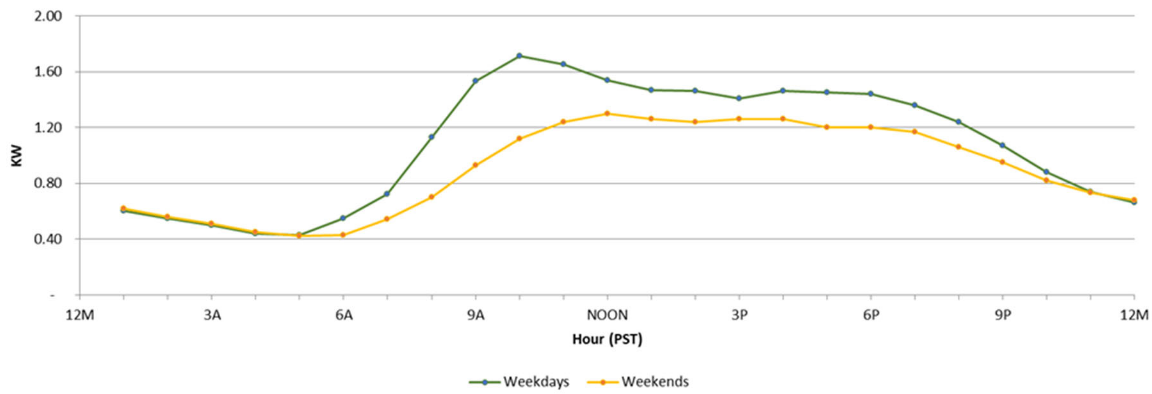
Hours	Weekday	Weekend
1:00:00 AM	0.86	0.93
2:00:00 AM	0.73	0.81
3:00:00 AM	0.62	0.69
4:00:00 AM	0.56	0.59
5:00:00 AM	0.63	0.49
6:00:00 AM	0.86	0.44
7:00:00 AM	1.33	0.5
8:00:00 AM	1.57	0.52
9:00:00 AM	1.55	0.59
10:00:00 AM	1.39	0.63
11:00:00 AM	1.26	0.67
12:00:00 PM	1.24	0.72
1:00:00 PM	1.23	0.76
2:00:00 PM	1.14	0.79
3:00:00 PM	1.02	0.79
4:00:00 PM	0.97	0.8
5:00:00 PM	0.95	0.8
6:00:00 PM	0.92	0.79
7:00:00 PM	0.95	0.81
8:00:00 PM	1.06	0.92
9:00:00 PM	1.16	1.04
10:00:00 PM	1.14	1.08
11:00:00 PM	1.06	1.04
12:00:00 AM	0.97	1

Chart 3 - Aggregate average hourly load profiles for TOU-EV-8 within programs (kWh)



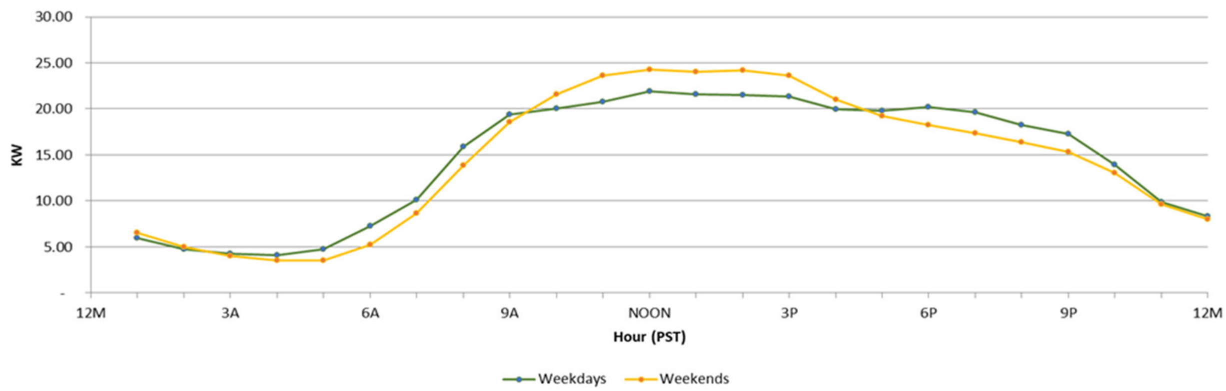
Hours	Weekday	Weekend
1:00:00 AM	3.05	3
2:00:00 AM	2.37	2.41
3:00:00 AM	2.16	2.15
4:00:00 AM	2.62	2.04
5:00:00 AM	4.15	2.08
6:00:00 AM	6.91	2.58
7:00:00 AM	11.75	3.07
8:00:00 AM	16.29	3.41
9:00:00 AM	16.68	3.71
10:00:00 AM	14.61	3.89
11:00:00 AM	12.35	4.01
12:00:00 PM	11.33	4.08
1:00:00 PM	10.55	4.21
2:00:00 PM	9.66	4.31
3:00:00 PM	9.07	4.14
4:00:00 PM	8.54	3.86
5:00:00 PM	7.95	3.84
6:00:00 PM	7.2	3.74
7:00:00 PM	6.7	3.62
8:00:00 PM	7.1	3.92
9:00:00 PM	7.34	4.47
10:00:00 PM	6.7	4.24
11:00:00 PM	5.58	3.52
12:00:00 AM	4.44	2.88

Chart 4 – Aggregate Average Load Profile for TOU-EV-7 (kWh)



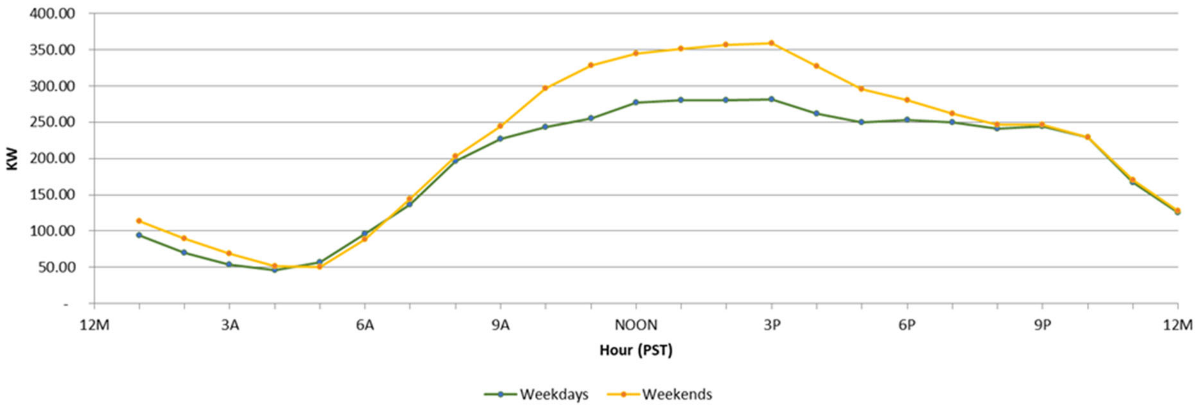
Hours	Weekday (kW)	Weekend (kW)
1	0.60	0.62
2	0.55	0.56
3	0.50	0.51
4	0.44	0.45
5	0.43	0.42
6	0.55	0.43
7	0.72	0.54
8	1.13	0.70
9	1.53	0.93
10	1.71	1.12
11	1.65	1.24
12	1.54	1.30
13	1.47	1.26
14	1.46	1.24
15	1.41	1.26
16	1.46	1.26
17	1.46	1.22
18	1.43	1.28
19	1.33	1.23
20	1.18	1.10
21	1.00	0.93
22	0.81	0.76
23	0.66	0.66
24	0.58	0.61

Chart 5 – Aggregate Average Load Profile for TOU-EV-8 (kWh)



Hours	Weekday (kW)	Weekend (kW)
1	5.98	6.57
2	4.73	4.97
3	4.22	4.05
4	4.13	3.50
5	4.74	3.51
6	7.28	5.23
7	10.13	8.64
8	15.92	13.88
9	19.42	18.57
10	20.03	21.61
11	20.79	23.64
12	21.87	24.29
13	21.58	24.03
14	21.47	24.20
15	21.34	23.65
16	19.94	20.99
17	19.79	19.21
18	20.24	18.26
19	19.63	17.37
20	18.21	16.40
21	17.27	15.35
22	13.90	13.08
23	9.83	9.65
24	8.36	7.99

Chart 6 – Aggregate Average Load Profile for TOU-EV-9 (kWh)



Hours	Weekday (kW)	Weekend (kW)
1	93.65	113.52
2	69.82	89.18
3	53.39	69.19
4	46.05	51.28
5	57.18	50.57
6	96.24	88.28
7	136.39	143.59
8	196.46	202.69
9	226.85	244.42
10	243.57	296.36
11	255.46	327.69
12	277.08	344.17
13	280.55	350.93
14	280.18	356.05
15	281.16	358.50
16	261.62	327.23
17	249.79	295.44
18	252.75	279.88
19	250.01	262.01
20	240.81	246.12
21	243.96	246.15
22	229.48	228.98
23	166.68	169.95
24	125.43	127.76