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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE

STATE OF CALIFORNIA

Order Instituting Rulemaking to Continue the Development of Rates and Infrastructure for Vehicle Electrification	Rulemaking 18.12-006

SOUTHERN CALIFORNIA EDISON COMPANY'S (U 338-E) MID-TERM REPORT ON VEHICLE-GRID INTEGRATION ACTIVITIES

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Dated: **September 15, 2021**

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SOUTHERN CALIFORNIA EDISON COMPANY'S (U 338-E) MID TERM-REPORT ON VEHICLE-GRID INTEGRATION ACTIVITIES

Pursuant to Ordering Paragraph (OP) 1 of Decision (D.) 20-12-029 (Decision), Southern California Edison Company hereby submits its 2021 Mid-Term Report on Vehicle-Grid Integration Activities. The Report outlines SCE's VGI activities through June 30, 2021.

Respectfully submitted,

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September 15, 2021

Vehicle-Grid Integration Strategies Mid-Term Report

Southern California Edison Company's Mid-term Report on VGI Programs and Pilots Metrics

September 15, 2021

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 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' reports annually starting on September 15, 2021 (with the first report limited to activity and program metrics) and ending September 15, 2030."[1] Additionally, in accordance with the Decision,[2] 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.[3] The data collection template is provided as a separate excel document, with narratives for metrics that are not easily quantifiable will be explained on a qualitative basis in this report. The narrative sections are included in this document under "Activity and Program Metrics."

The report covers the period from January 1 through June 30, 2021. Pursuant to OP 1, this initial mid-term report focuses solely on Program and Activity metrics and omits Outcome Metrics in order to allow time to phase in reporting for outcome metrics as identified in Attachment A, the data collection template. Omitted Outcome Metrics

[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.

include several narrative sections as well as columns I and J of the Program and Pilot Metrics tab of Attachment A.

Programs Background

This report focuses on metrics from five SCE Transportation Electrification (TE) programs and pilots. A brief description of each is included below:

Program/Pilot	Summary
Charge Ready Pilot/Bridge	SCE installs, owns, and maintains the electric infrastructure up to the make-ready stub, to serve light-duty Electric Vehicle Service Equipment (EVSE or chargers)[4] at non-residential long-dwell locations including workplaces, multi-unit dwellings, fleet parking, and destination centers. Includes marketing and outreach efforts.
Charge Ready Transport	SCE installs, owns, and maintains the electric infrastructure up to the make-ready stub to serve EVSE for medium and heavy-duty vehicles.
Charge Ready DR Pilot	Designed to incentivize Charge Ready customers who reduce or shift demand during specified Charge Ready DR events.
Charge Ready Schools	Site-host ownership rebate available to K-12 school facilities for EVSE installation and network fees.
Charge Ready Parks	Provides site hosts at select state parks and beaches or tribal lands with turn-key EVSE installation, operations and maintenance for publicly accessible charging.

On July 15, 2021 SCE filed Advice 4542-E requesting CPUC approval of three VGI pilot proposals (VGI Pilot Advice Letter) that support the scalability of VGI technologies. SCE's VGI Pilot Advice Letter is pending CPUC approval. Following CPUC approval of Advice 4542-E and implementation, SCE will begin to report on the authorized VGI pilots.

Data Collection Efforts

In this report, SCE provides information on existing 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

[4] SCE does not install, own, or maintain the EVSE, only the infrastructure up to the stub for the EVSE.

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. While SCE is beginning to track these new data elements, some information may not be available for this mid-term report. Additionally, SCE's TE programs are in various stages of implementation. As a result, some programs may have limited data. SCE discusses these areas in the final metric section, "Barriers to data collection and potential solutions" to align with the reporting template.

VGI Definitions

SB 676 originally defined VGI and gave authority to the Commission to revise the definition. 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 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:
> A. Increasing electrical grid asset utilization and operational flexibility.
> B. Avoiding otherwise necessary distribution infrastructure upgrades and supporting 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.[5]

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. SCE further breaks this down into direct and indirect forms:
    - Indirect V1G uses price signals and/or other mechanisms to optimize charging, including TOU rates and demand response

[5] D.20-12-029, p. 12-13.

    - 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
- V2B: Vehicle-to-building integration, under which an EV may provide power directly to a home or building
- V2G: Vehicle-to-grid 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.[6] 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.[7]

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 the required metrics.[8] 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 to provide an overview of the utility's VGI efforts and qualitative information, which SCE has grouped into the following metric categories: Automated Load Management (ALM), Demand Response (DR), Rates, and Miscellaneous metrics; and (2) a spreadsheet for reporting quantifiable data, such as pilot/program participation, costs, and other data. SCE's spreadsheet is provided as Attachment A.

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[6] Decision, p. 52.
[7] Id.
[8] Decision, p. 60.

Activity and Program Metrics

Pursuant to the Decision, for this initial mid-term report SCE is only reporting on program and activity metrics.[9] SCE will include outcome metrics in its future reports. Metrics are divided into the Sub-Categories defined in the reporting template: ALM, DR, Rates, and Miscellaneous Metrics, respectively.

Automated Load Management

Summary on efforts to develop and support complementary policies needed to support ALM technology (Activity Metric)

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

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

All EV Supply Equipment (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 EV Service Provider (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, and distribution impacts are reduced.

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 capacity of that system, assuming that the load could be present at any time. 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 electrical infrastructure to serve the load. In the advent of certified and capable energy management systems, it is helpful to assess the two alternatives and determine which is more economic and useful to all customers.

[9] Id.

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. As of this date, there is not a standing U.S. safety standard for computer network-controlled EV EMS or the configuration and commissioning of such systems. Despite the lack of standards, in 2017, SCE developed procedures to evaluate and approve such systems in support of SCE's responsibilities to evaluate and qualify EVSE systems for its Charge Ready programs and in response to customers' interest in EV EMS. 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 unrelated reasons, the two initial projects 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 procedure. As SCE 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. Another important aspect of Type II ALM deployment is the field commissioning. Each site must be properly configured with all of the EVSE types, their numbers, the infrastructure characteristics, protection settings, interface with utility systems, and fail-safe operating parameters. Each project at each site has uncertainty on the customer side with the AHJ and on the utility side with utility service design standards.

Subsequently, SCE in its Charge Ready Bridge program installed Type II capable systems, but the Type II capabilities were not implemented because the electrical infrastructure was capable of handling full load. The systems are still useful for providing customer and grid benefits as 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 serves on the CSA (CSA Group, Canadian Standards) and Institute of Electrical and Electronics Engineers' (IEEE) boards working on EV controls and EMS.

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 (Activity Metric)

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.

SCE has 140 sites and 2,667 ports participating in Type I ALM within our territory. The current list of sites is funneled through our Charge Ready Pilot & Bridge program.

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

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 (Activity Metric)

No Charge Ready Transport, Charge Ready Schools, or Charge Ready Parks sites 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 the customers 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.

Pilots underway with a discussion on the results and next steps including cost, lessons learned, etc. (Program Metric)

The Charge Ready DR Pilot began in 2018 and is still underway. Results have been generally positive through 2020 in reducing load between 4:00 pm and 9:00 pm by using a combination of control signals and incentives. Next steps include analyzing results at the end of the 2021 DR season and submitting a transition plan for moving from pilot to program. Costs for the Charge Ready DR Pilot are included in the Program and Pilot Metrics spreadsheet. Lessons learned include the difficulty in shifting EV charging to specific times, problems with using baselines to determine DR performance, and minimal negative feedback throughout the pilot.

Other pilots have been proposed or are currently under development. Therefore, next steps and lessons learned are not currently available.

Demand Response

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 (Program Metric)

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 Light Duty 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.

Number of EVs enrolled in DR programs (Program Metric)

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 signals from 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 (Attachment A).

Rate of change of EV DR enrollment and potential steps to increase enrollment (Program Metric)

Since participation in the Charge Ready DR Pilot is a condition for all Charge Ready Pilot and Bridge customers, 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.

EV DR enrollment capacity (MW) (Program Metric)

Based on 2,745 charging ports installed during the Charge Ready Pilot and Bridge phases, 100% utilization at an average of 6.6 kW is approximately 18 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 9 MW.

EV DR enrollment load shift (MWh) (Program Metric)

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 of

9 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 45 MWh. However, in reality the Charge Ready DR Pilot through 2020 averaged less than 0.5 MWh of load shift per event based on not all sites being live and much lower than 100% utilization of charging ports during events.

Rates Metrics

Site participation in rate-to-driver discussion on how to increase participation (Program Metric)

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.

Sites participating in DR, lessons learned and next steps to increase participation (Program Metric)

All active Charge Ready Pilot and Bridge sites participate in the Charge Ready DR Pilot, which began in 2018. A total of 146 EV charging sites participated in the Charge Ready Pilot and Bridge. Lessons learned include the difficulty in shifting EV charging to specific times, problems with using baselines to determine DR performance, and minimal negative feedback throughout the pilot. Since participation in DR was required for Charge Ready Pilot and Bridge 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.

Load shift for EV rate customers (Program Metric)

SCE offers a TOU-D-Prime rate for residential customers who have an electric vehicle or plug-in hybrid owners and lessees, customers with a residential battery, or customers with an electric heat pump system for water or space heating.[10]

SCE evaluated load impacts from customers enrolled in its TOU-D-Prime rate in 2019 and 2020. In 2019, non-Net Energy Metering (NEM) EV customers reduced their peak period (weekdays 4:00 to 9:00 PM) demand by 0.43 kW or 21.7% compared with customers not enrolled in the rate. In 2020, all customers reduced their peak period demand by approximately 0.33 kW or 14.0%. However, electricity consumption was high due to shelter-in-place during this time which partly reflects the reduced but still significant impacts. In addition, daily electricity consumption increased while customers were enrolled in the rate. Data from 2019 show that non-NEM customers increased their daily electricity usage by 3.61 kWh or 10.8%. This increase levelled off slightly to 7% in

[10] See https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans for details.

2020. SCE's findings show that the TOU-D-PRIME rate option is effective in shifting peak period demand from 4:00 to 9:00 PM during weekdays to off-peak periods, when the rate is lowest. A follow-up study will compare load impacts of EV customers who are enrolled onto TOU-D-PRIME with those that are enrolled onto other residential TOU rates.

Rate-to-driver enrollment by sites (Program Metric)

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.

Dynamic rate load shift (MWh) (Program Metric)

SCE does not currently have any EV tariffs that employ dynamic rates. While customers on dynamic rates may still charge EVs, this load is not visible to SCE at the vehicle level and is not expected to be significant at this time.

Aggregate unmanaged load profiles within programs (kWh) (Program Metric)

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 the purposes of this report.

Aggregate load profiles for EV TOU rates within programs (kWh) (Program Metric)

Chart 1 provides average weekday and weekend hourly load profiles for program customers on separately metered TOU-EV-7 between January 1, 2021 and June 30, 2021. The average weekday demand begins to rise around 5:00 AM where it is 0.3 kW and peaks around 9:00 AM with an average demand of 1.5 kW. For the rest of the day, charging within our program customers slowly tapers off after the 9AM peak. The weekend profile almost overlaps with the weekday profile before 6:00 AM. Weekend load gradually increases from 6:00 AM where it is 0.3 kW and peaks at 8:00 PM with an average demand of 0.8 kW, meeting the downward taper of the weekday profile.

Chart 1: Aggregate hourly load profiles for TOU-EV-7 within programs (kWh)

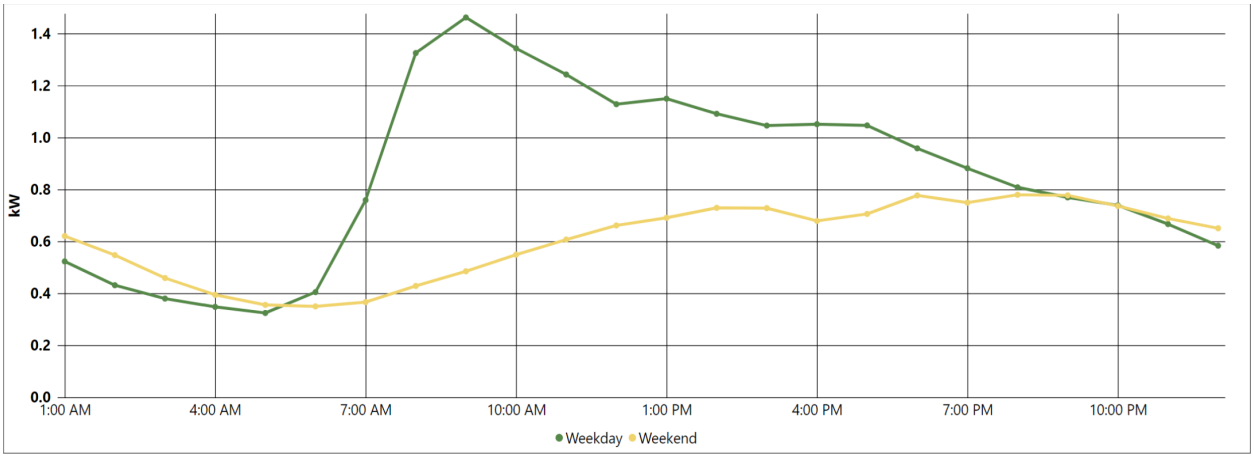
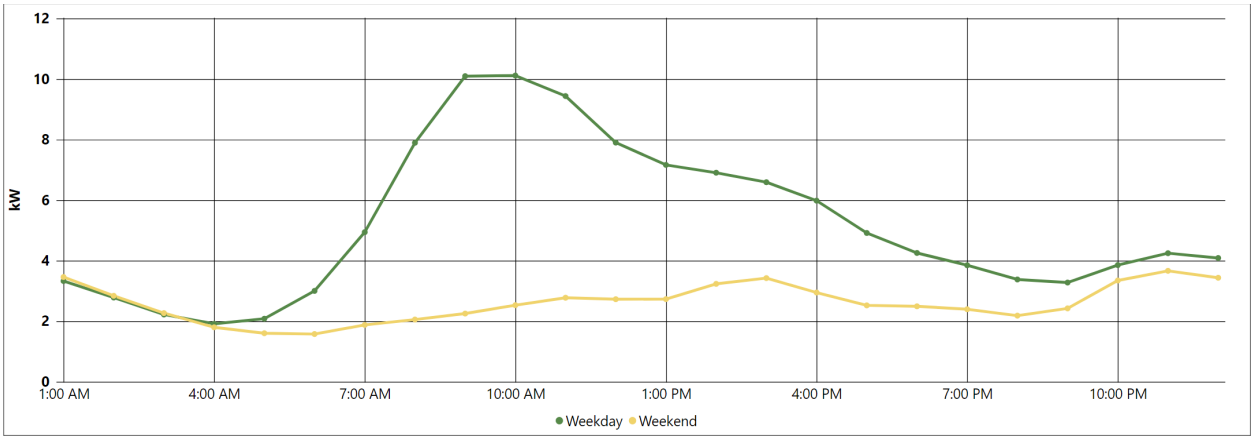


Chart 2 provides average weekday/weekend hourly load profiles for program customers on separately metered TOU-EV-8 between January 1, 2021 and June 30, 2021. The majority of our program customers receive TOU-EV-8. The average weekday demand begins to rise around 4:00 AM where it is 1.8 kW and peaks around 9:00 AM with an average demand of 10 kW. Charging demand is consistent at 10 kW for one hour and consumption slowly tapers off at 10:00 AM. After this, the load shape tapers off before a slight rebound at 9:00 PM to 4kW at 11PM. The weekend profile overlaps again with the weekday profile up to 4:00 AM and displays a slow increase up to 3:00 PM. Overall charging dips until a slight increase beginning at 8:00 PM which peaks around 11:00 PM where it is 3.7 kW.

Chart 2: Aggregate hourly load profiles for TOU-EV-8 within programs (kWh)



There are only seven program customers participating on TOU-EV-9, representing large commercial customers. With this in mind, the sample size is overly small and the data are not representative of the broader trends on the rate. Therefore, we omit this small

subset of data. 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 1 and 2 can be found in Attachment B.

Rate-to-host (Program Metric)

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 peak monthly usage. TOU-EV-7, TOU-EV-8, and TOU-EV-9 rates are applicable to commercial customers whose monthly max demand is 20 kW or less, 21 kW to 500 kW, and above 500 kW, respectively. There is currently a demand charge holiday until 2024. Charging infrastructure must be separately metered to qualify for these rates.

Rate-to-driver (Program Metric)

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.

Miscellaneous Metrics

Customer program or pilot and incentives related to VGI (Activity Metric)

The Charge Ready DR Pilot sends control signals from the utility to EVSP that throttles charging capacity by 50%. Customers who reduce load from a calculated baseline during event hours receive incentives. When the pilot launched, an incentive of $0.10 per kWh reduced was provided. The incentive amount was later increased to $0.15 per kWh reduced.

Adoption of rates that encourage VGI and adoption of mechanism to provide credit for export (Activity Metric)

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 are covered elsewhere.

SCE does not currently have a rate available that provides EV customers with credit for export but will report on these efforts as they develop.

Efforts to collaborate with CAISO to design wholesale market rules and access that support VGI (Activity Metric)

While there are many areas of collaboration between SCE and CAISO that may impact VGI, SCE is not currently involved in direct CAISO collaboration on wholesale market design specific to access and support for VGI.

However, SCE is currently working on a school bus pilot project that may ultimately participate in the CAISO.

Leveraging or supplementing EPIC and/or other sources of funding for VGI technology demonstration projects (Activity Metric)

SCE has three EPIC 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 VGI use 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 OIB)
- Service Center of the Future (SCOF)

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

V2G OIB: This project, though originally crafted with on-board inverter architecture in mind, has broadened to include off-board inverter systems with the added element of incorporation of SCE's Grid Management System. With four sets of partners, involving two light-duty original equipment manufacturers (OEM), automakers, an electric school bus, and a transit 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. This project demonstrates six VGI use cases with the partners and sets the stage for future field demonstrations and V2G interconnections and operations.

SCOF: The Service Center of the Future projects is a broad-scale project that brings microgrid control strategies together with facility modernization of a heavy-duty 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 and renewables integration.

Project results and reports will be available in the 2022-2024 timeframe.

Efforts to accelerate the use of VGI for resiliency (Activity Metric)

On June 15, 2021, SCE filed AL-4518-E outlining its LCFS Holdback spending proposal. This proposal includes a School Bus V2B Project with Baldwin Park Unified School District focused on providing resiliency power for emergency energy backup.[11] SCE may consider utilizing LCFS holdback credit proceeds for appropriate VGI resiliency projects in the future.

Additionally, on July 15, 2021, SCE filed AL-4542-E outlining its VGI Pilots spending proposal in response to Decision (D.)20-12-029. 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[12] explores options for behind the meter (BTM) storage services, in support of vehicle to building (V2B) functionality. Second, the Distributed Energy Resource (DER) VGI Pilot[13] explores integration with municipal fleets and provides nanogrid services.

Progress to reform interconnection rules to advance VGI (Activity Metric)

SCE's Rule 21 tariff and interconnection technical standards continue to evolve to support bi-directional VGI application. On September 24, 2020, the Commission issued D.20-09-035, which provides direction on how bi-directional VGI applications are to be addressed.

For certain type of systems (V2G-DC systems), the Decision clarified that these system can interconnect to the grid as long as the V2G-DC EVSE meets all Rule 21 requirements, including UL 1741 SA and other updated Smart Inverter Standards.[14]

For other type of systems for which standard currently do not exist (V2G-AC systems), the Decision ordered that IOUs develop a process for interconnecting V2G-AC systems pilot projects while ensuring that the necessary safety provisions are taken.[15]

[11] AL-4518-E, Appendix A p. 64.
[12] AL-4542-E Appendix B, p. 7.
[13] Id., Appendix C, p. 8.
[14] D.20-09-035, OP. 39., p. 218.
[15] D.20-09-035, OP. 44. p. 220.

Further D.20-09-035 requires the IOUs to participate in the committees that update the V2G-AC interconnection standards, update the Vehicle-to-Grid Alternating Current Subgroup on updates to the development of the V2G-AC standards, and to inform the Director of Energy Division when the standards have been developed.[16]

There are several standards that have or are in the process of being developed in order to allow V2G-AC systems to be interconnected. These standards include the following:

- SAE- J3072 - *Interconnection Requirements for Onboard, Grid Support Inverter Systems*
- UL 1741 SC - *Standard for Interconnection System Equipment (ISE)/EVSE*
- *SunSpec J3072-2030.5 profile standard and certification*

Support and adoption of non-interconnection technical standards to advance VGI (Activity Metric)

SCE actively supports development and maintenance of VGI and EV charging standards through SAE, IEEE, CSA, UL, SunSpec, and others. SCE co-chairs the SAE J2894 task force on power quality of PEV chargers. SCE is a member of the CSA task force on EVEMS (EV Energy Management Systems, also known as ALM), which is the first attempt in North America on standards for network-controlled EV charging energy management systems. This is supporting a critical need for a certifiable safety standard and implementation process for Type II EVEMS. SCE supports follow-on harmonization efforts with US standards bodies. In addition, SCE is a member of the IEEE 2030.13 committee on network managed EV charging facilities. SCE 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.

Additionally, on June 15, 2021, pursuant to OP 19 of the Decision, SCE submitted Advice 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. Advice 4521-E is pending Commission approval.

Summary on efforts to fund and launch VGI customer education (Activity Metric)

SCE has yet to launch a VGI customer education program. SCE does, however, currently support customers with questions through its Charge Ready programs as well as presents publicly on VGI technologies and their potential. Additionally, SCE is

[16] D.20-09-035, OP, 53 and 54, p. 225.

focused on educating customers about rate options (Time-of-use rates are contained in the definition of V1G) which include TOU-D-PRIME.

Implementation of VGI Pilots, lessons learned, and potential future efforts (Activity Metric)

As explained above, SCE filed a VGI Pilot Advice Letter on July 15, 2021, requesting CPUC approval of three VGI pilot proposals to support the scalability of VGI technologies. Specifically, SCE proposed:

(1) V1G Pilot: A large scale residential unidirectional managed charging (V1G) pilot to accelerate the adoption of load modifying demand response, resource adequacy, ancillary, and other services by aggregators and IOUs.
(2) Medium-Duty and Heavy-Duty (MD/HD) VGI Pilot: Explores options for behind the meter (BTM) storage services, in support of vehicle to building (V2B) functionality.
(3) Distributed Energy Resource (DER) VGI Pilot: Explores integration with municipal fleets and provides nanogrid services.

Following CPUC approval of Advice 4542-E and implementation, SCE will begin to report on the implementation and lessons learned associated with its authorized VGI pilots.

Integration of VGI across the utility relevant business activities (Activity Metric)

SCE is starting to include VGI in utility discussions on relevant business activities, including the development of potential new rates and how to address operational challenges.

Metrics on interconnection reform (Program Metric)

SCE does not currently have metrics around interconnection reform, although metrics will be developed as reforms take effect.

Effectiveness of credit-for-export availability, lessons learned, and potential next steps (Program Metric)

SCE currently does not have a mechanism to provide credit for export for EV customers, but will report on these efforts as they develop.

Participants in credit for export and discussion to increase participation (Program Metric)

SCE currently does not have a mechanism to provide credit for export for EV customers, but will report on these efforts as they develop.

Annual energy exported (kWh) and report out on potential efforts to increase participation (Program Metric)

This metric is not applicable at this time. There are no program customers exporting energy to our grid.

Overall barriers removed in V2B (Program Metric)

This metric is not applicable at this time, as SCE is in early stages of V2B analysis.

Barriers to data collection and potential solutions (Program Metric)

1. **Existing TE Programs are not able to separate O&M Costs by Market Segment**

   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, we are not able to separate O&M costs by market segment, and therefore budget and spend figures are presented as consolidated.

2. **Certain Metrics Require Baselines that have yet to be Established**

   Columns K-N of the Program and Pilot Metrics tab in the Attachment A, covering 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. SCE is assessing how to collect, track and best present this data for the annual report in 2022.

3. **Metrics SCE cannot Directly Gather**

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

Appendix A

VGI Reporting Template

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):**	**2667**	**140**	**0**			**$ -**	**$ -**	**$ -**	**$ -**	**$ 856,771,093.00**	**$ 54,004,430.00**
					Counts By Program or Pilot					Cost By Program or Pilot					
Program/Pilot	**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**	**Budget expended(1)**
Charge Ready Pilot & Bridge	Commercial	Workplace	DAC/Non-DAC	Active	1429	62	0								
Charge Ready Pilot & Bridge	Commercial	Destination Center	DAC/Non-DAC	Active	639	32	0							$ 43,855,000	$ 41,128,471
Charge Ready Pilot & Bridge	Commercial	Fleets	DAC/Non-DAC	Active	227	15	0								
Charge Ready Pilot & Bridge	Commercial	Multi-Family Dwellings	DAC/Non-DAC	Active	372	31	0								
Charge Ready Transport	Commercial	Medium-Duty Vehicle	DAC/Non-DAC	Active	0	0	0								
Charge Ready Transport	Commercial	School Bus	DAC/Non-DAC	Active	0	0	0							$ 356,362,471	$ 8,264,065
Charge Ready Transport	Commercial	Transit Bus	DAC/Non-DAC	Active	0	0	0								
Charge Ready Demand Response Pilot	Commercial	Workplace	DAC/Non-DAC	Active	1429	62	0	Outcome Metrics- not included in initial Mid-term Report		See Narrative Report Section on Barriers to Data Collection					
Charge Ready Demand Response Pilot	Commercial	Destination Center	DAC/Non-DAC	Active	639	32	0								
Charge Ready Demand Response Pilot	Commercial	Fleets	DAC/Non-DAC	Active	227	15	0							$ 429,953	$ 211,441
Charge Ready Demand Response Pilot	Commercial	Multi-Family Dwellings	DAC/Non-DAC	Active	372	31	0								
Charge Ready Light Duty	Commercial	N/A	DAC/Non-DAC	Active	0	0	0							$ 436,343,669	$ 3,041,624
Charge Ready Schools	Commercial	Schools	DAC/Non-DAC	Active	0	0	0							$ 9,890,000	$ 838,592
Charge Ready Parks	Commercial	Parks	DAC/Non-DAC	Active	0	0	0							$ 9,890,000	$ 520,237

Notes:

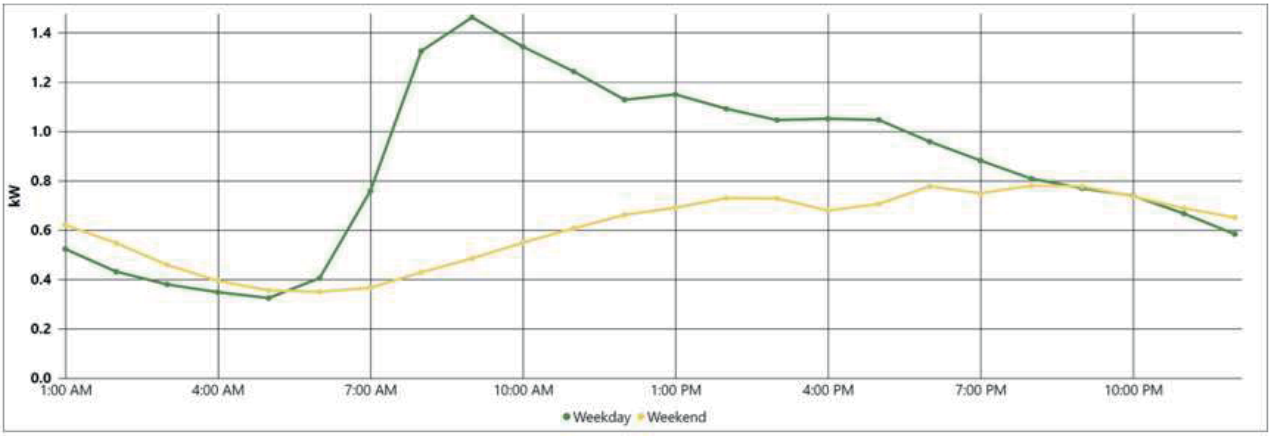
(1) Charge Ready Pilot & Bridge, Transport, Light Duty, Schools, and Parks budget expended are deflated for price inflation

(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.

Appendix B

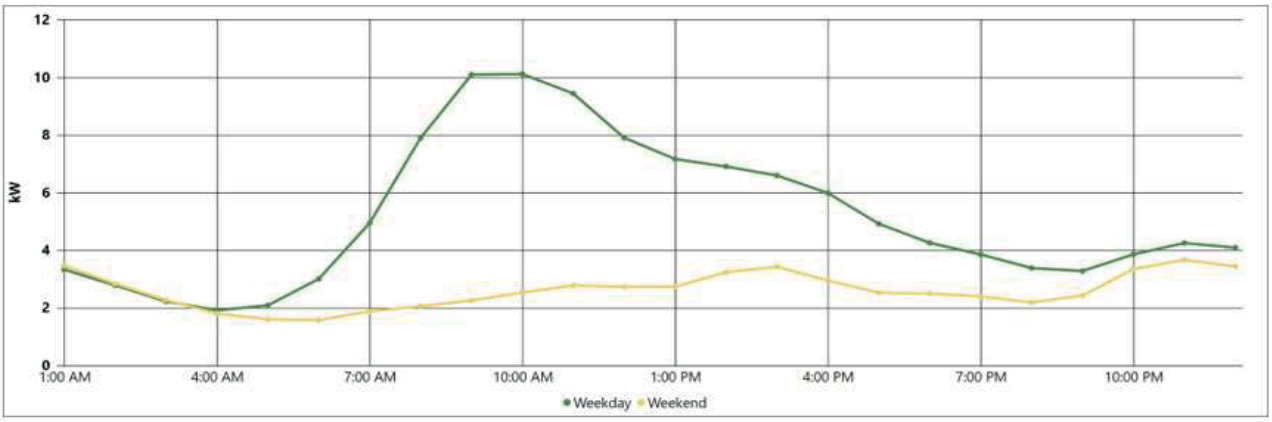
VGI Mid-Term Report Chart Data

Chart 1: Aggregate hourly load profiles for TOU-EV-7 within programs (kWh)



Hours	Weekday	Weekend
1	0.522884546	0.620419201
2	0.43112306	0.547037686
3	0.379683339	0.458808984
4	0.347802558	0.394081287
5	0.32425801	0.355411654
6	0.404585847	0.349573779
7	0.758685826	0.366036326
8	1.325022243	0.428245617
9	1.461886114	0.484820551
10	1.343002611	0.548624091
11	1.242309847	0.606960374
12	1.127986807	0.661208338
13	1.149321946	0.690638709
14	1.091112778	0.728985438
15	1.045691275	0.727885707
16	1.051139408	0.678680164
17	1.046372973	0.705555832
18	0.958036085	0.776867034
19	0.881422083	0.749082368
20	0.808099805	0.779362087
21	0.769134994	0.776896395
22	0.73855785	0.736145487
23	0.666516272	0.688261826
24	0.583423267	0.650377586

Chart 2: Aggregate hourly load profiles for TOU-EV-8 within programs (kWh)



Hours	Weekday	Weekend
1	3.327658811	3.459025518
2	2.782039722	2.839020929
3	2.220311377	2.268122121
4	1.91397451	1.799143472
5	2.082067357	1.602847762
6	3.001511599	1.576310086
7	4.941782138	1.877606563
8	7.893810202	2.055061286
9	10.09578719	2.252437169
10	10.11477117	2.529072229
11	9.437203878	2.77564042
12	7.899902459	2.726968858
13	7.163279273	2.729715187
14	6.905326336	3.233706928
15	6.591752924	3.423992797
16	5.982400643	2.947005289
17	4.914676102	2.523404357
18	4.254289802	2.492057633
19	3.84836911	2.395421195
20	3.378574888	2.184050406
21	3.276923331	2.424156643
22	3.854203501	3.344395087
23	4.246699609	3.664267815
24	4.087873714	3.434815806