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CA IOU Comments for FDAS EVSE RFI

Additional submitted attachment is included below.

February 26, 2025

Efficiency Division, Load Flexibility Branch
California Energy Commission
715 P Street
Sacramento, CA 95814

Topic: Request for Information (RFI) on Flexible Demand Appliance Standards for Electric Vehicle Supply Equipment

Docket Number: 24-FDAS-04
TN Number: 259603

Dear Commission Staff,

This letter comprises the comments of the Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE), collectively referred to herein as the California Investor-Owned Utilities (CA IOUs), in response to the California Energy Commission request for information (RFI) regarding flexible demand and load shifting for electric vehicle supply equipment (EVSE).

The CA IOUs comprise some of the largest utility companies in the nation, serving over 32 million customers in the Western United States. We are committed to helping customers reduce energy costs and consumption while striving to meet their evolving needs and expectations. Therefore, we advocate for standards that accurately reflect the climate and conditions of our respective service areas.

We respectfully submit the following comments to the California Energy Commission (CEC). This comment letter updates comments submitted to the CEC on December 20, 2024, sections with updates have been noted and are *italicized* .

The CA IOUs support the CEC's investigation of flexible demand appliance standards for electric vehicle supply equipment (EVSE).

The CA IOUs have ambitious targets to support California's clean transportation goals that are consistent with statewide flexible demand standards for electric vehicle supply equipment:

- PG&E intends to electrify a significant portion of its vehicle fleet and support the fueling of at least three million electric vehicles (EVs) within its service area by 2030. This initiative includes preparing the grid for 12,000 GWh of EV load and unlocking customer potential to participate in vehicle-grid integration (VGI) applications with the goal of enabling 550 MW of flexible load from those 3 million EVs.[1]

- SCE's Pathway 2045 White Paper commits to supporting electrification of 26 million light-duty vehicles, 900,000 medium-duty vehicles, and 170,000 heavy-duty trucks and buses by 2045.[2]
- SDG&E has set goals to support California's adoption of five million zero-emission vehicles by 2030 by expanding the charging network in its service area to accommodate cars, buses, trucks, shuttles, and more. They also aim to operate a 100% zero-emission fleet by 2035.[3]

Flexible EVSE will significantly contribute to achieving 7 gigawatts of flexible demand by 2030[4], and will benefit customers throughout the state. The CA IOUs offer time-of-use rate plans for electric vehicle charging, allowing customers to save money by charging when electricity costs are lowest. We are piloting vehicle-grid integration opportunities to improve customer experience and grid stability and minimize grid upgrades needed to support the increased electric load from EVs.[5] We support an equitable energy transition by siting a substantial portion of our electric vehicle charging infrastructure (EVCI) investments in disadvantaged communities and providing support for multi-family housing residents with onsite, workplace, and public-destination charging ports.

Updated comment from previous letter: The FDAS, under development at the CEC, promises to provide significant flexible demand resources for the California grid. As EVSE is an emerging technology, it is entering the California market more rapidly than the other product categories under consideration for FDAS. To maximize the flexible demand potential available through FDAS, the CEC should prioritize the development of an EVSE standard that can apply to these systems as they enter the market.

At the same time, the CA IOUs are sensitive to potential increased upfront costs associated with procuring electric vehicle chargers as EVs vie for market share against internal combustion engine vehicles. Supporting California ratepayers and ensuring low-income communities have access to affordable EVs and EVSE is essential. Therefore, the CA IOUs emphasize obtaining accurate, current information about the capabilities, costs, and benefits of flexible EVSE and vehicle-grid integration capabilities. This guidance will help CEC policymakers develop flexible demand appliance standards for EVSE that can help lower the cost of driving an EV.

[1] Pacific Gas & Electric, Inc., "PG&E Climate Strategy Report," June 2022, p. 20. https://www.pge.com/assets/pge/docs/about/corporate-responsibility-and-sustainability/pge-climate-strategy-report.pdf.
[2] Southern California Edison Corporation, "Pathway 2045," November 2019, https://newsroom.edison.com/_gallery/get_file/?file_id=5dc0be0b2cfac24b300fe4ca&ir=1.
[3] San Diego Gas & Electric, Inc., "SDG&E Clean Transportation Initiatives," SDGE, n.d., https://www.sdge.com/residential/electric-vehicles/electrification-projects-overview
[4] Brattle. 2024. "California's Virtual Power Potential: How Five Consumer Technologies Could Improve the State's Energy Affordability." Accessed Dec 19, 2024. https://gridlab.org/wp-content/uploads/2024/04/Californias-Virtual-Power-Potential-Vol-II-Technical-Appendix.pdf
[5] SDG&E Cajon Valley V2G Pilot: San Diego Gas & Electric Corporation, "Vehicle-to-Grid," sdge.com, n.d., https://www.sdge.com/business/electric-vehicles/power-your-drive-for-fleets/current-V2G-projects and SCE's Los Angeles Air Force base V2G pilot: Siddiq Khan and Shruti Vaidyanathan, "Strategies for Integrating Electric Vehicles into the Grid," *Aceee.Org* (American Council for an Energy-Efficient Economy, February 2018), https://www.aceee.org/sites/default/files/publications/researchreports/t1801.pdf.
PGE&E's Vehicle to Everything (V2X) Pilot Programs

1. **Please provide information to assist the CEC in determining whether the scope of devices in Table 1 of the RFI meets the needs of FDAS or if the CEC needs to consider revisions to the scope.**

Updated comment from previous letter: Considerable activity is currently underway in vehicle-to-grid (V2G) integration. This progress includes state and national policy development across numerous standards bodies and research conducted by national laboratories and vehicle original equipment manufacturers (OEMs). Given these moving parts, we recommend that the CEC focus its scope for this EVSE FDAS by optimizing for simplicity, load-shift potential (by total kWh), and target market. Thus, we suggest that the CEC prioritize AC Level 2 EVSE for its initial FDAS targeting this product and application.

   a. ***Level 2 EVSEs are rapidly increasing in California, making this the ideal time to implement an FDAS before the market reaches saturation.***

Level 2 (L2) private EVSE is the largest subcategory of EVSE. Adoption is driven by new EV purchases, with 68% of new EV drivers also installing an L2 EVSE at home for the first time. A summary of the J.D. Power 2024 U.S. Electric Vehicle Experience (EVX) Home Charging Study notes that "Combined, Level 2 portable and Level 2 permanently mounted charging stations are utilized by 84% of all EV owners who charge their vehicle at home."[6] In 2024, EVs accounted for 26% of new light-duty vehicle sales in California but only represent 5% of the nearly 39 million light-duty vehicles registered in the state. We estimate that 1.6 million private Level 2 EVSEs are installed in California homes,[7] with 660,000 installed between 2023 and 2024. We also expect the number of L2 private EVSEs to grow rapidly as EVs continue to claim larger shares of the new car market. The adoption of electric vehicles in California and globally seems to follow an "S"-shaped curve, similar to other emerging technologies.

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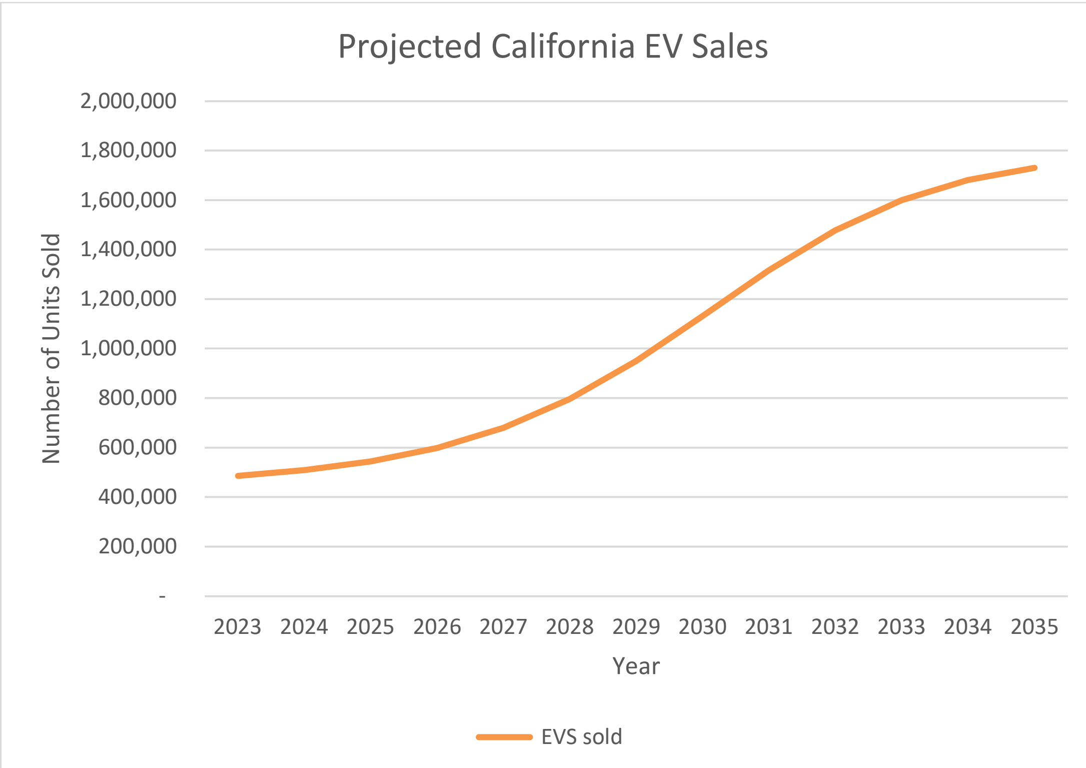
[6] "Home Charging Satisfaction a Bright Spot Among Electric Vehicle Owners, J.D. Power Finds Tesla Ranks Highest for Fourth Consecutive Year," *Jdpower.Com* (J.D. Power, March 26, 2024), https://www.jdpower.com/business/press-releases/2024-us-electric-vehicle-experience-evx-home-charging-study.

[7] Ibid. Based on J.D. Power's 2024 U.S. Electric Vehicle Experience Home Charging Study.

Figure 1. Projected California EV Sales



Source: California IOUs Team Analysis

Figure 1 illustrates the current California EV market and the statewide goal of achieving 100% light-duty vehicle sales by 2035. While we do not know whether California's EV adoption will follow this curve, the trend is consistent with the observed growth to date and the state's economic and regulatory environment. EVs already have lower levelized ownership costs than equivalent gasoline-powered cars. Continuing reductions in battery prices may result in EVs reaching first-cost parity with their gasoline counterparts.[8]

Assuming that 68% of new EV drivers will continue installing L2 EVSE at home as EVs continue to gain market share in California, by 2030 approximately 4.8 million private L2 EVSE could be installed in residential properties throughout the state. A conservative estimate for the eventual maximum penetration of private L2 EVSE is the number of single-family detached and attached homes in California, recorded at 7.8 million as of June 2020.[9] This number is anticipated to increase to 8.5 million by 2035, as indicated in Table 1 below.

Table 1. Stock Projections for Private Level 2 EVSE in California

[8] Andrei Nedelea, "The Price Gap Between EVs and ICE Cars Is Shrinking Fast," *InsideEVs*, January 26, 2025, https://insideevs.com/news/748568/price-gap-evs-ice-shrinking/.
[9] U.S. Census Bureau, "DP04Selected Housing Characteristics," data.census.gov, 2023, https://data.census.gov/table?q=DP04&g=040XX00US06.

Product Category	Estimated Stock in 2024	Projected Stock in 2030	Projected Stock in 2035
Private L2 EVSE	1.6 mil	4.8 mil	8.5 mil

b. L2 EVSE offers the best potential for scheduling, shifting, and curtailing EV load to support the CEC's flexibility goals.

In addition to a high near-term adoption rate, L2 EVSE represents a relatively large and potentially flexible connected load. A typical L2 EVSE can provide between 7.2 and 19.9 kW of electric power on a single-phase, 240 V residential circuit, depending on the EV's onboard battery charger and the battery's state of charge. Compared to other appliances considered for California FDAS, a consumer electric resistance water heater has a rating of 3 to 5 kW, and a heat pump water heater's compressor generally uses 0.5 kW. Low-voltage thermostats on residential HVAC systems control central air-conditioners (cooling only) or heat pumps (heating and cooling). A reasonable estimate for the average-rated wattage of the compressors used in both systems is 3.4 kW. EVs are typically connected to private L2 EVSE for 12 hours overnight. They can replenish the electricity used during the daily commute in about three hours, indicating the potential to shift load for six hours or more.

Table 2. Projected Connected* EVSE Load in California

Product Category	Connected Load		
	per unit	All Units 2030	All Units 2035
Private L2 EVSE	11.0 kW	52.8 GW	93.5 GW

**For Table 2, "connected" refers to galvanic attachment to the electricity distribution grid, not communications or internet connectivity. Connected load is the sum of the maximum consumption of all units, not the actual expected impact on the grid.*

Table 2 projects the connected load for private L2 EVSE based in California on typical equipment configurations and the adoption trend in Table 1. By 2030, the connected load for private L2 EVSE load is expected to reach 50% of the maximum for this product class. We project that the maximum load may be reached as early as 2035 when most California single-family homes have installed L2 EVSE. Conversely, the adoption rates for both electric storage water heaters and low-voltage thermostats are driven by the replacement of existing equipment and will be significantly slower than for private L2 EVSE.

The 2022 "PG&E Electric Vehicle Automated Demand Response Study Report"[10] affirms the scale of the L2 EVSE opportunity:

- *Among the 3,183 PG&E EV owners surveyed, 71% already owned a L2 charging station.*

[10] "PG&E Electric Vehicle Automated Demand Respond Study Report," *Calmac.Org* (Opinion Dynamics, February 2022), https://www.calmac.org/publications/PGE-EV-ADR-Study-Report_FINALV2.pdf.

- *The authors estimated a demand response potential of 31-40 MW between the hours of 12 a.m. and 4 a.m., based on the 366,000 PG&E EV owners at time of publication. They noted that "EV DR resource potential for the overnight period from (12:00 a.m. to 5:00 a.m.) is on par with or higher than the SmartAC and SmartRate programs."*

Therefore, the CEC should prioritize FDAS for private L2 EVSE to realize the flexible demand potential of EVSE in California as quickly as possible. Additional demand flexibility resources may be available in smaller sub-categories of EVSE. However, if a broader regulation takes longer to implement, the CEC could miss the current surge of private L2 unit installations, resulting in a more limited application of the FDAS to a smaller set of new installations and chargers being replaced at the end of life.

c. The CEC should leverage the ENERGY STAR® EVSE Specification for its FDAS.

The CA IOUs suggest that the CEC review the requirements in the United States (U.S.) Environmental Protection Agency's (EPA) ENERGY STAR EVSE Specification (Version 1.2[11]), which includes a "connected" charger option. These requirements could provide a useful reference for developing minimum connectivity requirements for an L2 EVSE FDAS while leaving flexibility for different communication standards to evolve in this emerging space. ENERGY STAR optional requirements for connected EVSE include:

- *Communicate bi-directionally using open standards (e.g., defined in the specification as either OCPP or the communication and equipment performance standards for SEP 2.0, CTA-2045, and/or OpenADR 2.0.)*
- *Provide open access through an API or provide "similar documentation that is intended to enable DR functionality."*
- *Schedule, remotely manage, provide energy consumption data to consumers, and respond to consumer overrides.*
- *Support open standard-defined charge modes: charge now, curtail charge, delay charge, and return to normal.*

The EPA is seeking input on an ENERGY STAR Version 2.0 EVSE Draft 1 Specification.[12] An updated specification could support a unified and flexible approach to connectivity within the class of L2 EVSEs. Notably, Draft 1 of the V2.0 EVSE specification requires that EVSEs conform to OCPP 2.0.1 or higher. OCPP is a widely accepted standard and product of the Open Charge Alliance (OCA), whose goal is to offer a uniform solution for the method of communication between the charge point and the central system.[13]

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[11] ENERGY STAR, "ENERGY STAR Program Requirements for Electric Vehicle Supply Equipment," *ENERGY STAR*, 2021, https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%201.2%20EVSE%20Final%20Specification_0.pdf.

[12] ENERGY STAR, "ENERGY STAR Program Requirements for Electric Vehicle Supply Equipment - Eligibility Criteria," *ENERGY STAR*, 2024, https://www.energystar.gov/sites/default/files/202501/ENERGY%20STAR%20V2.0%20EVSE%20Draft%201%20Specification.pd.

[13] Open Charge Alliance, "Open Charge Point Protocol - Open Charge Alliance," February 6, 2025, https://openchargealliance.org/protocols/open-charge-point-protocol/.

The draft V2.0 specification also requires EVSE to have "Powerline Carrier (PLC) capability for communication and is capable of Plug and Charge" and notes that this effectively requires the vehicle to use a version of ISO 15118, commonly ISO 15118-2, which specifies the communication between EVs (including Battery Electric Vehicles and Plug-In Hybrid Electric Vehicles) and EVSE.[14]

d. The CEC should exclude the power electronic components within the vehicle from this FDAS.

The CEC should exclude the power electronic components within the vehicle, as stated by other commenters to this RFI. The CA IOUs expect most vehicle-to-grid integration (VGI) logic to occur before reaching the vehicle. The following standards currently apply directly to components within EVs:

- *"FMVSS No. 305a Electric-Powered Vehicles: Electric Powertrain Integrity Global Technical Regulation No. 20 Incorporation by Reference" includes requirements for propulsion batteries in both light and heavy-duty electric vehicles.*[15]
- *ANSI's "Roadmap of Standards and Codes for Electric Vehicles at Scale," developed by the Institute's Electric Vehicles Standards Panel (EVSP), identifies key safety, performance, and interoperability issues, notes relevant published and in-development standards, and makes recommendations to address gaps in codes and standards.*[16] *The International Organization for Standards (ISO), the International Electrochemical Commission (IEC), and Society of Automotive Engineers (SAE) all provide standards specific to hybrid and plug-in electric vehicles with a focus on testing, fuel economy, emissions, and communications.*[17]
- *California Air Resources Board (CARB) regulates EVs through its Advanced Clean Cars II regulation.*[18] *As an example, CARB's ACC II scope includes requirements for minimum power output and maximum time to full charge for the on-board charging equipment, as described in the "Final Regulation Order for Section 1962.3 Electric Vehicle Charging Requirements."*[19]

e. The CEC should consider how an EVSE FDAS can interact with building-level load controls.

The CA IOUs also encourage the CEC to consider minimum performance standards for EVSE communication that do not preclude the flexibility to utilize Automated Load Management Software (ALMS) or other building-level controllers, rather than solely regulating each EVSE.

The CA IOUs have supported Title 24 Part 11 (CALGreen) compliance pathways that encourage the use of ALMS to control multiple EVSEs. ALMS provides power management based on a maximum permitted

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14 "Road Vehicles—Vehicle to Grid Communication Interface," iso.org, September 1, 2013, https://www.iso.org/standard/55365.html.

15 Department of Transportation, "Federal Motor Vehicle Safety Standards; FMVSS No. 305a Electric-Powered Vehicles: Electric Powertrain Integrity Global Technical Regulation No. 20 Incorporation by Reference," *Federal Register* 89, no. 245 (November 20, 2024): https://www.govinfo.gov/content/pkg/FR-2024-12-20/pdf/2024-28707.pdf.

16 "ANSI Draft Roadmap of Standards and Codes for Electric Vehicles at Scale Released for Comment," *American National Standards Institute - ANSI*, March 31, 2023, https://www.ansi.org/standards-news/all-news/2023/03/3-31-23-ansi-draft-roadmap-of-standards-and-codes-for-electric-vehicles-at-scale-released.

17 "Electric Vehicles." ANSI Webstore. https://webstore.ansi.org/industry/automotive/electric/electric-vehicles.

18 California Air Resources Board, "Advanced Clean Cars II," ca.gov, n.d., https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii.

19 California Air Resources Board. "Final Regulation Order: Advanced Clean Cars II," January 2023. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/2acciifro1962.3.pdf.

load at the panel, meter, and site levels. The ALMS algorithm allocates available power to the EVSEs based on factors such as driver needs and state of charge. ALMS capacity can be dynamically reduced below the maximum setpoint in response to demand response (DR) events, time-of-use (TOU) rates, and greenhouse gas (GHG) signals. An installed ALMS controller allows for a trade-off by reducing the per-space amperage required by CALGreen[20] *while delivering significant grid value and flexibility by networking several EVSEs. ALMS is widely used in many commercial and multifamily applications, offering demand flexibility to its connected EVSEs.*

2. **What is the current landscape of options for charging schedules that prioritize the driver experience, emissions reductions, financial savings, and/or other factors? Please provide information or data on customer receptiveness to various charging schedules, such as charge immediately, charge by departure, etc. and the entity who possesses such information.**

The CA IOUs recommend that the CEC engage vehicle OEMs and charging service providers for this data.

3. **Please comment on the various EVs or EVSE consumer charging preferences such as charge immediately or "charge by departure", where the EV is charged to a specified percentage with a set time to be ready.**

The CA IOUs recommend that the CEC work with vehicle OEMs and charging service providers to collect consumer data, including consumer charging patterns (e.g., a battery's state of charge before and after charging), charging duration time or charging speed, types of chargers, battery capacity, battery temperature before and after charging, weather conditions, time-of-day preference, and expected changes over time.

4. **When will DC charging equipment be available for residential installation? What are the expected use cases, penetration, price range and power level of DC equipment used in the residential sector? Would certain DC chargers installed at private residences require a Battery Energy Storage System to manage peak load?**

Updated comment from previous letter: The CA IOUs observe that DC EVSE currently comes with a significant up-front cost premium relative to AC EVSE—approximately five times more expensive.[21] *The leading low-power DC charging options available for residential use today are the dcbel Ara ($5,000 cost and 15.2 kW output power)*[22] *and Wallbox Quasar 2(~$5.000, 11.5 kW output power*[23]*). Both provide bi-directional charging capability. Installation can be limited by the building's main panel capacity and/or the owner's ability to get a secondary utility drop (similar challenges as with AC EVSE).*

Some of this cost premium results from the additional functionality present in residential DC chargers, including bidirectional capability and integration with solar PV. These chargers would not require stationary storage to manage peak load but can be used alongside a PV/energy storage system for better efficiency (eliminating AC/DC conversion).

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[20] International Code Council. "Chapter 5: Nonresidential Mandatory Measures." 2022 California Green Building Standards Code (CAGBC), https://codes.iccsafe.org/content/CAGBC2022P3/chapter-5-nonresidential-mandatory-measures#CAGBC2022P3_Ch05_SubCh5.1.

[21] Svarc, Jason. "Bidirectional EV Chargers Review — Clean Energy Reviews." Clean Energy Reviews, October 28, 2024, https://www.cleanenergyreviews.info/blog/bidirectional-ev-chargers-review.

[22] "How Much Does the Home Energy Station Cost?" dcbel.energy, January 13, 2022. https://www.dcbel.energy/support/.

[23] Wallbox. "Quasar 2 Product Overview," Quasar 2 - Product Overview - Wallbox Help Center.

- *dcbel has an option for battery/solar installation in their inquiry form.*
- *Wallbox does not include a battery/solar option but includes language about dynamic load management.*
- *In their RFI response, SWTCH agreed that a Battery Energy Storage System (BESS) was not required.*

As a result of the high incremental cost, DC charging is likely to remain a low-volume premium product for residential users, appealing to customers seeking bi-directional (including vehicle to grid) capability before bidirectional/V2G capability with AC charging is available.

5. **What software and hardware capabilities could enable public EVSEs to relieve/eliminate grid congestion at the Distribution (referring to Transmission and Distribution, T&D, for the grid) level? What control strategies are available to the grid operator and/or load aggregator to shift and/or curtail demand from EVSEs at the Distribution level to maintain grid reliability?**

Updated comment from previous letter: The CA IOUs observe that public and private chargers may use similar strategies, hardware, and software to implement flexible demand. Thus, significant overlap exists between Question 5 and Question 6. However, public charging users may have less flexibility to shift or curtail charging sessions due to their shorter dwell time and public customer expectations for a time-efficient charge compared to private overnight residential charging sessions.

In responding to this question, the CA IOUs use the following working definition of a "public EVSE":

A public EVSE is an EVSE (typically Level 2 or DC fast charger) that is available at a public location, such as public lots and road stops, where drivers can charge their EVs without having to cross a barrier or enter a gated space. EVSE at workplaces or in multifamily units would be considered "shared-private."

Several key sources detail the dwell times for public chargers. While the focus of the Smart Electric Power Alliance's (SEPA) 2023 report "State of Bidirectional Charging" is bi-directional charging, the report includes important insights related to public charging dwell times. The authors explain that "public charging is often short and unpredictable[24]" but also that ". . . utility SMEs stated that long-term public parking, such as that for airports, sports stadiums, and park-and-rides, has sufficient dwelling time to allow for discharging and may provide an avenue for public bidirectional charging applications."[25]

A U.S. Department of Energy Office of Energy Efficiency and Renewables (EERE) report supports this with data on actual charging times at public chargers. Their study of 2.3M DC fast-charging sessions between 2020-2023 yielded an average charge time of 54 minutes at public chargers (and just 42 minutes when sessions required payment).[26] Even in use cases with longer dwell times, customers aim to maximize the range attained from a public charging session, with 60% of customers expecting to charge for 30 minutes

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[24] Smart Electric Power Alliance, "The State of Bidirectional Charging in 2023," September 2023. https://s3.us-east-1.amazonaws.com/fonteva-customer-media/00Do0000000Yi66EAC/ruHbLFZi_SEPA_State_of_Bidirectional_Charging_Report_pdf.

[25] Ibid.

[26] Energy.gov. "FOTW #1319, December 4, 2023: EV Charging at Paid DC Fast Charging Stations Average 42 Minutes per Session," n.d. https://www.energy.gov/eere/vehicles/articles/fotw-1319-december-4-2023-ev-charging-paid-dc-fast-charging-stations-average.

or less.[27] Customers are often unwilling to defer or delay a charge at public EV chargers, prioritizing minimized dwell time to increase convenience and reduce cost.

A more recent 2023 JD Power study supports this point: "EV owners are increasingly dissatisfied with the amount of time it takes to charge their vehicles. The attribute for speed of charging has the most significant negative effect on overall [public] Level 2 satisfaction, decreasing 36 points year over year."[28]

Based on this customer expectations data, the CA IOUs expect that public charging will offer fewer opportunities for flexible demand than residential charging.

6. **Similarly, what software and hardware capabilities are best suited to enable residential EVSEs to relieve grid congestion at the Distribution Level? What control strategies can be deployed by the grid operator and/or load aggregator to shift and/or curtail demand from residential EVSEs at the Distribution level to support grid reliability?**

Multiple pathways exist to enable residential EVSEs to relieve grid congestion at the distribution level.

a) Networked EVSEs and automatic load management systems (ALMS) can connect to cloud-based services for grid-level and distribution-level events. To manage distribution-level congestion, the aggregator needs granular location data from the grid operator's cloud service to target specific EVSEs for demand curtailment. The cloud-based aggregator would use signals from the grid operator to determine when the local distribution network requires an EVSE to shift or curtail demand. The aggregator could then report on each EVSE's participation or opt-out behavior.
   - Standards are available for this connectivity, including OCPP, OpenADR, and IEEE 2030.5. We would like to note that the California Public Utilities Commission already ordered the CA IOUs to implement distributed energy resources management systems (DERMS) based on IEEE 2030.5[29,30]
   - A working example is MCE Sync,[31] an EV smart charging app that allows users to set charging needs (via a "ready-by" time) and allows MCE to schedule charging during off-peak times.

b) In the future, with the advanced metering infrastructure (AMI) 2.0 network, the grid operator could send address-level signals to EVSEs, either directly via specially AMI-communication capable EVSE[32] (AMI to EVSE) or using grid-edge applications[33] within the Smart Meter (AMI to Smart Meter to connected EVSE) to access the networked EVSE.

c) The message to shift or curtail can also come from aggregators. Aggregators could receive distribution-level grid signals from the operator and could then communicate to the vehicle OEM

[27] Lauritz Fischer et al., "Exploring Consumer Sentiment on Electric-vehicle Charging," McKinsey & Company, January 9, 2024, https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/exploring-consumer-sentiment-on-electric-vehicle-charging#/.

[28] J.D. Power, "Public Charging Issues May Short-Circuit EV Growth, J.D. Power Finds," jdpower.com, August 16, 2023. https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-experience-evx-public-charging-study.

[29] California Public Utilities Commission. 2021. "Resolution E -5038." Accessed Dec 19, 2024. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M401/K369/401369674.PDF

[30] Quality Logic. 2019. "IEEE 2030.5 Takes Off: The Latest News on the IEEE 2030.5 Standard." Accessed Dec 19, 2024. https://www.qualitylogic.com/knowledge-center/ieee-2030-5-takes-off/

[31] MCE, "MCE Sync: EV Smart Charging App," MCE – Community Choice Energy, November 19, 2024 https://mcecleanenergy.org/mce-sync/

[32] Aclara. "Aclara EV2c: Utility Controlled EV Charging." Website, 2024, https://www.hubbell.com/aclara/en/products/ev2c-level-2-evse/p/15655864.

[33] Itron, Inc. "Itron and PG&E Collaborate to Enable Real-Time Control of Electric Vehicle Charging With Grid Edge Intelligence," Iron.com, n.d.,https://na.itron.com/w/itron-and-pge-collaborate-to-enable-control-of-ev-charging.

cloud. The OEM would use EV telematics and GPS information to confirm the location of a charging vehicle and send shift or curtail commands via the same interface. This would eliminate the need for a connected EVSE. Examples of this approach include:

- PG&E's EPIC 4.04 pilot is described in a 2024 R&D Strategy report[34] as follows: "Working with WeaveGrid, PG&E launched a program that utilizes software to manage residential customers' EV charging. This program optimizes charging schedules based on grid conditions. The program, funded by EPIC 4.04, will evaluate if managing EV load can alleviate distribution grid constraints and extend the life of distribution assets while providing financial benefits to the customer."
- BMW's ChargeForward program uses a similar approach.
- ChargeScape[35] builds upon the earlier Open Vehicle-Grid Integration Platform (OVGIP) collaborative effort led by the Electric Power Research Institute (EPRI) to create a software application that can connect various nodes and enable utilities to manage charging activity for a variety of grid needs.

d) Several "autonomous" functions could deliver load shifting without new hardware, software, or communication added to the EVSE or the vehicle. Many EVs and EVSEs offer scheduled charging features that are not connected to time-of-use (TOU) utility rates or real-time demand response signals. Instead, they can schedule charges to minimize consumption during known peak times (e.g., 4 pm to 9 pm daily). On-board EV or EVSE controls that manage charging by the "complete by departure time" settings are especially important to avoid so-called "snapback" effects, where new local peaks are created by timer-based charger control coming on at the same time, for example directly at the 9 p.m. rate change. Many OEMs offer this control, and it can autonomously manage charging to incorporate the added diversity inherent in driver and EV conditions and operations. This method can effectively reduce grid impact and ensure EVs are charged as desired without the cost of network control systems.

Generally, addressing grid congestion at the distribution level will require more geographically granular signaling of EVSEs than when addressing opportunities to reduce GHG emissions or relieve transmission and distribution congestion by managing EVSE operation. Furthermore, some distribution circuits' peak hours may not coincide with California Independent System Operator (CAISO) peak hours. Responding only to price signals or greenhouse gas signals from the Market Informed Demand Automation Server (MIDAS), without having distribution circuit-specific capacity considerations, may inadvertently challenge the distribution circuit's reliability.

Updated comment from previous letter: Finally, one EV manufacturer, Tesla, currently offers EVs that, in theory, can already interface with its bespoke EVSE network to provide geographically granular load shifting. About half of all registered EVs in California are Teslas[36] representing a significant existing demand response potential.

[34] Pacific Gas & Electric, Inc. "*R&D Strategy Report*," 2024, https://www.pge.com/assets/pge/docs/about/pge-systems/pge-rd-strategy-report-2024.pdf.

[35] ChargeScape, LLC., "A Global Vehicle-grid Integration Platform," chargescape.com, 2024, https://chargescape.com/.

[36] California Energy Commission, "Light-Duty Vehicle Population in California," n.d., https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/light.

7. **What hardware and software are needed on the EV's Onboard Charging System to enable load shifting? What percentage of EVs currently receive grid signals (e.g., electricity prices, GHG emissions and California Independent System Operator Flex Alerts) to schedule load shifting, demand response, and/or bi-directional charging? What percentage of EVs require the EVSE to receive grid signals to schedule load shifting, demand response, and/or bi-directional charging? What are the most common methods for communicating signals to EVSEs and EVs (e.g. Ethernet, Wi-Fi, Cellular, AM/FM broadcast)?**

Multiple hardware and software combinations would yield the desired demand flexibility in EVSEs. In many cases, no specialized hardware is needed on the vehicle side to enable load shifting. The EVSE can orchestrate the load shifting on its own. The simplest way to do this may be to place an on/off relay into the AC supply side of the EVSE circuit that accepts the load shifting signals (e.g., via OpenADR, or IEEE 2030.5).

Load shifting can also occur without grid communication (via fixed scheduling). This method could achieve some of the benefits of grid-connected devices via TOU rates.

The latest EV models from most vehicle OEMs can receive and act upon grid signals via telematics (cellular connection). However, vehicles' telematics systems do not engage directly with utility programs at this moment. Instead, cloud service providers "connect" the vehicle back-office with the utility back-office to pass the information along. Likewise, EVSEs may connect to these cloud service providers via wireless/wired Ethernet or cellular connections.

Finally, almost all newer model EVs use 4G or 5G modems and have telematics capability, but no currently available models directly receive grid signals. Customers must opt-in to utility programs that offer incentives for load shifting. Program participants may need to pay monthly for telematics coverage through their vehicle manufacturer. There may also need to be a cloud service (e.g., WeaveGrid, ev.energy) configured to transfer vehicle information between the utility and vehicle manufacturers' cloud. One key challenge in shifting or curtailing EVSE charging is receiving urgent customer priorities including departure time and required energy level (which would potentially override grid signals) to ensure customer satisfaction. Some EVSEs, including those with grid connection, may lack a data connection to the vehicle to confirm that charging can be delayed without adverse customer impacts (based on the current vehicle state of charge and future range needs). However, standards exist to support this communication. ISO 15118 is composed of a set of standards for communication between the EV and EVSE, utilizing power line communications (PLC) for Level 2 AC charging and DC Fast charging.

8. **(Focused on EV manufacturers) Is the EV telematics system used to receive grid signals (e.g., electricity prices, GHG emissions, and California Independent System Operator Flex Alerts) and schedule charging in response to those grid signals? If so, what is the monthly cost charged to the customer for these capabilities?**

The CA IOUs recommend that the CEC engage EV manufacturers and other stakeholders for this information.

9. **How can medium-duty and heavy-duty (MDHD) EVs and their EVSE fit into the CEC's goal of load shifting to avoid GHG emissions?**

While EVSE for MDHD EVs may present an attractive application in the future, the CA IOUs recommend that they not be included in the first iteration of CEC's EVSE FDAS. Many MDHD EVs will belong to fleets of vehicles with centralized, managed charging that requires a different approach than private, Level 2 EVSE.

Some MDHD fleets may take advantage of different electric rate schedules or price signals to maximize cost savings. These rates, whether available now or in the future, could signal the vehicles to charge when the grid's GHG emissions are low or to delay or curtail charging when the grid is constrained. However, other fleets, especially those with high volume or continuous operations, have a limited opportunity to delay charging.

A table from NYSERDA's *Managed Charging for Electric Vehicles White Paper*,[37] assumes a relatively slow uptake of TOU rates for many MDHD vehicle types. School buses, refuse trucks, and transit buses are assumed to enroll in TOU rates more quickly than other MDHDs because they are better suited for load shifting due to their predictable schedules and long dwell times. Although California non-residential customers have already moved to TOU rates, this example illustrates how the willingness of different MDHDs to enroll in future dynamic rates or to opt-in to load flexibility signals might vary based on vehicle type.

Figure 2. New York's MHDV Managed Charging Modeling Assumptions: Take-Up Rates

Table 11. MHDV Managed Charging Modeling Assumptions: Take-Up Rates

Vehicle Category	TOU Take-Up Rate 2020	TOU Take-Up Rate 2030	TOU Take-Up Rate 2040	TOU Take-Up Rate 2050
Light Commercial Trucks	20%	40%	60%	60%
Transit Buses	50%	80%	95%	95%
School Buses	50%	80%	95%	95%
Refuse Trucks	50%	80%	95%	95%
Single Unit Short Haul Truck	N/A	20%	40%	60%
Combination Unit Short Haul truck	N/A	20%	40%	60%
Single Unit Long Haul Truck	N/A	20%	40%	60%
Combination Unit Long Haul truck	N/A	20%	40%	60%

[37] Adam Ruder et al., "Managed Charging for Electric Vehicles," *NYSERDA's Promise to New Yorkers* (New York State Energy Research and Development Authority, April 2022), https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Transportation/22-09-Electric-Vehicle-Managed-Charging-White-Paper.pdf.

MDHD applications with the greatest potential demand response impact have a typical dwell/connected time that is significantly longer than their charge time, allowing a shift inside the dwell window without impacting asset utilization. One area to evaluate is the number of chargers per MDHD EV. When vehicles are rotated for charging, the EVSE is always necessary, making it unsuitable for a load shift program.

While not a focus of this RFI, there are many electric powered vehicle accessories using shore power that could participate in flexible demand. As an example, hybrid-electric transportation refrigeration units (eTRUs) are increasingly used by internal combustion engine trucks and electrified trucks and trailers, replacing diesel cooling in some cases. An eTRU with battery backup or one that can precool the trailer and an incorporated thermal storage system using electric power could participate in short-term Flex Alerts. Each eTRU could reduce power consumption by 6 to 20 kW. However, one risk associated with load-shifting with eTRUs is the potential operation of the diesel engine and related emissions, so safeguards must be put in place to prevent this type of use.

Some overlap exists in light and MDHD charging equipment, with DC fast chargers used in both sectors. Thus, regulating DC fast chargers for one market segment may cause unintended consequences for another.

10. **Should the scope of this regulation include load shifting criteria for EVs such as forklifts, boats, and other off-road vehicles? Do off-road vehicles typically have a defined use-cycle that fits the need for load shifting? If so, which types of off-road vehicles? Please provide off-road EV counts, types of EVSE for off-road EVs, and charging strategies for off-road EVs.**

Updated comment from previous letter: The CA IOUs recommend that the CEC exclude applications, such as forklifts, boats, and other off-road vehicles, from the scope of the EVSE FDAS's first iteration due to their small segment size compared to private L2 EVSE and the business constraints presented by their operations. The largest of these segments, forklifts, is already well developed, and electric forklift charging technology has diverged from EVSE for light-duty vehicles. SAE EVSE specifications do not cover forklift chargers, which use different connectors from those of EVs.

Since the FDAS are appliance standards, they apply to any covered appliance, regardless of the use case. For example, if the FDAS applied to L2 EVSE, and one of the above off-road vehicles used an L2 charger, the grid could receive demand flexibility benefits from that device, regardless of its connection.

However, we expect many of the above-referenced off-road vehicles to use specialty charging equipment, have low volume, or possess inflexible duty cycles, making them less conducive to load flexibility. The following studies and data affirm this expectation:

- *In the January 2023 "Zero-Emission Forklift Rulemaking Workshop," CARB staff estimated a total of 79,000 Class I and Class II electric forklifts in operation in California.*[38]
- *CARB's 2022 "Large Entity Fleet Reporting" counts 3,899 off-road electric yard tractors in California.*[39]

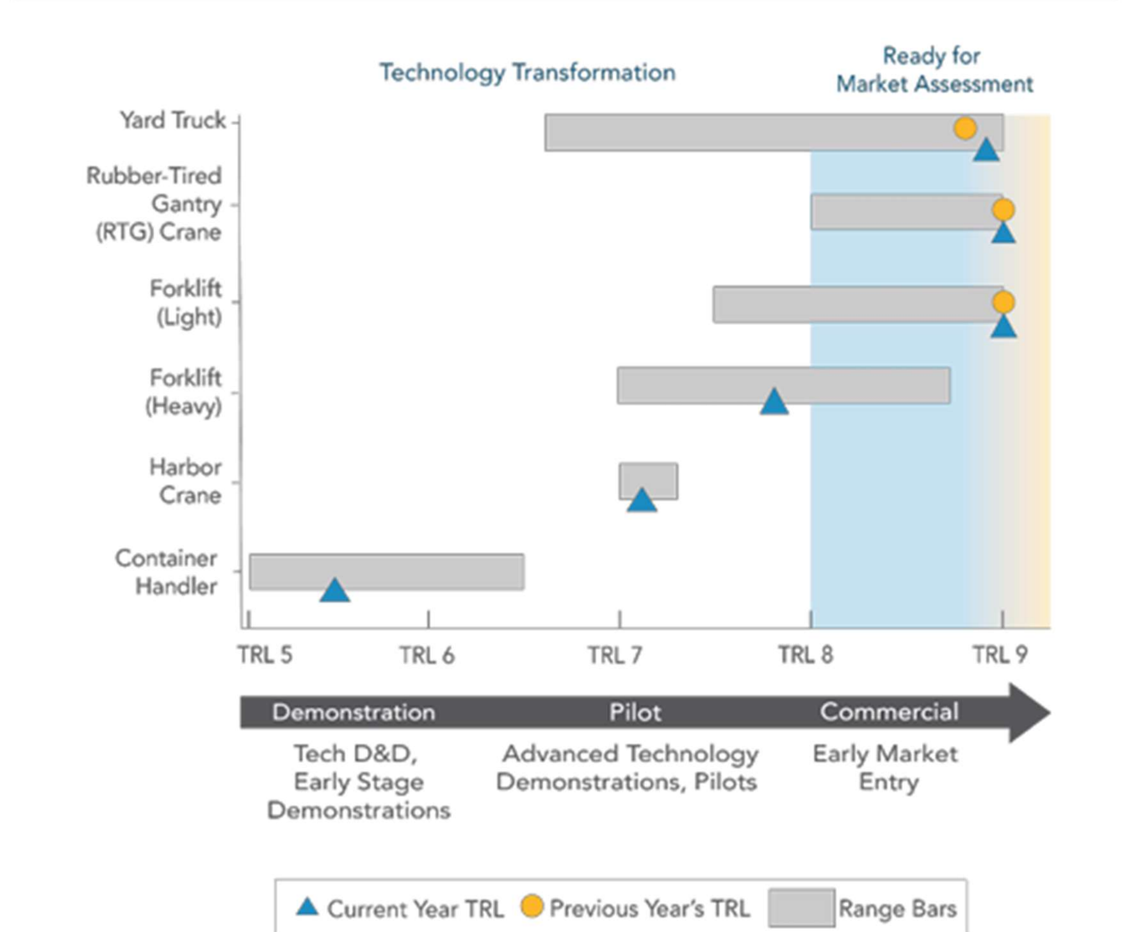
[38] California Air Resources Board, "Zero-Emission Forklift Rulemaking Workshop," January 24, 2023, https://ww2.arb.ca.gov/sites/default/files/2023-01/ZEF%20January%202023%20Workshop%20Presentation_1.pdf.
[39] "Large Entity Fleet Reporting," California Air Resources Board, n.d., https://ww2.arb.ca.gov/sites/default/files/2022-02/Large_Entity_Reporting_Aggregated_Data_ADA.pdf.

- *CALSTART provides data demonstrating that yard tractors and others with low range requirements dominate sales in the medium-heavy duty (MHD) zero-emission truck (ZET) segment, with yard tractors leading the U.S. ZET market share (by registration) at 41%.*[40]
- *These off-road segments are dwarfed by the total number of light-duty electric vehicles, with 1.26M registered EVs in California, as of September 2024.*[41]

However, as EV penetration in these segments increases to substantial levels, future revisions of the FDAS could accommodate these applications and their associated charging equipment. Future expansion could prioritize applications based on technology transformation data, such as in the figure below, presented in CALSTARTS's "Methods for Assessing Technology and Market Readiness for Clean Commercial Transportation."[42]

Figure 3. CARB Technology Status Snapshot Example.

Figure 2. Technology Status Snapshot Example: Off-Road Battery-Electric: Cargo Handling Equipment (CARB, 2022)



[40] CALSTART. "Zeroing in on Zero-Emission Trucks." *Market Update,* June 2022, https://calstart.org/wp-content/uploads/2022/07/ZIO-ZETs-June-2022-Market-Update.pdf.

[41] U.S. Department of Energy Efficiency & Renewable Energy, "Electric Vehicle Registrations by State: Alternative Fuels Data Center: Maps and Data," September 2024, https://afdc.energy.gov/data/10962.

[42] CALSTART and California Air Resources Board, "Methods for Assessing Technology and Market Readiness for Clean Commercial Transportation," *Calstart.Org*, October 2022, https://calstart.org/wp-content/uploads/2022/10/assessing_technology_and_market_readiness_october_2022.pdf.

11. **There are currently some buses that use wireless charging to top off batteries at bus stops. What are other applicable uses for wireless charging, and is wireless charging planned in your product roadmap? If so, when is wireless charging expected to be more widely available?**

Updated comment from previous letter: Wireless charging is available, has been demonstrated in the field, and is in commercial use in some areas, such as transit buses.

Current standards include:

- *L2 wireless inductive charging (SAE J2954)*[43]
- *Higher-power standards are expected from SAE within one to two years (SAE J2954/2, in development)*

Other potential use cases for wireless charging, with limited demonstrations,[44] *include autonomous vehicles and taxi and rideshare lines at airports, hotels, and other high-density areas.*[45] *These will initially be the focus for wireless charger OEMs, although short dwell times limit their value as flexible demand resources.*

Demonstrations of wireless EVSE technology are limited to date.[46] *However, we anticipate that wireless charging for autonomous vehicles will grow significantly, particularly among users of taxi and rideshare lines at airports, hotels, and other high-density areas.*

If wireless chargers reach cost parity with galvanic EVSE, and if automotive OEMs include the hardware required for wireless charging in light-duty EVs, they could provide load flexibility value through longer connected times with increased potential for load shifting compared to traditional galvanic EVSE.

In addition, if a high percentage of EV parking spots use wireless charging pads, it eliminates the need for customer action for the EV battery to be accessible as a grid asset. This elimination should theoretically increase flexibility by ensuring more vehicles are grid-connected for more of their hours parked.[47]

12. **What are the charging practices for commercial fleets? Bus fleets? Overnight depot level charging? What power levels? How is the charging of the fleet managed? Manually rotated? Management software?**

The CA IOUs recommend that the CEC engage with fleet owners to obtain this data.

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[43] "SAE International Finalizes Light Duty Wireless Charging 'Gamechanger' Standard to Enable Mass Commercialization," August 20, 2024, https://www.sae.org/news/press-room/2024/08/sae-j2954.
[44] Florian Nägele and Shivika Sahdev, "Perspectives on Wireless and Automated Charging for Electric Vehicles," McKinsey & Company, April 3, 2023, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/perspectives-on-wireless-and-automated-charging-for-electric-vehicles.
[45] "Wireless Cities: The Future of Urban Living," n.d., https://witricity.com/wireless-charging-solutions/smart-cities.
[46] Nägele and Sahdev, "Perspectives on Wireless and Automated Charging for Electric Vehicles," April 3, 2023. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/perspectives-on-wireless-and-automated-charging-for-electric-vehicles.
[47] Eric Cohen, "V2G: Delivering Limitless Energy to Feed the Grid," *WiTricity*, October 1, 2024, https://witricity.com/media/blog/v2g-delivering-limitless-energy-to-feed-the-grid.

13. **Which communication protocols or components of existing communication protocols are used to enable load shifting capabilities for EVs and EVSE? What is the implementation status of these communication protocols? Are industry-wide standard communications and control protocols currently in use or planned? Are there remaining gaps to enabling load shifting capabilities?**

Updated comment from previous letter: In 2017, the Vehicle-Grid Integration Communication Protocol Working Group[48] *was formed to assess the need for a standardized communication protocols to enable EVs as VGI resources. This group, which consisted of staff from the CPUC's Energy Division, CEC, CARB, CAISO, and Governor's Office of Business and Economic Development (GO-Biz), conducted an extensive evaluation of communication protocols for VGI. In its October 2018 final report, the group determined that "it is not advisable to require the investor-owned utilities to only use a single protocol, or specific combination of protocols, for their infrastructure investments at this time. However, Energy Division does provide certain hardware performance recommendations intended to enable the market to trial and potentially converge on a protocol in the future.*[49][50]

In 2018, Rulemaking 18-12-006 ordered the development of a VGI Working Group to address the items not answered in the VGI Communication Protocols Working Group, with a Scoping Memo and Ruling[51] *and final documents completed in June 2020.*[52] *The CA IOUs participated in the VGI Working Group. While much of this group's analysis and conclusions remain valid, they could be updated with additional details and enhanced to include new pathways, such as in premise-based energy management systems and grid-edge AMI.*

Key requirements for VGI communications were detailed in CPUC's D.22-08-024,[53] *which set minimum requirements for all EVSE installed via ratepayer funding or through a CA IOU-administered program. OCA OCPP 1.6 or later is required for communications and controls between the EVSE and a network service provider. The EVSE must also be ISO 15118 ready and equipped with hardware that enables high-level communication via ISO 15118.*

Finally, in November 2022, D.22-11-040 directed the CA IOUs to host an annual VGI Forum in collaboration with the CPUC, with the first annual event in March 2024.[54]

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[48] California Public Utilities Commission, "Vehicle Grid Integration Communications Protocol Working Group," cpuc.ca.gov, 2017, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/vehicle-grid-integration-activities/vehicle-grid-integration-communications-protocol-working-group.

[50] VGI Communication Protocol Working Group, Energy Division Staff, and California Public Utilities Commission, "VGI Communication Protocol Working Group Energy Division Staff Report," October 2018, https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/v/6442460144-vgi-communication-protocol-final-staff-report-w-appendices-dec-11-2018.pdf.

[51] California Public Utilities Commission, "Proposed Decision on Application of Pacific Gas and Electric Company," December 13, 2018, http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M285/K712/285712622.PDF.

[52] California Public Utilities Commission et al., "Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group," June 30, 2020, https://gridworks.org/wp-content/uploads/2020/07/VGI-Working-Group-Final-Report-6.30.20.pdf.

[53] California Public Utilities Commission, "Decision Adopting Plug-In Electric Vehicle Submetering Protocol and Electric Vehicle Supply Equipment Communication Protocols," August 4, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M496/K419/496419890.PDF.

[54] California Public Utilities Commission, "VGI Policy, Pilots, and Technology Enablement," cpuc.ca.gov, 2024, https://www.cpuc.ca.gov/vgi/.

This discussion remains an active topic. The CA IOUs believe that FDAS for EVSE should avoid further tightly controlling potential communication standards. This viewpoint is supported by submitted comments and feedback from our outreach. The industry consensus is that FDAS should not be overly prescriptive regarding communication standard requirements.

Technology is developing quickly, and manufacturers should not be constrained to specific versions of communication standards that could soon become obsolete. We recognize the challenge for a regulatory program to refer to future, unknown version of standards for mandatory application. Instead, we recommend the CEC develop regulations that allow for technology to evolve while meeting minimum verifiable criteria.

The CA IOUs observe only a few remaining technical gaps in communication standards. However, in some cases, the standards continue to evolve rapidly, and in all cases, gaps remain in practical, widespread adoption. Dominant standards include:

- *OpenADR, which is used for most demand response signaling from the utility cloud.*
- *Open Charge Point Protocol (OCPP) (as referenced in Q1 above and in D.22-08-024), which is used to control individual connected EVSEs, either from dedicated hardware or cloud service.*
- *ISO 15118 (also referenced in Q1 above and in D.22-08-024), which is used for communication between the EV and EVSE during charging.*

Any FDAS requirements for communication standards should be future-proofed to allow for updates. They should also provide sufficient time for EVSE and vehicle OEMs to implement the necessary changes, given lengthy product development cycles for EVs and constantly evolving standards. According to the Center for Automotive Research, between 2010 and 2019, the average lifecycle (between updated models) for light-duty cars and trucks was 6.7 years.[55] *Even after standards are finalized, vehicles on the market may still take significant time to become compatible.*

Lawrence Berkeley National Laboratory's (LBNL) Survey and Gap Prioritization of U.S. Electric Vehicle Charge Management Deployments[56] *includes this valuable graphic detailing the communication protocols at each stage and between each node, consistent with CA VGI Working Group #1 reports.*

[55] Center for Automotive Research, "Automotive Product Development Cycles and the Need for Balance with the Regulatory Environment," September 20, 2017, https://www.cargroup.org/automotive-product-development-cycles-and-the-need-for-balance-with-the-regulatory-environment/.

[56] Douglas R. Black et al., "Survey and Gap Prioritization of U.S. Electric Vehicle Charge Management Deployments | LBL ETA Publications," *Eta-Publications.Lbl.Gov*, 2024, https://eta-publications.lbl.gov/publications/survey-and-gap-prioritization-us

Figure 4. LBNL Assessment of Communication Protocols for EVs.

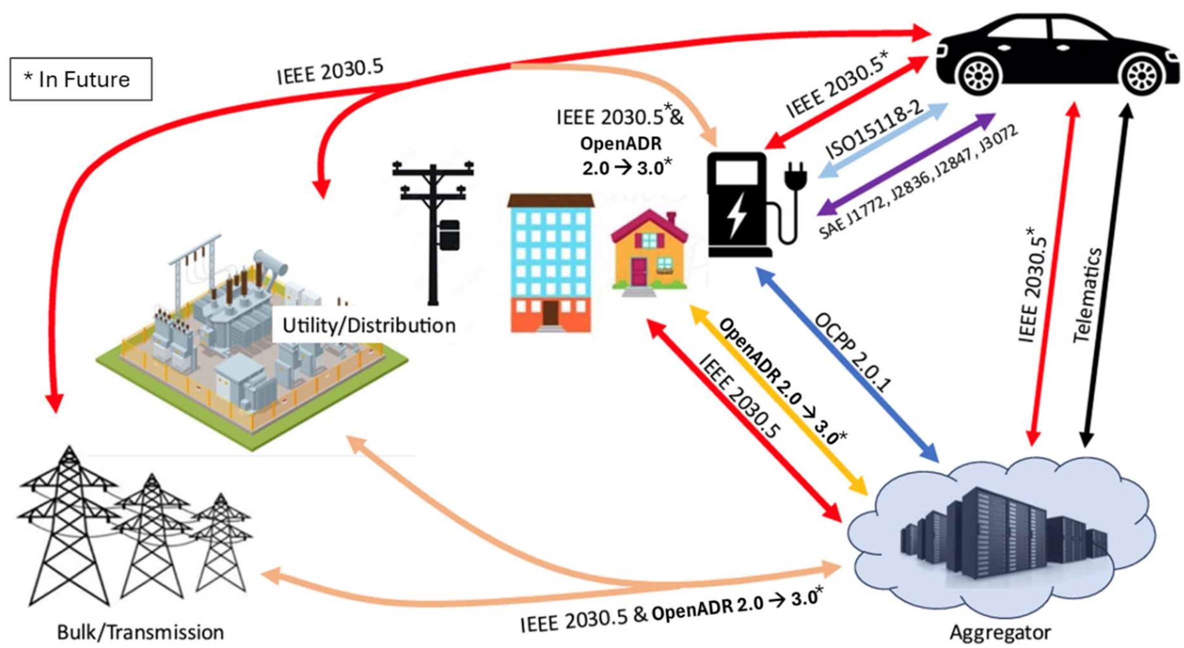

Figure 8. Multiple communication pathways and protocols between EVs, EVSEs, aggregators, buildings, distribution systems, and bulk power transmission systems. This figure is not exhaustive, with several other possible pathways and configurations.

14. **Does data exist on the effect of bidirectional charging on EV battery life? How is battery capacity affected by the frequency and level of bidirectional charging (for example, power level, total energy discharge, and so on)? Does this affect the warranties or insurance of the EV owner? If so, can the loss in value, if any, be quantified over the life of the battery?**

The CA IOUs recommend that the CEC engage with vehicle OEMs and battery manufacturers for this data.

15. Can a load shift program work with EVSEs/EVs responding to generic signals, or must signals be tailored for each EVSE/EV?

Updated comment from previous letter: For utility load-shifting programs, signals for EVSEs or EVs can be generic, although signaling tailored to specific EVSEs and EVs could offer additional benefits in some scenarios. Demand flexibility programs use a variety of signals to engage EVSEs or EVs, transmitting both prices and demand response event information. Utility-provided price signals can be generic and non-specific to individual EVSE and EV products or end users. These signals can be transmitted through asynchronous communication, such as email. In the future, this information could be transmitted using AMI.

California has historically used TOU electricity rates to signal customers to shift EV charging off-peak hours. These rates are not specific to the characteristics of an end user's EVSE or EV, and the price differential between peak and off-peak rates motivates users to shift load without necessitating EVSE and EV-specific communication or automation.

To better account for end-user characteristics and grid needs, such as distribution circuit constraints that may not align with CAISO system peaks, utilities now plan to evaluate more granular, dynamic price signals for EVSE/EV users. These signals could account for location-specific capacity needs and might be tailored to optimize user preferences, including charging capacity, charge speed, and departure time. For example, in SCE's Dynamic Rate Pilot, which includes EVSEs, customers are provided with a tailored subscription for their monthly electricity use based on their historical usage. They receive dynamic energy rates that reflect grid conditions via Automation Service Providers (ASPs).[57]

Ongoing work similar to this pilot will help quantify the benefit of tailored price signals and the process by which they can be used from both the customer and utility perspectives, including signal targeting, information transmission, product response, and data evaluation. We note that in some California regions, customers do not have access to local TOU rates. In these scenarios, these customers have no potential to monetarily benefit from EVSE/EV load shifting until time-varying rates are available, and then, these customers would only benefit if rates were compatible with the customers' electricity consumption patterns and flexibility.

In addition to price signals, event-based demand response (DR) signals can be transmitted to EVSEs and EVs to provide additional customer and grid benefits. Standardized protocols, such as OpenADR 2.0 and 3.0 transmit DR event information to DR providers/aggregators and end-use customer devices. This signaling pathway has been evaluated in past and ongoing pilots or programs, including in the Emergency Load Reduction Program (ELRP) Group A.5, PG&E's Vehicle-to-Everything (V2X) pilot, and SCE's Charge Ready program.

In addition to signal type, different signaling pathways exist, including communication to aggregators by the utility or direct communication with end-use customers and devices. In demand flexibility programs targeting EVSEs or EVs, the CA IOUs have typically worked with aggregators or service providers that manage customer participation, including the signaling of individual devices. For some programs, simple email notifications can communicate with aggregators.

[57] California Public Utility Commission, "DR21.03 Dynamic Rate Pilot," *California Public Utility Commission*, 2021, https://www.dret-ca.com/wp-content/uploads/2023/12/DR21.03-SCE-Dynamic-Rate-Pilot.pdf.

Where communication is automated, standardized communication protocols transmit information to aggregators or distributed energy resource management systems. These protocols include OpenADR 2.0 and IEEE 2030.5. The protocol depends on the program's goal and architecture; for example, managed charging versus demand response versus bidirectional vehicle-to-grid integration.

Programs do not necessarily specify how aggregators or service providers signal end-use EVSE or EV customers. Customers may receive email communication, which allows them to respond manually or via scheduling within their systems. Communication with devices may occur via standardized means like OpenADR or OCPP, which leverage customer Wi-Fi. Alternatively, providers may use manufacturer-proprietary API integrations and platforms to signal products.

Overall, the CA IOUs support standardization and open and secure protocols to signal EVSE and EV customers, aggregators, and automation service providers for demand flexibility programs. Further technological development is needed to fully automate EVSE and EV responses to demand flexibility signals, as this response has not been automated in programs to date. Additionally, automakers may support specific open or proprietary protocols or standards for their products and specific signaling pathways.

Ultimately, the decision to respond should lie with the customer. The CA IOUs support seamless, interoperable communication between the utility, aggregator, or service provider and the end-use customer or device. Although this vision is not yet a reality, current pilots and programs will provide data to determine the best path forward.

As an additional resource, the following table includes information on selected CA IOU EVSE/EV flexible demand programs to facilitate further review by the CEC.

Table 3. Selected CA IOU EVSE/EV Flexible Demand Programs

Utility	***Initiative***	***Timeframe***	***Relevant Information***
PG&E	*Emergency Load Reduction Program (ELRP) Group A.5*[58]	*2021-present*	*Any communicating vehicle/charger combination is eligible to participate if they enroll with an ELRP aggregator. Participating vehicles and devices include BYD battery electric buses paired with Tellus bidirectional EVSEs and Ford F-150 Lightning trucks with the Ford/Sunrun Home Integration System and Pro charge station. Signaling methods include email, proprietary API communication, or OpenADR 2.0. Aggregators are responsible for communication with end-use customer EVSEs/EVs.*
PG&E	*V2X Pilots*[59]	*2021-present*	*Participating EVSEs/EVs include those described for ELRP A.5 above. New qualifying devices will be accepted once hardware is UL approved and data-sharing agreements with OEMs are in place. These are anticipated to include the Kia EV9 and Wallbox Quasar 2 bidirectional EVSE.*

[58] Pacific Gas and Electric Corporation and Olivine Climate Response, "Emergency Load Reduction Program," March 26, 2024, https://elrp.olivineinc.com/.
[59] "Vehicle to Everything (V2X) Pilot Programs," n.d., https://www.pge.com/en/clean-energy/electric-vehicles/getting-started-with-electric-vehicles/vehicle-to-everything-v2x-pilot-programs.html.

PG&E	*EV Charge Manager*[60]	*2024-present*	*This program partners with WeaveGrid to schedule electric vehicle charging according to electricity prices. Tesla vehicles, or EVs that use Level 2 Wallbox, ChargePoint or Emporia chargers are eligible. Signaling occurs via proprietary API communication.*
SCE	*Plug-In Electric Vehicle (PEV) Workplace Charging Pilot*[61]	*2013-2016*	*This pioneering study deployed EV charging stations at SCE facilities and tested customer response to TOU rates and DR events. The study evaluated DR potential from EV charging, assessed consumer response to premium pricing during DR events, and informed a methodology for accurately measuring EV charging load curtailment.*
SCE	*Charge Ready Pilots*[62]	*2021-present*	*This pilot used OpenADR for DR events and demonstrated load management with TOU rate implementation. The utility sent control signals to the EV service provider, who could then communicate with the EVSEs to stop, throttle, or start charging. Controls reduced charging capacity by 50% during the utility peak window.*
SCE	*DER Partnership Pilot*[63]	*2021-2024*	*The pilot proposed a new framework for procuring behind-the-meter distributed energy resources to avoid or defer utility distribution investments, including considering circuit-level aggregations and leveraging a DERMS and IEEE 2030.5 communication. The pilot design may be useful for future efforts.*
SDG&E	*Residential Load Management Smart Home Study*[64]	*2018-2020*	*This study used the Itron IntelliSOURCE Residential DERMS API to communicate with and control devices, including Level 2 EVSE. It evaluated both TOU and dynamic rate signals.*
SDG&E	*Cajon Valley School District V2G Pilot*[65]	*2018-present*	*This study prioritizes researching technology integration with battery-electric school buses and bidirectional capable chargers, the utility interconnection process, customer education, and other objectives. It includes some testing of communication signaling capabilities for energy export under ELRP.*
SDG&E	*SDG&E Campus V2X Pilot*[66]	*2024-present*	*This pilot includes the Toyota bZ4X EV and the Fermata Energy bidirectional charger. The study prioritizes researching technology integration, the interconnection process, customer education, testing multiple customer use cases (V2B, etc.), and*

[60] "EV Charge Manager Program," n.d., https://www.pge.com/en/clean-energy/electric-vehicles/ev-charge-manager-program.html.
[61] California Public Utilities Commission, "Energy Division Central Files Document Coversheet," July 22, 2016, https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/w/6442453598-workplace-charging.pdf.

[62] Southern California Edison Corp., "Vehicle-Grid Integration Strategies Mid-Term Report," *Cpuc.ca.Gov*, September 15, 2021, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M407/K998/407998634.PDF.
[63] Southern California Edison Corp., "Integrated Distributed Energy Resources Partnership Pilot," SCE, n.d., https://www.sce.com/business/savings-incentives/integrated-distributed-energy-resources-partnership-pilot.
[64] Southern California Edison Corp. et al., "Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources," September 2020, https://www.dret-ca.com/wp-content/uploads/2021/03/EPC-15-048.pdf.
[65] "Wheels on the Electric Bus Go Round and Round | SDG&E Today," n.d., https://sdgetoday.com/EVSD.
[66] San Diego Gas & Electric, "Toyota Expands Vehicle-to-Grid (V2G) Research with San Diego Gas & Electric Company Collaboration | SDG&E Today," sgetoday.com, November 14, 2023, https://sdgetoday.com/news/toyota-expands-vehicle-grid-v2g-research-san-diego-gas-electric-company-collaboration.

			additional economic analysis. It also includes testing communication signaling capabilities for energy export under ELRP.
SDG&E	*Managed EV Charging Demonstrations*	*2025-present*	*SDG&E is planning future projects and studies to prioritize further research on technology integration, the interconnection process, customer education, and other objectives surrounding field deployed managed charging with battery EVs. These projects will have limited to no testing of communication signaling capabilities for demand response.*

16. What data or information is needed from the EV and/or EVSE to enable load shift while ensuring driver mobility and range needs are not compromised (for example, kWh needed by the vehicle)? How could this data or information be communicated across all vehicle and supply equipment models, regardless of the manufacturers' involvement?

As discussed in question seven, ensuring driver satisfaction with load shifting is necessary for it to have an impact—otherwise, drivers may opt out of load-shifting features. Current VGI features in the market, including load shifting, typically rely on drivers to set preferences in the vehicle settings menu, including:

- Maximum state of charge (typically 80% to preserve battery life for Nickel Manganese Cobalt (NMC) chemistry batteries and 90% for Lithium Iron Phosphate (LFP), noting that displayed SOC may differ from actual battery chemistry SOC).
- Minimum state of charge to enable charge scheduling (e.g., never defer charging if plugged in below 40% state-of-charge).
- Time/date and desired state of charge for departure (conservative use is recommended until drivers' preferences are better understood, though machine-learning can be a valuable tool for optimization).
- Desired preconditioning (i.e., cabin temperature for departure).

Although these variables are typically displayed to customers as "states of charge" for simplicity, they are processed as energy values (in kWh) in the vehicle's internal control system.

To ensure driver satisfaction with load shifting, the vehicle, vehicle OEM cloud, or vehicle OEM / EVSE mobile app must either:

1. **Communicate key information:**
    - Current energy level in kWh.
    - Desired energy level in kWh.
    - Intended departure time.
    - Customer minimum energy level in kWh.

   This information should be sent to an EVSE or another entity responsible for managing the charging session (e.g., ALMS controller). These energy levels are derived from the customer state-of-charge inputs, as described above.

   or
2. **Manage the charging session:**
   - Use its on-board state of charge and customer preference data.
   - Combine this data with grid signals received from its telematics module.

- Manage the charging session through the on-board charger.

Many EVs have these features fully developed and deployed. In many cases, vehicle manufacturers[67] and charging service providers have confirmed their support,[68] enabling customers to use their EVs to participate in utility demand management programs if they choose.

17. What is the energy consumption impact from adding flexible demand capability to existing EVSE?

While the potential to shift and curtail energy usage from EVSEs is significant, the energy penalty for this connectivity is negligible. In most cases, the incremental energy consumption is zero because many connected EVSEs already possess flexible demand capability, and energy is used for customer mobile app amenities.

When new communication equipment, such as a Wi-Fi module, needs to be added, the power consumption of these components is low, typically around 2 watts (W). For example, if a Wi-Fi module with a maximum power consumption of 2 W is added to an EVSE to enable load shifting, even if it operates at maximum power for 24 hours per day, it will account for only approximately 0.05% of the energy required to charge a mid-sized EV with a 100-kWh battery. This calculation is based on vehicle consumption data from the *ENERGY STAR Certified Electric Vehicle Chargers (AC-Output) Excel File Export*.[69]

The ENERGY STAR Version 1.2 EVSE Specification[70] has a "no vehicle mode power allowance" of 5 W for Wi-Fi or ethernet-connected EVSE and 7 W for cellular-connected EVSEs. Of the 192 AC EVSE without a cellular modem nor display listed in the ENERGY STAR® Certified List, the average "no vehicle mode input power" is 3.4 W.

18. Please discuss strategies for EVSE to best utilize the CEC's Market Informed Demand Automation Server (MIDAS) which provides access to utilities' time-varying rates, GHG emission signals, and California Independent System Operator (California ISO) Flex Alerts?

Updated comment from previous letter: Several commenters on this RFI pointed to the value of price signals. LBNL's related response to questions nine and ten from the CEC FDAS Low-voltage Thermostat

[67] Ford. 2024. "Ford Customer Experiences, Behaviors, and Performance in Vehicle - Grid (VGI) Integration Programs," DistribuTech 2024 Conference Panel.
[68] blink, "Demand Response Management for EVs," blinkcharging.com, February 21, 2024, https://blinkcharging.com/blog/demand-response-management-for-evs.
[69] U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE), "ENERGY STAR Certified Electric Vehicle Chargers (AC-Output)," energystar.gov, n.d., https://www.energystar.gov/productfinder/product/certified-evse-ac-output/results.
[70] U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE), "ENERGY STAR Program Requirements for Electric Vehicle Supply Equipment," *Energystar.Gov*, 2021, https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%201.2%20EVSE%20Final%20Specification_0.pdf.

RFI states that "[t]he availability of dynamic prices may motivate thermostat manufacturing to build the capability to integrate with MIDAS."[71]

MIDAS provides access to utilities' time-varying rates, GHG emission signals, and CAISO Flex Alerts via multiple pathways. In the future, EVSEs should be able to communicate with MIDAS directly or through an aggregator to allow customers to take advantage of these rates and signals.

For example, EVSEs could integrate an app- or cloud-enabled software layer to communicate with the MIDAS API. By performing daily data pulls from MIDAS, EVSE could identify the most favorable hours of day to charge, reducing customer bills and GHG impacts. Drivers could schedule at these optimal times using an app or back-office cloud based on their preferences and the current vehicle status received via a hardwired or telematics-enabled data connection to the EV. This approach allows multiple strategies to meet goals, such as minimizing costs, charging time, and emissions while maximizing fairness.[72] *However, we are unaware of any EVSEs currently taking this method.*

As a second example, EVSEs could use an indirect connection to MIDAS through an aggregator cloud to provide the same functionality. This approach would not rely on any EVSE-specific configuration relative to MIDAS. Instead, an external aggregator cloud would incorporate signals from MIDAS.

The difficulty of incorporating into products the ability to communicate with MIDAS and respond to MIDAS signals will vary depending on an EVSE/EV's capabilities and the product manufacturer's product roadmap. In addition, the MIDAS price signal available through the Rate Identification Number (RIN), is likely to be location specific. If the EVSE or EV is mobile and will be charging at different locations, it is not clear whether or how MIDAS would send the right RIN to the EVSE or EV for the location being used at any particular time. We recommend that the CEC discuss this further with relevant stakeholders, including OEMs, aggregators, ASPs, and DERMS providers, to understand their plans for integrating MIDAS into their products and programs.

19. What are the cybersecurity challenges and needs associated with communicating signals from the grid, or a third-party, to accomplish supplying energy to electric vehicles?

As with most connected devices, the weakest link in the communication is the customer's Wi-Fi network. Authentication and end-to-end encryption of all signals are required to ensure cybersecurity for non-Wi-Fi systems,[73] which may involve building a "pass-through" capability in EVSE software. This action would prevent EVSEs from decrypting messages intended for direct transmission between the vehicle and the grid or vice versa. New endpoints (e.g., third-party servers or mobile apps) will introduce additional attack interfaces that the software developers for these entities must monitor.

On September 16, 2024, Southern California Edison, in work conducted under direction from the CPUC on behalf of California IOUs, filed a mid-term report on their progress towards completing a

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[71] Lawrence Berkeley National Laboratory, "Lawrence Berkeley National Laboratory Comments - Berkeley Lab Comments - CEC RFI Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats (24-FDAS-03)," *Eta-Publications.Lbl.Gov*, November 27, 2024,
https://efiling.energy.ca.gov/GetDocument.aspx?tn=260346.

[72] gridX, "EV Charging Strategies," grid.ai, October 16, 2024,
https://www.gridx.ai/knowledge/ev-charging-strategy

[73] "*V2G Cybersecurity: EVSE: DITM*" a presentation from EPRI at the V2G Business, Policy & Technology Forum (Oct 23-24, 2024).

cybersecurity gap analysis “to identify potential gaps in existing cybersecurity protocols and EV charging equipment products used for transportation electrification (TE) programs, and to provide recommendations on how to address those gaps.”[74] The report details ongoing collaboration between SCE and cybersecurity experts and organizations, including EPRI, national laboratories, and the United States (U.S.) Department of Energy (DOE) Vehicle Technology Office in advancing EV charging cybersecurity.

20. Are there any considerations to ensure equity when developing a load shifting strategy for supplying energy to electric vehicles? For example, are there concerns that flexible demand will be disproportionately accessible based on income level?

An intentional equity focus is vital when developing a load shifting strategy for EVs, especially as EV adoption has been more prevalent in higher-income neighborhoods so far.[75] The maturing pre-owned EV market and substantial incentives for low- and middle-income households can help increase broader EV adoption. However, equitable TOU rate design and approaches to developing flexible demand potential that target and include low-income and other disadvantaged electricity customers is crucial to the equitable distribution of benefits.

We share the following equity considerations at this initial stage and note that regional and local stakeholder engagement can most effectively identify location-specific barriers and methods to increase equitable access and adoption.

Housing and Household Characteristics

- Single-family housing typically has charging equipment accessible to only one household, while multi-family housing often has shared charging equipment, making demand flexibility less feasible.
- California homeowners are three times as likely as renters to own an EV[76] and have autonomy over installing and operating their home charging equipment. Renters typically require approval to install any charging equipment, limiting access to associated flexible demand programs and EV purchasing options. They are more likely to purchase an EV if they are assured access to charging at their future residence.
- Households with ad-hoc or inconsistent vehicle usage may not be able to participate in many flexible demand initiatives. For example, drivers with inconsistent or unpredictable shift work may not be able to realistically commit to charging their vehicle at specific times or to anticipate when it will need a full charge.

[74] Southern California Edison, Inc., Janet S. Combs, and Rebecca Miers-De Pastino, “Southern California Edison Mid-Term Vehicle-Grid Integration Strategies Report,” September 16, 2024, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M540/K719/540719872.PDF.

[75] Nadia Lopez and Erica Yee, “Who Buys Electric Cars in California — and Who Doesn’t?, CalMatters, March 22, 2023, https://calmatters.org/environment/2023/03/california-electric-cars-demographics/.

[76] Lucas W. Davis, “Evidence of a Homeowner-renter Gap for Electric Vehicles,” *Applied Economics Letters* 26, no. 11 (September 24, 2018): 927–32, https://doi.org/10.1080/13504851.2018.1523611.

Supporting Technology

- Public charging availability can positively influence EV adoption, but as with shared multi-family charging, it may not allow for easy participation in flexible demand initiatives. Customers also strongly prefer at-home charging, and reliance on public charging could increase fuel costs.[77]
- Some equipment types may help lower barriers to EV adoption and flexible demand program participation. For example, AC vehicle-to-grid equipment is much more affordable than DC equipment, which increases its access to users and its likelihood to be used for flexible demand programs.

Distribution of Benefits

- Flexible demand solutions should be compatible with California Alternate Rates for Energy (CARE), Family Electric Rate Assistance (FERA), and other income-qualified discount rates and programs. Ensuring households can stack the benefits of their existing discount rate with EV load flexibility programs can reduce uptake barriers and more equitably distribute the benefits of these initiatives.
- Targeting specific geographic areas, such as disadvantaged communities as defined by CalEnviroScreen 4.0, may not effectively deliver load-shifting benefits at the household level.
- Gasoline "superusers" below the state median income comprise over one-third of high-gasoline consumption drivers.[78] These individuals may disproportionately benefit from EV adoption coupled with participation in flexible demand initiatives, though presumed shorter dwell times could limit participation.
- Involving priority customers, such as low-to-moderate (LMI) consumers or households in geographically disadvantaged communities, in flexible demand programs may require tailored methods of consumer education and engagement.[79]
- Some publicly-owned utilities do not currently offer time-of-use rates; therefore, load shifting of EVSE would not provide customer bill-saving benefit in those service areas.

Considering the characteristics of LMI EV drivers leads to the following design guidelines for an EVSE FDAS:

A FDAS focused on private L2 EVSEs would be more accessible and beneficial to single-family homeowners, who do most of their EV charging with a single EVSE located at their home and under an electric utility account in their name. LMI EV drivers are more likely to live in homes that cannot easily accommodate private L2 EVSE and are more likely to use public or shared chargers. These drivers can still take advantage of EVSE demand response programs. For example, Tesla maintains a network of 40,000 L2 "destination chargers" that can be used by any Tesla owner, including LMI drivers without

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[77] "*EVI-Equity*" a presentation from NREL at the Vehicle Technologies Office Annual Review (Jun 21, 2022).
[78] Matthew Metz et al., "Cracking the Gasoline Code," *Coltura.Org*, 2024, https://coltura.org/wp-content/uploads/2024/01/Gasoline-Superusers-3.0-Full-Report-Coltura-2024.pdf.
[79] Union of Concerned Scientists. "Flexible Demand Opportunity," January 22, 2020, http://www.ucsusa.org/resources/flexible-demand-opportunity.

EVSE at their homes. If the FDAS requires EVSE to accept and integrate user information, such as the planned connection duration, the destination chargers can adjust charging to take advantage of fluctuating rates and ensure the vehicle receives the desired charge.

LMI drivers are more inclined than non-LMI drivers to choose preowned vehicles, including EVs. As EV technology evolves, each model year brings advancements, including improved telematics and power train configurations. While these new technologies will eventually reach preowned EV drivers, non-LMI drivers will likely have moved on to the latest advancements. Consequently, the EVs driven by LMI and non-LMI drivers may differ in age and technological sophistication. Therefore, to serve LMI drivers as well as non-LMI drivers, the FDAS should accommodate older EV technologies in addition to new products.

The CA IOUs appreciate the opportunity to provide these comments regarding the Flexible Demand Appliance Standards on Electric Vehicle Supply Equipment. We thank the California Energy Commission for its consideration and look forward to the next steps in the process.

Sincerely,

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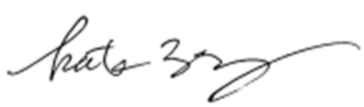

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