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Wevo Energy Response to 24-FDAS-04 - Flexible Demand and Load Shifting

Wevo Energy is an industry leader in electric vehicle (EV) charging management software. We specialize in providing advanced EV charging solutions that are designed to meet the unique needs of high-density locations. Our platform leverages AI-powered load balancing technology to optimize charging times and power usage, enabling our clients to maximize charging station deployment. Our software is OCPP-certified, hardware agnostic, and integrates seamlessly with solar energy systems, ensuring a future-proof and scalable solution.

Please find answers to the questions outlined in the Request for Information (RFI) regarding flexible demand and load shifting in California. We hope that our insight will help inform your staff in the development of a sound and effective Flexible Demand Appliance Standard (FDAS).

Additional submitted attachment is included below.

wevo

California Energy Commission
715 P Street
Sacramento, CA 95814
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RE: **Docket No. 24-FDAS-04**
Flexible Demand and Load Shifting in California for Electric Vehicle Supply Equipment

Dear California Energy Commission:

Wevo Energy is an industry leader in electric vehicle (EV) charging management software. We specialize in providing advanced EV charging solutions that are designed to meet the unique needs of high-density locations. Our platform leverages AI-powered load balancing technology to optimize charging times and power usage, enabling our clients to maximize charging station deployment. Our software is OCPP-certified, hardware agnostic, and integrates seamlessly with solar energy systems, ensuring a future-proof and scalable solution.

Flexible demand standards are crucial for EV charging because they enable grid operators and utilities to better manage electricity demand and balance supply during peak usage times. These standards will optimize energy distribution, reduce costs, and enhance grid stability while integrating renewable energy sources. These standards are also essential for supporting programs like demand response, where consumers are incentivized to reduce or shift their energy consumption during peak periods.

Please find answers to the questions outlined in the Request for Information (RFI) regarding flexible demand and load shifting in California. We have included some important information about charging behavior gleaned from our experience with hundreds of residential buildings with EV charging in Israel where there are no incentives for EV charging, just time of use rates. We hope that our insight will help inform your staff in the development of a sound and effective Flexible Demand Appliance Standard (FDAS). We would be happy to meet with California Energy Commission staff to further discuss these answers and recommendations, and to share how our load management features can significantly assist in reducing grid congestion. Please reach out to us at your convenience.

Respectfully,

Marina Hod
Managing Director Americas
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Wevo Energy Response to Docket No. 24-FDAS-04
Flexible Demand and Load Shifting in California for Electric Vehicle Supply Equipment

Question 1.
Please provide information to assist the CEC in determining whether the scope of devices listed here meets the needs of FDAS or if the CEC needs to consider revisions to the scope:

- Level 1 Electric Vehicle Supply Equipment
- Level 2 Electric Vehicle Supply Equipment
- DC-output Electric Vehicle Supply Equipment
- Wireless Electric Vehicle Supply Equipment
- Medium voltage AC input supply Electric Vehicle Supply Equipment
- Power electronic components inside the vehicle
- Pantograph Electric Vehicle Supply Equipment
- Equipment with an automated connection system

Wevo Energy Answer:

We believe the devices listed here should be included in the scope of devices considered for the FDAS. Devices available within the EV charging space that offer dynamic energy use and grid interaction should be included in these demand standards as collective and increased use of these devices can significantly shape grid stability in the long-term.

Question 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.

Wevo Energy Answer:

The current landscape of EV charging is varied and continues to evolve as EV adoption increases. Currently there are several charging schedule options or types adopted by electric utilities and/or state programs:

- **Time-of-Use (TOU) Rates** - Under this scheduling option, utility companies offer different electricity rates based on the time of day. Charging during off-peak hours (usually late at night or in the early morning) is cheaper than peak hours. TOU scheduling encourages charging when grid demand is low or when other renewable energy resources (e.g., solar, wind) are available and abundant. Rates can be 50% or more lower during off-peak hours, which allows a strong financial incentive for program participation. Utilities in states such as California, Texas, and New York offer charging programs based on time-of-use rates.

More specifically, PG&E, Southern California Edison (SCE), and Con Edison offer EV charging incentives based on TOU rates.

- **Smart Charging** - This form of charge scheduling allows chargers to automatically optimize charging schedules to align with grid conditions or user preference (e.g., lowest cost, fastest charge). Many Level 2 chargers support smart charging through mobile apps. EVs like Tesla, Rivian, and Ford also have built-in scheduling features.

- **Demand Response Programs** - Under these programs, utilities provide incentives to EV owners to reduce or delay charging during peak demand time frames. Programs in states like New York, Florida, and California offer such demand-response options, offering discounts, rebates, or direct payments for participation. Examples include Florida Power & Light Commercial Demand Reduction, New York National Grid's commercial demand response programs, and Southern California Edison's Demand Response Program for Homes.

- **Flat-Rate EV Charging Plans** - With flat-rate plans, utilities charge a monthly fee for unlimited or discounted EV charging during certain hours. A sample of this scheduling option is Georgia Power's Overnight Advantage. In this program, customers are offered unlimited charging at a flat rate during the hours of 11.00 pm to 7:00 am.

From our experience managing and processing thousands of EV charging sessions globally (most of them in multi unit dwellings), we have found that regular drivers and residents rarely override default setting. Our software functionality includes a "boost" capability, designed to optimize electric vehicle (EV) charging by allowing drivers to override default charging setting that delay charging to off peak times. Thus if a driver plugs in their vehicle during on peak, high priced times, the charging does not start until after the off peak rates kick in. Typically charging during on peak times would cost more than double as off peak. In multi unit residential dwellings, the default setting is typically set at pause charging until off peak rates go info effect, unless the driver choses to override this default setting. In such cases, they would start charging right away but pay a premium for this.

To understand the data gleaned from 10,000 charging sessions in which drivers had the opportunity to override default settings, it is important to understand the two (2) charging options in the Boost Program:

1. **Standard option** - standard charging under this program was not a flat charge but one based on time-of-use (TOU). TOU consisted of peak hours (from 5:00 pm to 10:00 pm). Under the standard option, the default was not to start charging immediately when plugged in. Drivers would plug in, but charging would not start until off-peak hours. Moreover, charging could also be delayed further to avoid congestion of the grid.

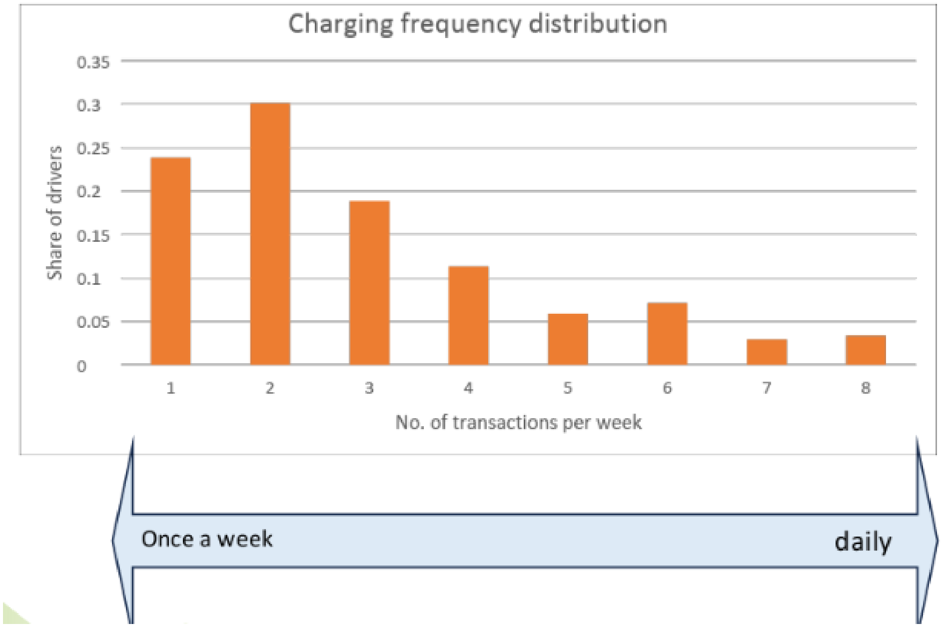
2. **Boost option** - under the Boost option, drivers would plug in and charging would start immediately. The cost of charging would be greater under the Boost option than in the Standard option.

The charging behavior in question was whether drivers were susceptible to “battery anxiety,” or, in other words, whether drivers were concerned about the need to charge immediately when plugging in or whether they would be willing to wait until off-peak hours. The data revealed the following key conclusions:

1. Drivers typically charged only two to three times a week.
2. Only 5-6% of the charging under this program resulted from drivers that selected to charge immediately via Boost functionality, overriding the default Standard setting.
3. Drivers were willing to wait for charging until off-peak hours and were, seemingly, not worried about having a full battery.

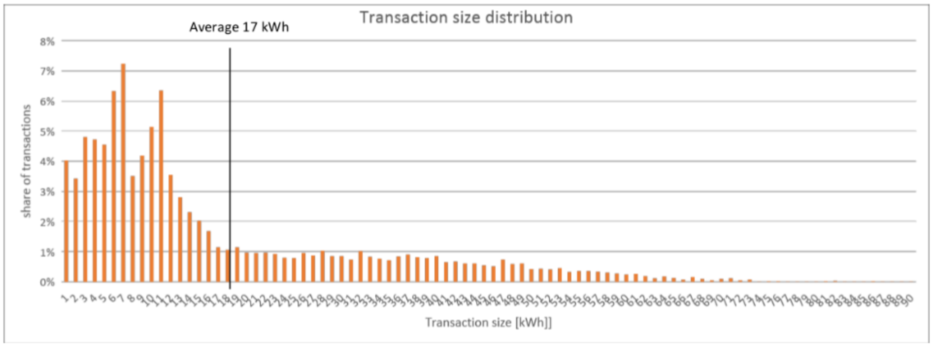
This is demonstrated below in Image A:

Image A



The size of the charging transaction correlates with the data that most drivers charge two to three times a day as opposed to daily. The average charge in cases where “Boost” was selected was 18 kilowatt-hour, which equates to about 60 miles of drive. In Israel, EV users drive an average of 30 miles a day, which is consistent with charging two to three times a week. This is demonstrated below in Image B.

Image B



One factor learned by the analysis of the data was that while drivers averaged 18 kilowatt-hour per charge, there was a large standard deviation of 17 kilowatt-hour, which indicates that there are some drivers that require a large transaction when they charge, i.e., they need to fill their battery completely, and then some drivers that required smaller transactions, seemingly "topping off" their batteries a little at a time. Of particular note in understanding charging behavior is that 60% of drivers never opted for the Boost override option and only one third of the drivers would use the option but only for a short period of time.

The data gleaned from analyzing the Boost charging transaction also provides insight for charging behavior in parking lots. Some 40% of charging that occurred in parking lots resulted from drivers who used the parking lot only for a few hours. Among drivers that selected the Boost override option while using the parking lot, they only stayed for a few hours. A majority of drivers that stayed for shorter periods in the parking lots were those that selected the Boost option. This is demonstrated below in Image C.

Image C

Arrival time

Exit time	0-6	6-9	9-12	12-15	15-18	18-21	21-24
0-6	1%	0%	0%	0%	1%	2%	4%
6-9	2%	1%	1%	3%	5%	10%	10%
9-12	1%	2%	2%	1%	2%	4%	5%
12-15	1%	1%	3%	3%	1%	1%	2%
15-18	0%	0%	2%	5%	3%	1%	1%
18-21	0%	0%	1%	2%	5%	3%	0%
21-24	0%	0%	0%	0%	1%	3%	2%

30% - night parking
40% - daily errands

The Wevo Energy experience with Boost override functionality over default settings offers insight on the financial implications of developing charging policies, rules, and standards. When the cost of charging increased, fewer drivers selected the Boost option. This was particularly true in the summer season when charging was most expensive. Drivers selected the Boost option mostly in the fall and spring when rates were more affordable than in the summer. Driver behavior is influenced by the cost of charging and can adapt their charging behavior to charge during off-peak hours.

Question 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.

a. How does using charge strategy balance factors such as battery life, price, etc.?
b. What consumer data is available that provides customer charging habits such as: demographics and population percentages that prefer to charge at home, at work, or in public shared spaces? What times of day?
c. What charger types are typically used?
d. How do charging patterns change as EV owners gain experience with their vehicle?
e. What percentage of battery capacity is typically charged per session?
f. How is this behavior expected to change as ownership of EVs expands beyond the early adopters?

Wevo Energy Answer:

Consumers of electric vehicles (EVs) show varying preferences in their charging strategies. Many prioritize “charge by departure” where they set a target battery percentage and specify when the car should be ready for use, helping to optimize battery health and energy costs. This strategy balances factors like battery life, as charging to 100% frequently can degrade the battery faster, whereas partial charging (e.g., 80%) preserves its longevity. Charging immediately, however, may be preferred for those in a rush, but it can be less energy-efficient depending on the grid demand.

Consumer charging habits show that most EV owners charge primarily at home, with work charging or public stations being secondary. Home charging, particularly overnight, aligns with the preference for off-peak hours, often between 10:00 pm and 6:00 am. Public charging is more common for longer trips or where home charging is unavailable. Demographically, more affluent and urban populations tend to adopt home charging, whereas those with less stable housing or access to dedicated parking rely more on public chargers.

Charger types vary, with Level 2 chargers being the most common for home use due to their faster charging speeds compared to standard 120V outlets. Level 3 DC fast chargers are used for rapid public charging. As EV owners become more experienced, they typically learn to optimize charging patterns to extend battery life, often charging to lower percentages (e.g., 60-80%) and avoiding full charges. Charging sessions generally range from 20% to 80% of the battery's capacity, depending on the user's needs and timing. As EV adoption expands beyond early adopters, it's expected that charging behavior will evolve toward more mainstream preferences, with broader use of public charging infrastructure and potentially more diverse charging times as consumers adapt to EV ownership.

Please refer to some of the charging behavior learned through Wevo Energy's standard vs boost charging capabilities outlined in Question #2 above.

Question 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?

Wevo Energy Answer:

While DC charging equipment is more commonly installed for commercial installation projects, there are some options and devices available for residential use. There are low-power power DC chargers (10-25 kW) designed for residential and light commercial use with a power output sufficient to recharge most EVs in a couple of hours depending on the battery size of the vehicle. There are also portable DC chargers that could be applied to residential use, which can be directly wired or plugged into high-capacity power outlets. Designed for flexibility and convenience, these units can offer 10-15 kW output. While not mandatory, some DC chargers for residential use may benefit from a Battery Energy Storage System (BESS) to manage peak loads better.

Question 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?

Wevo Energy Answer:

There are software and hardware features that could both enable public charging and reduce grid congestion. With respect to software, these features include:

- **Dynamic Load Management (DLM) -** Dynamic load management works by adjusting charging rates in real-time based on demand, grid conditions, and transmission and distribution capacity. This function can reduce peak loads and ensures that chargers pull power only when the grid is capable of it. Wevo Energy leverages smart grid communication protocols like OpenADR. By integrating OpenADR into its platform, Wevo Energy enables intelligent load management and automated demand response, optimizing power distribution based on real-time data. This allows more vehicles to charge efficiently without the need for costly infrastructure overhauls. The practical implications of EV load management and automated demand response are far-reaching, helping to balance grid demand while reducing costs for both consumers and utilities.

- **Energy Management Systems (EMS) -** EMS platforms integrate chargers into building or microgrid-level energy management in order to balance EV charging with other energy loads and onsite generation (e.g., solar, wind). These platforms revert grid overload at the distribution level by prioritizing loads dynamically.

- **Grid-Responsive Algorithms -** These systems predict and respond to local grid congestion by shifting charging sessions to off-peak times or lower transmission and distribution-stressed regions, reducing stress on distribution transformers and avoiding upstream congestion at substations.

- **Advanced Data Analytics and Forecasting -** This type of forecasting uses machine learning and historical data to predict congestion patterns and optimize EVSE operations accordingly and then proactively prevents congestion by rerouting energy flows or scheduling lower-intensity charging.

Similarly, there are hardware options that can help eliminate grid congestion:

- **Bidirectional Charging Equipment -** This hardware supports vehicle-to-grid (V2G) or vehicle-to-building (V2B) operations by allowing electric vehicles to act as energy sources. Bidirectional charging results in an offload of excess energy during grid congestion, mitigating strain on distribution lines.

- **Integrated Battery Energy Storage Systems (BESS) -** The devices and related systems operate during low-demand periods and discharge during peak times to support charger operations or stabilize grid demand, decreasing instantaneous power draw from the grid and acting as a buffer for transmission and distribution systems. A good example is the Tesla Megapack that integrates with high-power EV charging hubs.

- **DC Microgrids for EVSE Clusters -** With this option, multiple EV chargers are connected to a localized DC microgrid to optimize energy flow and reduce conversion losses, minimizing the energy load on transmission and distribution infrastructure by keeping energy flows localized.

- **On-Site Renewable Energy Generation -** On-site renewable generation reduces dependence on transmission and distribution infrastructure by using solar or wind energy to power EV chargers directly, alleviating grid stress by offsetting the power needed from the grid. Solar canopies over EV charging hubs are a good example of on-site renewable energy generation.

- **Smart Transformers and Advanced Meters -** These hardware devices monitor and dynamically adjust energy flow at the distribution level, which prevents overloading of grid infrastructure and facilitates integration of distributed EV chargers. Siemens smart transformers paired with EV charging clusters work in this fashion.

To maintain grid reliability at the distribution level, grid operators and load aggregators employ a range of strategies to manage demand charging equipment. These approaches generally fall into direct load control, price-based mechanisms, and distributed energy resource (DER) integration, each tailored to ensure stability while accommodating the growing adoption of electric vehicles.

Direct load control is one of the most effective methods for managing charging demand. Through managed charging, operators can either delay charging sessions to off-peak times or dynamically adjust charging rates in real time to respond to grid conditions. In some cases, charging may even be interrupted entirely during periods of high grid stress. Utility demand response programs are another avenue for direct control, allowing operators to send signals to EVSEs to reduce or pause energy usage when the grid faces critical constraints. Advanced EVSE technology also enables dynamic responses to grid signals, adjusting power levels to support real-time needs such as frequency regulation or voltage stabilization.

Price-based mechanisms play a complementary role in shifting charger demand away from peak periods. Time-of-use (TOU) rates incentivize users to charge during designated off-peak hours by offering reduced electricity prices, while more sophisticated dynamic pricing models, such as real-time or critical peak pricing, adjust costs in near real time based on grid conditions. For commercial charger operators, demand charges can encourage optimization of charging schedules, reducing the likelihood of excessive peak loads.

Distributed energy resource integration introduces another layer of flexibility to grid management. Vehicle-to-grid (V2G) technologies enable bidirectional flow, allowing EVs to discharge energy back to the grid during high-demand periods, effectively acting as mobile energy storage. EVSE installations can also pair with on-site battery storage systems to buffer demand or integrate with solar panels to generate and use renewable energy directly, reducing strain on the grid during daylight hours. At the grid's edge, advanced tools like voltage and frequency control mechanisms and load aggregation platforms help distribute charging impacts more efficiently. Smart inverters and next-generation EVSE systems can respond to fluctuations in grid stability, helping to prevent outages in areas with high renewable energy penetration. Aggregators play a crucial role by managing multiple EVSEs as a virtual power plant, optimizing their collective response to grid constraints. Advanced metering infrastructure (AMI) further enhances these efforts, providing precise data for predictive modeling and allowing grid operators to anticipate and mitigate reliability risks proactively.

Regulatory and policy tools also support these efforts by defining how and when load adjustments occur. In some cases, critical infrastructure like hospitals, schools, and government agencies may receive prioritization, with non-essential charging curtailed more aggressively during emergencies. Distribution energy management systems (DERMS) integrate these various strategies, allowing real-time optimization of all resources on the grid to ensure EV charger usage aligns with local constraints. Consumer behavior must also be managed to balance grid needs with user satisfaction.

Question 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?

Wevo Energy Answer:

Similar to public charging, there are several software and hardware options to enable residential chargers to reduce grid congestion at the distribution level. With respect to software, there are the following options, features, and functions, which often require cooperative programming between electric utilities and the software integrated into residential charging devices:

- **Demand Response Integration** - DR integration requires software that can receive and respond to demand response signals from utilities or aggregators. This includes capabilities for load curtailment, shifting, or complete interruption during periods of grid stress.

- **Smart Charging Algorithms** - Intelligent scheduling algorithms optimize charging times based on grid conditions, electricity rates, and user preferences. These algorithms can ensure that charging is deferred during peak demand periods and prioritized during off-peak times.

- **Vehicle-to-Grid (V2G) Enablement** - Advanced software is required to manage bidirectional energy flow, allowing EV batteries to discharge power back to the grid. This involves coordination with grid frequency and voltage requirements, as well as the integration of user-defined settings to ensure EV availability for driving needs.

- **Real-Time Monitoring and Communication** - EVSE software should support continuous monitoring of grid conditions and real-time data exchange with utilities or distribution energy management systems (DERMS). Open protocols like OpenADR or ISO 15118 ensure interoperability and future-proofing.

- **Dynamic Pricing Integration -** This allows the ability to adjust charging behavior based on real-time or time-of-use electricity pricing is critical. Software that integrates with utility rate structures can encourage users to shift demand voluntarily, benefiting both the grid and their energy costs.

- **Load Aggregation and Virtual Power Plant (VPP) Participation -** Software platforms that aggregate multiple residential EVSEs into a virtual power plant enable distributed coordination. These platforms optimize collective responses to grid congestion by balancing loads across a wide area.

Like software features, hardware devices used for residential charging can also impact congestion at the distribution-level and include the following:

- **Bidirectional Chargers -** Used in vehicle-to-grid (V2G) applications, bidirectional chargers with inverters are capable of feeding power back into the grid diverting power back into the system when needed.
- **Smart Meters and Advanced Metering Infrastructure (AMI) -** Integration with smart meters allows EV chargers to accurately measure and report energy consumption, peak demand, and grid export (for V2G). This data is crucial for billing and grid optimization.
- **Dynamic Power Adjustment -** Residential charging equipment can and should have hardware capable of variable charging rates, allowing them to adjust power levels in real-time. This supports load flexibility and enables partial curtailment instead of complete interruptions.
- **Communication Modules -** Hardware must include communication capabilities such as Wi-Fi, cellular, or Ethernet connectivity, along with compatibility with open communication protocols like OCPP (Open Charge Point Protocol) or IEEE 2030.5. These enable seamless interaction with grid operators and aggregators.
- **Energy Storage Integration -** EV chargers integrated with residential battery energy storage systems (BESS) can provide additional grid relief by buffering charging demand. The hardware supports coordinated operation between EVSEs, batteries, and the grid.
- **Onboard Sensors for Voltage and Frequency -** Charging hardware can and should include sensors that monitor local grid voltage and frequency, enabling proactive responses to grid instability. This is especially useful in areas with high penetration of renewable energy sources.

For these capabilities to work effectively, residential EV charging must be part of a broader ecosystem that includes: distributed energy resource management systems (DERMS) (platforms that orchestrate charging activity alongside other grid resources like solar, storage, and demand response assets); utility communication networks (i.e., robust communication networks that interact with chargers in real time, especially during emergencies); and cloud-based analytics (or platforms that can analyze charger usage patterns and predict demand, helping utilities and aggregators optimize grid operations).

To support grid reliability, grid operators and load aggregators can deploy various control strategies to shift or curtail demand from residential charging at the distribution level. These strategies leverage direct control mechanisms, price signals, and advanced grid technologies to ensure that EV charging aligns with grid conditions. Strategies that can be applied include efforts and systems that optimize direct load control (e.g., managing charging, emergency load shedding, or demand response programs), time-based and dynamic pricing (e.g., time-of-use rates, critical peak pricing), aggregation and virtual power plant (VPP) opportunities (e.g., via load aggregation platforms and locational curtailment), vehicle-to-grid (V2G) integration, distribution energy resource management systems (DERMS), and advanced monitoring and predictive control (e.g., real-time load monitoring and predictive analytics).

One of the most cost effective measures that grid operators can implement to reduce congestion at the distribution level is consumer education and behavior management among consumers. Incentivizing consumer participation through clear communication and opt-in programs is critical for success. Apps, software, and utility portals can allow EV owners to set preferences for charging times, prioritizing off-peak hours or participation in grid support events. Moreover, programs that reward users for shifting or curtailing demand encourage voluntary alignment with grid needs.

Question 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 bidirectional 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)?

Wevo Energy Answer:

To enable load shifting in an electric vehicle's (EV) onboard charging system, both hardware and software components are essential. Hardware-wise, the onboard charger must support bidirectional power flow, allowing it to both receive and send electricity. This capability is crucial for functions like vehicle-to-grid (V2G) operations. On the software side, the system requires intelligent energy management software that can interpret grid signals - such as electricity prices, greenhouse gas (GHG) emissions data, and alerts from grid operators like the California Independent System Operator (CAISO) - to optimize charging times and rates. This software enables the EV to charge during periods of low demand or high renewable energy availability, thereby supporting grid stability and reducing costs.

Regarding the current adoption of these technologies, specific percentages of EVs equipped to receive grid signals for load shifting, demand response, or bidirectional charging are not readily available from our perspective. However, the integration of such capabilities is increasing as the industry recognizes the benefits of smart charging and V2G technologies. In terms of communication methods between Electric Vehicle Supply Equipment (EVSE) and EVs, several technologies are commonly used. Wi-Fi and Ethernet connections are prevalent, providing reliable data transfer for managing charging sessions. Cellular networks offer broader coverage, enabling communication even in areas without Wi-Fi access. Additionally, some systems may utilize power line communication (PLC), which transmits data over existing electrical wiring, facilitating communication between the EV and EVSE without the need for additional communication infrastructure. The choice of communication method depends on factors such as the specific application, required data transfer rates, and infrastructure availability.

Generally speaking, much can be accomplished in the way of load management even if there are no such capabilities within the EV itself, but rather the charger is a “smart charger” that can be managed. With this kind of approach, the capabilities of the vehicle is less important than ensuring that the chargers deployed at OCPP-compliant and can be managed in a standard and secure way.

Question 8.
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?

Wevo Energy Answer:

In short, yes, telematics systems can be used to receive grid signals and schedule charging in response to them. These systems typically serve as the communication link between the EV, the grid operator, and the user, enabling smart charging capabilities like time-of-use (TOU) optimization, demand response participation, and environmental impact reduction (e.g., minimizing greenhouse gas (GHG) emissions). Telematic systems have several capabilities that support smarter and more controlled charging:

- **Receiving Grid Signals -** Telematics systems can receive information such as real-time electricity prices (e.g., TOU or dynamic pricing rates), GHG emissions intensity data to charge during cleaner energy periods, and grid stress notifications.

- **Smart Charging Control -** Based on the received signals, the telematics system can adjust charging schedules to avoid peak periods or take advantage of low-cost energy. Telematics can further participate in demand response programs by pausing or reducing charging during grid events and optimize charging to align with user preferences while supporting grid reliability.

- **User Interface Integration -** Users can set preferences for charging, such as departure times, minimum charge levels, or participation in grid support programs, often through a mobile app connected to the telematics system.

The monthly cost of using telematics-based smart charging features varies by manufacturer and service provider, averaging about $15/month from our research. Payment options for telematics-based charging including bundled options with electric vehicle purchase, subscription fees, and incentive-based models where utility programs or aggregators provide telematics services at little or no cost in exchange for enrolling the EV in managed charging programs. These programs may even offer financial incentives (e.g., rebates or bill credits) to customers who participate.

However, as described earlier, much of the logic and communications can flow directly to the charger rather than the vehicle, as long as the charger is a “smart charger” and can accept signals and commands in a standard and secure manner. In such cases, telematics would not be necessary in order for EV charging to become a very useful grid resource. In addition, ISO 15118 and the ability for the software operating the charger to know the state of charge (SOC) of the vehicle can be accomplished without telematics.

Question 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?

Wevo Energy Answer:

Medium-duty and heavy-duty (MDHD) electric vehicles (EVs) and their associated charging infrastructure play a critical role in advancing government goals for load shifting and reducing greenhouse gas (GHG) emissions. These vehicles, which include electric buses, delivery trucks, and freight vehicles, typically have large batteries with significant energy demands, making their charging patterns highly impactful on grid operations and environmental outcomes.

By adopting smart charging, renewable energy integration, and demand response strategies, MDHD EVs and their EVSE contribute to reducing the carbon intensity of transportation - a sector that remains one of the largest sources of GHG emissions. Their ability to shift significant loads to cleaner energy periods aligns with government goals of achieving carbon neutrality while also improving grid reliability and reducing costs for fleet operators. This alignment of technology, policy, and operational strategies positions MDHD EVs as essential assets in the effort to reduce GHG emissions and transition to a more sustainable energy system. Their role will only grow as governments continue to prioritize transportation electrification and decarbonization as key pillars of climate action.

There are several measures that can be adopted to leverage medium-duty and heavy-duty (MDHD) EVs, and related charging equipment, to support the goal of load shifting to avoid GHG emissions, which include the following:

- **Aligning Charging with Clean Energy Periods**

  One of the primary strategies for leveraging MDHD electric vehicles to reduce GHG emissions is scheduling their charging during periods when renewable energy generation is abundant, such as midday when solar production is high or overnight during low demand and wind energy availability. Government agencies can and should encourage or require entities to shift energy consumption to these cleaner periods. By charging MDHD EVs during these times, operators can significantly reduce the carbon intensity of the electricity used to power these vehicles. For example, transit agencies operating electric buses can take advantage of time-of-use (TOU) rates that incentivize charging during off-peak hours, coinciding with lower GHG emissions from grid electricity. Similarly, freight operators using MDHD EVs for nighttime deliveries can schedule charging to coincide with these cleaner energy windows, ensuring that the vehicles' operation aligns with broader decarbonization goals.

- **Demand Response and Load Management**

  Medium- and heavy-duty (MDHD) charging can participate in demand response programs to alleviate grid stress and contribute to load shifting goals. By responding to utility signals to pause or reduce charging during peak demand periods, MDHD electric fleets help prevent the need for peaking power plants, which are often fossil-fuel-based and disproportionately contribute to GHG emissions. In return, fleet operators often receive financial incentives or reduced electricity rates, creating a win-win scenario for both environmental and economic objectives. Advanced software solutions further enhance the ability of MDHD charging to shift loads dynamically. These systems enable operators to manage charging across entire fleets, optimizing charging schedules based on grid conditions, operational needs, and environmental priorities. Such technologies are critical for large fleet operators, allowing them to manage their significant energy demands without overburdening the grid or increasing GHG emissions.

- **Integration with Renewable Energy and Storage**

  The integration of MDHD chargers with on-site renewable energy systems, such as solar panels, offers another opportunity to support load shifting and GHG reduction goals. During the day, solar energy can directly charge MDHD EVs or be stored in batteries for later use, reducing reliance on grid electricity during peak demand periods. By aligning vehicle charging with on-site generation, operators can further minimize their carbon footprint. In addition, vehicle-to-grid (V2G) technologies provide a pathway for MDHD EVs to actively contribute to grid decarbonization. With their large battery capacities, MDHD EVs can discharge stored energy back to the grid during periods of high demand or low renewable energy availability. This bidirectional flow supports renewable energy integration and reduces reliance on fossil-fueled power plants.

- **Policy Support and Incentives**

  Governments play a key role in encouraging MDHD electric vehicles to contribute to load shifting and GHG reduction. Programs can offer credits for charging during periods of low carbon intensity. Additionally, utility programs often include incentives for MDHD fleet operators who adopt smart charging technologies or participate in load management initiatives. Regulatory mandates also drive alignment with these goals. Regulation can require fleet operators to adopt zero-emission vehicles, while also promoting strategies like managed charging to reduce overall environmental impact. Federal and state initiatives can and should provide funding for infrastructure projects that support clean energy integration and load management.

Question 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.

Wevo Energy Answer:

The scope of the regulation in question could include load-shifting criteria for off-road EVs like forklifts, boats, and other specialized vehicles, as these often have predictable use cycles and charging patterns. Forklifts, for instance, are commonly used in logistics with downtime periods that align well with load-shifting strategies. Boats and other off-road vehicles used in recreation or industrial settings might also follow patterns conducive to charging during off-peak times. Off-road EV counts vary by category and region, but forklifts dominate the segment due to widespread use in warehouses. EVSE types for off-road EVs typically include Level 2 chargers or custom industrial chargers tailored to the power needs of these vehicles. Charging strategies focus on overnight or scheduled downtime charging, aligning with operational needs and electricity cost optimization. Initially, we believe the scope should focus on light- and medium-duty vehicles as adoption for these vehicles is more prevalent at this time. One consideration though is that these types of electric vehicles are often charged with a “dumb” charger that is more difficult to manage.

Question 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?

Wevo Energy Answer:

Wireless charging, or inductive charging, is emerging as a promising solution to enhance the convenience and accessibility of electric vehicle (EV) charging across various sectors. Beyond its current use in transit buses that charge wirelessly at stops or depots, this technology has the potential to transform other industries and applications. Its advantages lie in its seamless, cable-free design, which eliminates physical wear and tear, improves safety, and offers weather-resistant operation.

In public transit systems, wireless charging is already proving effective. Transit agencies are using it not only to top off buses during brief stops but also for overnight charging at depots. This approach ensures operational efficiency while reducing maintenance needs associated with traditional plug-in connectors. Wireless charging is also well-suited for taxis and rideshare fleets. Pads installed at taxi stands or key urban locations allow vehicles to recharge while waiting for passengers, maintaining their readiness without disrupting operations.

Residential and workplace charging are other key areas where wireless technology is gaining traction. Homeowners can benefit from the convenience of wireless charging pads in garages or driveways, especially in regions where harsh weather can make handling cables difficult. Similarly, workplaces are beginning to adopt wireless systems in parking lots, enabling employees to charge their vehicles throughout the day without needing to plug in manually.

For logistics and freight operations, wireless charging can streamline processes at distribution centers, where vehicles often idle during loading and unloading. Rest stops equipped with wireless charging pads could support long-haul trucks, providing incremental charging without extending drivers' schedules. Meanwhile, micromobility networks - such as e-bikes and scooters - are also exploring wireless charging for docking stations, reducing downtime and simplifying fleet management.

Autonomous vehicles (AVs) are another compelling use case. Wireless charging aligns naturally with autonomous technology, as it eliminates the need for human intervention. AVs can align themselves precisely over charging pads, enabling continuous operation for fleets in urban mobility systems. Beyond static applications, dynamic wireless charging - where vehicles charge while driving over embedded coils in the roadway - holds transformative potential. Though still in experimental stages, this technology could extend range and reduce the need for larger, more expensive batteries.

As this technology evolves, many organizations are integrating wireless charging into their product roadmaps. Early adoption is focused on stationary systems for transit and urban fleets, with pilots also targeting private residential and workplace charging. Over the next three to five years, wireless charging is expected to expand into public parking spaces and high-traffic areas, with dynamic charging systems potentially emerging in the longer term.

Despite its promise, wireless charging faces challenges, including efficiency losses compared to wired systems, high installation costs, and the need for standardization to ensure compatibility across manufacturers and regions. Nevertheless, advancements in efficiency, cost reduction, and power delivery for larger vehicles are paving the way for broader adoption.

Question 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?

Wevo Energy Answer:

Charging practices for commercial and bus fleets are designed to balance operational efficiency, cost management, and infrastructure optimization. For most fleets, overnight depot charging serves as the foundation. Vehicles are charged during off-peak hours, often using Level 2 chargers for light-duty fleets or DC fast chargers for medium- and heavy-duty vehicles (MDHD). Transit buses and freight trucks, which typically have larger battery capacities, require higher power levels - ranging from 150 kW to 450 kW for depot charging - with some heavy-duty applications exploring ultra-fast chargers exceeding one (1) MW.

In addition to overnight charging, many fleets employ opportunity charging to top off batteries during the day. Transit buses, for example, may charge at stops or layover locations using high-power DC chargers or wireless inductive systems. This ensures uninterrupted operations on longer or high-frequency routes. Similarly, delivery and logistics fleets can take advantage of brief charging sessions at hubs to supplement their overnight charging routines. Managing fleet charging involves striking a balance between vehicle availability and infrastructure capacity. Smaller fleets sometimes rely on manual rotation, where staff manually connect and disconnect vehicles. However, this approach is increasingly being replaced by automated charging management systems, particularly for larger or more complex fleets. These systems optimize charging schedules based on operational priorities, such as departure times and battery state of charge, while minimizing electricity costs through time-of-use (TOU) rate adjustments and load balancing.

Advanced software can also integrate with telematics to streamline fleet operations. For example, transit agencies use these tools to align charging schedules with fixed route timetables, ensuring critical buses are charged first. Freight operators benefit similarly, as automated systems help optimize charging across large depots while maintaining fleet readiness. Additionally, charging management platforms can participate in demand response programs, adjusting charging rates or schedules in response to grid signals, reducing energy costs, and supporting grid stability. The integration of high-power charging infrastructure, coupled with sophisticated management software, has transformed fleet electrification. These practices ensure that fleets can charge efficiently while maintaining operational reliability, positioning them to scale up as the transportation sector transitions to electric mobility.

Question 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?

Wevo Energy Answer:

Communication protocols enabling load-shifting for EVs and chargers include Open Charge Point Protocol (OCPP), ISO 15118, and Smart Energy Profile (SEP) 2.0. These protocols facilitate bi-directional communication, enabling EVSE and EVs to receive signals like electricity prices and grid conditions for dynamic charging adjustments. OCPP is widely implemented and supports features like remote monitoring and load management. ISO 15118 is growing, offering plug-and-charge authentication and energy flow control for V2G applications. SEP 2.0 supports home energy management systems but is less commonly implemented. While there are industry-wide protocols in use, adoption is fragmented, and full interoperability across platforms is still a challenge. Remaining gaps include harmonizing communication standards globally, ensuring compatibility across manufacturers, and addressing cybersecurity concerns. Future updates to protocols like ISO 15118-20 aim to bridge these gaps.

Question 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?

Wevo Energy Answer:

Data on the effect of bidirectional charging (V2G) on EV battery life is emerging but not yet conclusive. Frequent bidirectional cycling can accelerate battery degradation, depending on factors like power levels, depth of discharge, and thermal management. High power levels and deep cycles tend to reduce capacity faster, while controlled, shallow discharges have minimal impact. Advanced battery chemistries and management systems mitigate these effects, but wear can still occur. Battery warranties often limit V2G use or specify degradation thresholds, reflecting manufacturers’ concerns about accelerated wear. Insurance policies rarely address V2G directly, but liabilities or risks might influence premiums. Quantifying value loss is complex, varying by EV model, usage, and energy market participation. V2G could reduce battery capacity over its lifespan, though revenue from grid services may offset this loss. Manufacturers and policymakers are still working to balance these trade-offs.

Question 15.

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

Wevo Energy Answer:

A load shift program can work with chargers and EVs responding to generic signals, such as time-of-use (TOU) electricity prices or grid demand levels. Generic signals are often sufficient for broad participation, as many EVSEs and EVs are programmed to optimize charging based on such inputs. Nonetheless, tailoring signals to specific EVSEs or EVs can enhance efficiency and effectiveness. Factors like battery state of charge, vehicle usage patterns, and local grid conditions can allow for more precise control, maximizing benefits for both the grid and the EV owner. Many programs use a hybrid approach, combining generic signals with tailored adjustments when data is available.

For example, during the summer 2024 period, Wevo Energy's load management technology was able to shift approximately 60MW of load for six peak hours. Doing this with a grid-side battery would have required a 360MWh battery, estimated at $432,000,000. Wevo Energy was able to accomplish this with no additional hardware onsite and entirely via generic ToU signals, not any custom-tailored EVSE/ EV signals.

Question 16.
What data or information is needed from the EV and/or charger 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?

Wevo Energy Answer:

Load shifting can be accomplished by ensuring that the EV charger is OCPP compliant and working a CPMS system that is able to appropriately receive signals and manage the charger to respond to those signals. To enable load shifting while maintaining driver mobility, data from the EV and/or charger that would be helpful or nice to have but not necessarily required includes:

- **Battery State of Charge (SoC) -** The current energy level in the battery.
- **Energy Requirement (kWh Needed) -** The amount of energy required to reach the driver's desired range or trip destination.
- **Charging Schedule Preferences -** The driver's desired departure time and range requirements.
- **Battery Health Data -** Information about safe charging and discharging thresholds.
- **Current and Planned Charging Power -** To align with grid capabilities and constraints.

To communicate this data across all EV and charger models, standard protocols like ISO 15118 and Open Charge Point Protocol (OCPP) should be universally implemented. These protocols support interoperability and can transmit essential information like SoC and charging preferences.

Harmonizing data definitions and ensuring compliance across manufacturers through industry agreements or regulations is key to achieving uniformity.

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

Wevo Energy Answer:

Adding flexible demand capabilities to existing charging equipment typically has minimal impact on energy consumption itself, as the total energy required to charge the EV remains unchanged. However, there can be slight increases in auxiliary energy use from the hardware for communication, control, and data processing functions. The primary energy impact comes from when charging occurs, not how much energy is consumed. By shifting charging to off-peak periods or aligning with renewable energy availability, flexible demand can improve grid efficiency and reduce reliance on high-emission generation sources, indirectly contributing to overall energy savings and grid stability.

Question 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?

Wevo Energy Answer:

To best utilize the California Energy Commission's (CEC) Market Informed Demand Automation Server (MIDAS), which provides access to time-varying rates, GHG emission signals, and California ISO Flex Alerts, EVSEs can integrate with MIDAS using a combination of smart software, communication protocols, and grid-responsive algorithms. By integrating MIDAS signals, EVSEs can play a key role in supporting grid stability, reducing emissions, and optimizing energy costs for consumers, all while ensuring that the needs of EV owners are met. These strategies can enable a responsive, adaptive charging infrastructure that aligns with California's energy goals. Strategies that EVSE could adopt include the following:

- **Integration with MIDAS through Open Communication Protocols:**
  EVSEs can integrate with MIDAS by implementing industry-standard communication protocols such as Open Charge Point Protocol (OCPP) or ISO 15118. These protocols support real-time communication between EVSEs and grid data providers, enabling EVs to adjust charging based on time-of-use rates, GHG emissions, and Flex Alerts. MIDAS can send grid signals, which the EVSE interprets and uses to adjust charging schedules dynamically.

- **Time-of-Use Optimization:**
  EVSEs can optimize charging based on time-varying electricity prices provided by

MIDAS. By charging during low-price periods and avoiding peak hours, EVSEs can reduce energy costs for consumers and help balance grid demand. This would require EVSEs to have software that can dynamically schedule charging based on real-time price signals.

- **Minimizing GHG Emissions:**
  EVSEs can prioritize charging when the grid's carbon intensity is lowest, as indicated by MIDAS's GHG emission signals. This feature is particularly valuable for users who prioritize sustainable energy use. EVSEs can optimize charging times to coincide with periods when renewable energy resources, like solar or wind, are abundant, minimizing the carbon footprint of charging.

- **Response to California ISO Flex Alerts:**
  During periods of grid stress (as indicated by California ISO Flex Alerts), EVSEs can delay or reduce charging to avoid contributing to grid congestion. This can be done by receiving Flex Alert signals from MIDAS and adjusting charging times or rates accordingly. EVSEs could implement algorithms that prioritize emergency load-shedding, balancing user mobility needs with grid stability.

- **User Preferences and Mobility Needs:**
  EVSEs should balance load-shifting strategies with user needs. For example, while load-shifting can be beneficial for cost savings and reducing GHG emissions, users may still need to meet specific mobility requirements. EVSEs should have the ability to prioritize charging for essential trips (e.g., based on preset schedules or user inputs) while shifting non-urgent charging to optimal times.

- **Real-time Feedback and Alerts:**
  To increase user engagement and allow real-time adjustments, EVSEs can provide notifications or feedback to EV owners regarding the best times to charge based on pricing, emissions, and grid conditions. This enables users to make informed decisions, improving their participation in grid optimization efforts.

- **Energy Storage Integration:**
  For locations with sufficient infrastructure, integrating energy storage (e.g., battery systems) with EVSEs could help mitigate timing mismatches. For instance, EVSEs could charge from stored energy during periods of high demand or high emissions, while charging the storage system when rates are low and renewable energy is plentiful.

Question 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?

Wevo Energy Answer:

Cybersecurity challenges in communicating grid signals to EVs or EVSEs include protecting against unauthorized access, data breaches, and signal spoofing that could disrupt charging schedules or compromise grid stability. Key concerns are as follows:

- **Authentication:**
  Ensuring that only authorized parties can send or receive signals. Weak authentication can allow malicious actors to impersonate grid operators or third parties.

- **Data Integrity:**
  Preventing tampering with charging instructions or energy usage data to avoid misuse or inaccurate billing.

- **Privacy:**
  Protecting sensitive user data, such as location and usage patterns, from being exposed.

- **Resilience:**
  Safeguarding systems against distributed denial-of-service (DDoS) attacks or malware that could disable charging infrastructure. This is a particular concern in lesser populated or dense areas with fewer charging options.

To address these challenges, robust encryption protocols (e.g., TLS), secure software updates, and adherence to cybersecurity standards like ISO/IEC 27001 are essential. Interoperability-focused protocols like ISO 15118 also incorporate encryption and secure authentication to reduce vulnerabilities. Features developed by software and network providers can also address the necessity of security in charging. For example, Wevo Energy offers its Secure Mode feature, which ensures only authorized users can access chargers using an RFID or mobile app activation. Collaboration across stakeholders is needed to maintain secure communication channels as EV adoption continues to increase across wider geographies.

Question 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?

Wevo Energy Answer:

Equity is a critical consideration in developing load-shifting strategies for EV energy supply. Flexible demand programs could disproportionately benefit higher-income individuals who are more likely to own EVs, have access to home chargers, and afford smart EVSE that enables advanced load-shifting features. Lower-income individuals, renters, or those relying on public charging may face barriers to participation. In order to address these concerns, policy makers and state or utility incentive program administrators can implement or consider the following to promote greater equity:

- **Subsidies and Incentives:**
  Offer financial support for installing smart EVSE and participating in demand-response programs, targeting underserved communities.

- **Public Infrastructure Investment:**
  Ensure public charging stations incorporate load-shifting capabilities and are accessible in all neighborhoods, including low-income and rural areas.

- **Program Design:**
  Develop simple, accessible programs that do not require expensive equipment or advanced technical knowledge.

- **Education and Outreach:**
  Provide resources to help all EV owners understand and benefit from load-shifting opportunities.