DOCKETED	
Docket Number:	22-EVI-04
Project Title:	Electric Vehicle Charging Infrastructure Reliability
TN #:	252762
Document Title:	EVgo Comments on Proposed EV Charging Infrastructure Reliability Regulation
Description:	N/A
Filer:	System
Organization:	EVgo
Submitter Role:	Public
Submission Date:	10/25/2023 3:42:36 PM
Docketed Date:	10/25/2023

Comment Received From: Noah Garcia
Submitted On: 10/25/2023
Docket Number: 22-EVI-04

EVgo Comments on Proposed EV Charging Infrastructure Reliability Regulation

Additional submitted attachment is included below.

October 25, 2023

California Energy Commission
715 P Street
Sacramento, CA 95814

Re: Docket No. 22-EVI-04 – Presentation of CEC's Proposed Regulations for EV Charger Inventory, Utilization, and Reliability Reporting

I. Introduction

EVgo appreciates the opportunity to submit comments on California Energy Commission's (CEC) Draft Staff Report on Regulations for Improved Inventory, Utilization, and Reliability Reporting (Draft Regulation). Founded in 2010, EVgo is a leader in charging solutions, building and operating the infrastructure and tools needed to expedite the mass adoption of electric vehicles (EVs) for individual drivers, rideshare and commercial fleets, and businesses. Since 2019, EVgo has purchased renewable energy certificates to match 100% of the electricity consumed on its network. As one of the nation's largest public fast charging networks with over 688,000 customer accounts, EVgo's owned and operated charging network includes more than 900 fast charging locations in over 60 metropolitan areas in over 30 states.

EVgo appreciates CEC's efforts to develop the Draft Regulation pursuant to Assembly Bill (AB) 2061 and shares the CEC's goal to support an enhanced customer experience for EV drivers in California. As the CEC notes in its draft AB 2127 report, the success of EV charging investments in California depends on their ability to successfully support EV drivers' charging needs. EVgo wholeheartedly agrees and appreciates CEC's holistic approach to understanding EV driver customer experience, which, as noted in the report, is the collective responsibility of many stakeholders, including but not limited to EV charging network providers, charging manufacturers, automakers, utilities, and payment processors.[1]

Further, EVgo appreciates CEC's intent to align with the National Electric Vehicle Infrastructure (NEVI) program, which includes robust targets for charger uptime, in the same way that California has sought to align other aspects of its programs with NEVI and its technical standards. Altogether, these efforts will aid in the development of a consistent, enhanced customer experience that extends across state lines.

While EVgo is aligned with California's efforts to enhance the EV driver customer experience, EVgo respectfully recommends the following as it relates to CEC's Proposed Regulations:

- Proposed utilization data collection efforts unrelated to AB 2061 should be bifurcated in a separate docket;

[1] Draft Regulation at 10-11.

- EVgo recommends CEC explore data sharing agreements with its sister agencies before imposing another data collection burden on electric vehicle service providers (EVSPs) and other obligated parties;
- EVgo strongly recommends that CEC strengthen data confidentiality provisions in the Draft Regulation;
- EVgo recommends that the CEC coordinate closely with industry to better understand charger downtime, especially related to vandalism and preventative maintenance;
- EVgo recommends that the CEC provide recordkeeping and reporting agents (RRAs) with the opportunity to provide input on the data templates used to submit semiannual reports; and
- To complement the Draft Regulation, CEC should also focus its programs on addressing root cause issues that affect the EV charging experience.

II. Proposed utilization data collection efforts unrelated to AB 2061 should be bifurcated in a separate docket

EVgo understands and appreciates the CEC's efforts to collect inventory and utilization data on the state's existing charging network. However, this proceeding was scoped specifically to address implementation of AB 2061 and the collection of associated reliability data.

In the CEC's January 31 Order Instituting Rulemaking (OIR) in docket 22-EVI-04, the CEC states that staff may:

- *develop uptime recordkeeping and reporting standards for EV chargers and charging stations;*
- *initiate a public workshop process to develop a definition of "uptime";*
- *create a formula to calculate uptime;*
- *evaluate additional reliability metrics;*
- *hold a public workshop in consultation with the California Public Utilities Commission (CPUC) to identify best practices and charger technology capabilities to increase reliability;*
- *develop standards for disclosing reliability data reporting requirements to participants in future publicly funded EV charger infrastructure programs; and*
- *develop requirements in consultation with the CPUC to increase charging station uptime, including, but not limited to, uptime requirements, operation and maintenance requirements, and operation and maintenance incentives.*[2]

EVgo posits that proposed regulations beyond those required by AB 2061 are outside the scope of this proceeding and should be addressed in a separate docket.

In particular, the collection of utilization data is plainly beyond the scope of this proceeding and is not referenced in the OIR. EVgo encourages CEC to realign the focus of the Draft Regulation on collecting relevant reliability data necessary to implement AB 2061.

[2] *Order Instituting Rulemaking,* Docket No. 22-EVI-04, California Energy Commission, filed January 31, 2023.

EVgo understands that the primary reason for the CEC's interest in collecting incremental utilization data from charging network operators in the Draft Regulation is to further assess the need for additional EV charging infrastructure required to meet state goals.[3] EVgo respectfully disagrees with staff's understanding of utilization information and how it can be used to help the state accurately account for charging infrastructure needs. Notwithstanding, this issue should be discussed in docket 19-AB-2127 and not in docket 22-EVI-04.

Furthermore, EVgo commends the CEC for its analysis of California's EV infrastructure needs in its latest draft AB 2127 report and maintains that the CEC has presented a realistic expectation of future EVSE demand even in the absence of comprehensive utilization data from charging network operators.[4] While California's EV market continues to rapidly accelerate, there remains a significant gap in the number of EVs and chargers needed to meet state goals. The CEC can continue to make no-regrets investments in a portfolio of charging solutions necessary to further drive transportation electrification at this early stage and continue to refine its strategy to evolve with market needs.

Finally, many CEC existing solicitations for EV charging infrastructure require the confidential submission of utilization data. The utilization data that CEC collects may already be a reasonable proxy for utilization expected at similar chargers across the state and encourages CEC to assess whether this data can adequately assist in estimating future EV charging needs. For these reasons, EVgo recommends that the CEC not collect additional charger utilization data at this time.

III. EVgo recommends CEC explore data sharing agreements with its sister agencies before imposing another data collection burden on electric vehicle service providers (EVSPs) and other obligated parties

All of the inventory data that the CEC proposes to collect in Section 3123(b)(2)(A-J) of the Draft Regulation is already required for submission to CARB and AFDC per CARB's EVSE Standards for publicly available EVSE in California.[5] To ease administrative burden, EVgo recommends that CEC and CARB establish a data sharing agreement for all relevant inventory data required by the Draft Regulation and not require RRAs to submit inventory data that is already reported to CARB and AFDC. RRAs can supplement this information on public EVSE by submitting additional required inventory data for private EVSE subject to the Draft Regulation.

The table below shows the overlap between the inventory data fields CEC is proposing with the data fields already required for reporting in the EVSE Standards.

[3] Draft Regulation at 6.
[4] https://efiling.energy.ca.gov/GetDocument.aspx?tn=252343&DocumentContentId=87357
[5] https://ww2.arb.ca.gov/sites/default/files/2020-06/evse_fro_ac.pdf

Table 1: Comparison of Draft Regulation Inventory Data Reporting Requirements with CARB EVSE Standard Reporting Requirements

Proposed CEC Data Field	Required Submission per CARB EVSE Standard
Charger address	**Yes**
Geographic coordinates	**Yes**
Model	**Yes**
Nameplate power	**Yes**
Serial #	**Yes**
Serial # of replacement (if applicable)	**Yes**
Power/connector type	**Yes**
# of connectors	**Yes**
Charger ID	**Yes**
Port ID	**Yes**
Primary use (public, fleet, etc.)	**Yes**

IV. EVgo strongly recommends that CEC strengthen data confidentiality provisions in the Draft Regulation

a. Section 2505

The Draft Regulation does not categorize the following data fields as confidential pursuant to Section 2505(a)(5)(b)(10)[6]:

> *Section 3123(b)(3)(A) For each charging port of a public and / or ratepayer funded charger, for the first six years after a charger is installed, the uptime data required by section 3124 of this Article.*
>
> *Section 3123(b)(3)(B)(4)The percentage of successful charging sessions for the reporting period relative to the total number of charge attempts for the reporting period.*

In other words, the Draft Regulation does not preclude the public disclosure of data pertaining to *per-port* uptime percentages or percentages of successful charging attempts on a *per-port basis*. EVgo strongly recommends that these data fields be automatically designated as confidential and included as protected data categories in Section 2505(a)(5)(b)(10) and proposes the following modifications to Section 2505(a)(5)(b)(10):

> *10. Information regarding a charger submitted pursuant to subsections section 3123(b)(2)(K), section 3123(b)(3)(A), section ~~or~~ (b)(3)(B)(1) through (b)(3)(B)(4~~3~~), or section 3125(b)(4), of Article 2 of Chapter 12.*

[6] Draft Regulation at 44.

EVgo's recommendations are summarized in the following tables with recommended modifications in red.[7]

Table 2: CEC-Proposed Reliability Data Reporting Requirements

Data Field	Level of Confidentiality	CEC Public Reporting Granularity
Uptime %	Public	Per-port
Total charging attempts	Confidential	County or census tract per EVSP
Successful charging attempts	Confidential	County or census tract per EVSP
Failed charging attempts	Confidential	County or census tract per EVSP
% of successful attempts	Public	Per-port

Table 3: EVgo Recommendations for Reliability Data Reporting Requirements

Data Field	Level of Confidentiality	CEC Public Reporting Granularity
Uptime %	**Confidential**	**Statewide Industry Average**
Total charging attempts	Confidential	**None**
Successful charging attempts	Confidential	**None**
Failed charging attempts	Confidential	**None**
% of successful attempts	**Confidential**	**Statewide Industry Average**

The Draft Regulations also propose that charger address, geographic coordinates, serial number, charger ID, and port ID can be designated as confidential information upon filing a request for confidentiality.[8] As noted above, charging network providers already provide this data to the California Air Resources Board (CARB) and the Department of Energy Alternative Fuels Data Center (AFDC) pursuant to CARB's Electric Vehicle Supply Equipment (EVSE) Standards for publicly available EVSE. It should be noted that unlike CEC's proposal, this information, including EVSE model data, is held confidentially by CARB.[9]

EVgo reiterates that CEC should seek to bifurcate inventory data reporting regulations in another docket and work with its sister agencies on data sharing agreements to obtain the data it feels is necessary to contribute to the AB 2127 report and other functions, and that this data is not necessary to support implementation of AB 2061. That said, if CEC does seek to collect this inventory data, data should remain confidential for all chargers subject to the regulation, as CARB has done. As drafted, making public information that CARB has chosen to keep confidential can put EVSPs at risk of being targeted by malicious actors that could misuse inventory data – including EVSE model data – in a manner that threatens EV charger reliability.

[7] Different EVSPs have different data collection and reporting capabilities and it is unclear at this time whether the reliability data that CEC will collect pursuant to the Draft Regulation will be directly comparable across EVSPs.
[8] Draft Regulation at 43.
[9] https://ww2.arb.ca.gov/sites/default/files/2020-06/evse_fro_ac.pdf

EVgo's recommendations are summarized in the following tables with recommended modifications in red.

Table 4: CEC-Proposed Inventory Data Reporting Requirements

Data Field	Level of Confidentiality	CEC Public Reporting Granularity
Charger address	May be designated confidential	All non-residential chargers
Geographic coordinates	May be designated confidential	All non-residential chargers
Model	Public	All non-residential chargers
Serial #	May be designated confidential	All non-residential chargers
Serial # of replacement (if applicable)	May be designated confidential	All non-residential chargers
Charger ID	May be designated confidential	All non-residential chargers
Port ID	May be designated confidential	All non-residential chargers

Table 5: EVgo Recommendations for Inventory Data Reporting Requirements

Data Field	Level of Confidentiality	CEC Public Reporting Granularity
Charger address	**Automatic confidential designation**	**None**
Geographic coordinates	**Automatic confidential designation**	**None**
Model	**Automatic confidential designation**	**None**
Serial #	**Automatic confidential designation**	**None**
Serial # of replacement (if applicable)	**Automatic confidential designation**	**None**
Charger ID	**Automatic confidential designation**	**None**
Port ID	**Automatic confidential designation**	**None**

b. Section 2507

The Draft Regulation proposes to add the following text to Section 2507 of the California Code of Regulations[10]:

> *(D) Confidential data provided pursuant to section 3123(b)(2)(K) or (b)(3)(B)(1) through (b)(3)(B)(3), or section 3125(b)(4), of Article 2 of Chapter 12 may be disclosed in the following manner:*
>
> *1. For an individual charging network provider or charging station operator, data aggregated at the county or census tract level by year and customer sectors.*
> *2. For the sum of all charging network providers or charging station operators, data aggregated at the county or census tract level by year and customer sectors.*

[10] Draft Regulation at 45.

EVgo does not support the inclusion of this language and maintains that all data designated as confidential should remain confidentially held by the CEC. The Draft Regulation does not provide a public policy rationale for publicly disclosing confidential and commercially sensitive information. Moreover, the Draft Regulation does not explain the circumstances that would trigger the public disclosure of confidential information, nor does it describe the manner or format in which the data would be released. The uncertainty surrounding the release of this data creates material business risks for charging network operators and increases concerns about the misuse of confidential information. Ultimately, confidential data disclosure does not support the CEC's core goals of enhancing the customer experience for EV drivers, as is the goal of AB 2061, or assessing EV charging infrastructure needs, which should be discussed in a separate docket.

V. EVgo recommends that the CEC coordinate closely with industry to better understand charger downtime, especially related to vandalism and preventative maintenance

EVgo appreciates CEC's alignment with NEVI requirements. Where the Draft Regulation goes beyond NEVI, such as addressing topics related to vandalism or preventative maintenance, EVgo recommends that CEC work closely with station operators to better understand causes for charger downtime and potential safety issues related to putting a charging station back online as requested by the timeline proposed by the CEC (e.g., after a vandalism event). Similarly, CEC should work closely with EVSPs to better understand preventative maintenance and how it improves the resiliency of EV charging networks in the state to avoid unintended consequences. For example, the Draft Regulation's stringent vandalism response time requirements may have the unintentional consequence of discouraging charger development and EV adoption in areas that experience high levels of vandalism and equipment damage. Similarly, the two-week notice requirement for preventative maintenance may deter such activities that are key to the resilience of charging networks. EVgo understands the spirit of these requirements, but CEC staff should seek to better understand these nuances in more detail.

VI. EVgo recommends that the CEC provide recordkeeping and reporting agents (RRAs) with the opportunity to provide input on the data templates used to submit semiannual reports

The Draft Regulation states that the CEC will provide templates for RRAs to submit semi-annual data reports. EVgo recommends that the CEC provide RRAs with the opportunity to provide input on the final design of the templates to ensure data can be efficiently collected and reported in accordance with the final regulation.

VII. To complement the Draft Regulation, CEC should also focus its programs on addressing root cause issues that affect the EV charging experience

The data being collected in the Draft Regulation pursuant to AB 2061 is an important starting point for the CEC to gain greater understanding of why charging sessions may fail and the role state government can play in addressing root cause issues that will benefit the full EV ecosystem and propel EV adoption. EVgo encourages the CEC to continue coordinating with EVSPs and other stakeholders to address root cause issues that affect the charging experience, such as codes and standards development and vehicle

interoperability. These efforts to enhance the charging experience are bolstered by parallel efforts to improve charger reliability at the federal level and within EVgo.
At the federal level, for example, the Joint Office of Energy and Transportation (JO) recently established the National Charging Experience Consortium (ChargeX) comprised of nearly 30 leading industry, non-profit, and government stakeholders to improve the EV charging experience for consumers.[11] Codes and standards improvements are a major focus of this effort, and in September 2023, ChargeX released a new report recommending 26 minimum required error codes that the EV charging industry could adopt to better identify and address root causes of customer experience challenges – including issues stemming from vehicle or customer education errors.[12] Vehicles and charging equipment both lack standardization in this regard, and minimum error codes could propel the industry forward and allow EVSPs, vehicle OEMs, and charging equipment manufacturers alike to more quickly diagnose root cause issues and develop solutions.

EVgo encourages the state, as a national leader in EV adoption, to undertake efforts that are complementary to ChargeX to adopt a similar strategy and take a comprehensive approach to resolving the root causes of charging experience issues at the intersection of vehicles, chargers, and customer education. Concepts like Charge Yard and VOLTS, for example, should be accelerated. EVgo's Innovation Lab and customer experience teams recently developed a number of industry-wide best practices and codes that we hope will be a valuable resource to the EV ecosystem and state governments, and we continue to elevate a number of these solutions through the ChargeX Consortium, CharIN, codes and standards bodies, and a number of other outlets.[13] These best practices are attached to these comments.

In addition to EVgo's work to promote industry-wide solutions, EVgo also recently announced important progress on network enhancements made as part of the ReNew™ program.[14] Notable highlights include:

- In the first two quarters of 2023, EVgo upgraded, replaced, or decommissioned legacy equipment at more than 120 stalls in key markets across the U.S., bringing its cumulative total to over 350 DCFC stalls nationally since the start of 2022.
- 95% of all new EVgo stations include at least four fast charging stalls, with more than 40% of stations under construction featuring 6+ stalls.
- Nearly all EVgo stations operationalized year to date in 2023 feature high-power 350kW fast chargers to satisfy customer demand and futureproof the network.
- EVgo performed annual preventative maintenance and health checks on more than 1,500 stalls since the start of 2022.
- Cut the average station repair time in half over the last 12 months.
- EVgo's goal is to achieve One & Done success rates of more than 95% by the end of 2023, and EVgo has already improved six percentage points over the first six months of the year.

[11] https://driveelectric.gov/chargex-consortium
[12] https://inl.gov/content/uploads/2023/07/ChargeX_MREC_Rev5_09.12.23.pdf
[13] https://site-assets.evgo.com/f/78437/x/9048a036b5/connect-the-watts_charger-reliability-best-practices_vfw.pdf
[14] https://www.evgo.com/press-release/evgo-advances-network-enhancements-through-evgo-renewtm-program-releases-best-practices-to-promote-greater-industry-wide-charger-reliability/

VIII. Conclusion

EVgo appreciates the opportunity to provide comments and recommendations on the CEC's Draft Regulation. Ultimately, the focus of the Draft Regulation must center on implementation of AB 2061 and enhancing the customer experience to support California meeting its ambitious goals for EV adoption and decarbonization of the transportation sector. EVgo understands that customer experience is paramount to bolstering consumer confidence to drive EV adoption and shares California's goals for a convenient, reliable statewide charging network. We look forward to working with the CEC as a national leader and model in transportation electrification to see through the implementation of AB 2061 and to dive deep into resolving root cause issues that will propel the nascent EV industry forward. We respectfully encourage the CEC to adopt the recommendations identified in these comments in the final regulation.

Respectfully submitted this 25th day of October,

Noah Garcia
Manager, Market Development and Public Policy
EVgo Services, LLC
11835 W. Olympic Blvd., Suite 900E
Los Angeles, CA 90064
Tel: 310.954.2900
E-mail: noah.garcia@evgo.com

EVgo FAST CHARGING

CONNECT THE WATTS™ POWERED BY EVgo

Best Practices for Enhancing Network Reliability & Customer Experience

Charger Reliability Solutions

A convenient, reliable, and seamless charging experience is necessary to bolster consumer confidence in electric vehicles (EVs) and propel the massive market transformation needed to decarbonize our transportation system. As part of EVgo ReNew™, a comprehensive maintenance program designed to improve uptime and enhance the customer experience, EVgo seeks to address not only reliability, but also "One & Done" success rates, or the percentage of time a customer has a successful charging experience on their first try. With data from hundreds of thousands of charging sessions on the EVgo network each month, EVgo has found that charging attempts can be unsuccessful for a variety of reasons associated with the vehicle, the charger, the driver, or a mix of all three. No matter the reason, an unsuccessful charge attempt is frustrating, and EVgo is committed to resolving all charging issues to ensure drivers have the best charging experience possible.

Solutions to address root causes of reliability and unsuccessful charge events will require the entire ecosystem to work together, including EV charging equipment manufacturers, automakers, and electric vehicle service providers (EVSPs) like EVgo. Based on its decade plus of experience building, owning, operating, and maintaining a nationwide fast charging network, coupled with the technical expertise at its Innovation Lab in El Segundo, CA, EVgo has identified the following best practices to maximize fast charger reliability for the Connect the Watts™ community:

1) Standardize Error Codes Across Both Charging Equipment and Vehicles, 2) Incorporate Vehicle Interoperability Testing with EVSPs Prior to Sale of New EVs, 3) Allow More Time for Charging Session Authentication Before Time Out, 4) Strengthen Safety Standards and Prioritize Compliance, 5) Establish Safety Standards for Charging Adapters, 6) Standardize Vehicle Port Location, 7) Extend Preventative Maintenance to Components, 8) Encourage Suppliers to Prioritize Replacement Part Availability to Support Shorter Repair Timelines, and 9) Build Fault Tolerance and Resilience Into the Charging Process.

Standardize Error Codes Across Both Charging Equipment and Vehicles

Best Practices:

- Currently, error codes for charging infrastructure vary widely across charging equipment manufacturers, automakers, and subsequently, charging networks. To encourage standardization, EVgo published recommended minimum required error codes to encourage standardization.
- Through uniform error codes, that uniquely and correctly identify issues, charging networks will be able to better diagnose problems and institute solutions to enhance customer experience.

Incorporate Vehicle Interoperability Testing with EVSPs Prior to Sale of New EVs

Best Practices:

- Some charging reliability root causes originate with the vehicle and can only be resolved by close collaboration with automakers to strengthen vehicle and charger interoperability. EVgo invites all automakers to participate in interoperability testing at its full service Innovation Lab before their vehicles go to market. If firmware updates or other changes are needed once vehicles are in operation, automakers should be proactive and contact EVSPs to diagnosis and treat any potential charging issues.
- Other sample vehicle interoperability best practices include compatibility with both DIN 70121 and ISO 15118-2 charging standards, enabling drivers to utilize Autocharge+, proper inlet locking and unlocking behavior, and more.

Allow More Time for Charging Session Authentication Before Time Out

Best Practices:

- Standards that apply to both charging equipment and vehicles require a charging session to "time out" if too much time passes between the time when a customer plugs the connector into their vehicle and session initiation. For example, DIN 70121 specifies 150 seconds, and ISO 15118-2 only specifies 60 seconds, which is an insufficient amount of time for an EV driver, especially a new driver, to start a charge. After expiration, the connector must be unplugged and then re-plugged into the vehicle to initiate a charge. Amending these standards to allow customers up to five minutes before timing out would provide EV drivers with the time needed to initiate a session, regardless of their preferred payment method. And, as new EV drivers use public fast charging for the first time, a longer timeout window would contribute to a more positive customer experience.
- EVgo's Autocharge+ feature, which allows EV drivers to seamlessly initiate a charging session by simply plugging their vehicle into an EVgo fast charger, bypasses the time out issue completely, bolstering charging success rates and streamlining the customer experience by removing separate identification and payment authorization.

Strengthen Safety Standards and Prioritize Compliance

Best Practices:

- All chargers deployed by EVgo are UL certified and must pass rigorous safety, interoperability and reliability testing at the EVgo Innovation Lab before installation.
- While public funding programs commonly require chargers to be certified by a United States Occupational Health and Safety Administration's Nationally Recognized Testing Laboratory (OSHA NRTL) like UL, enforcement is not as common and should be a priority, as some charging equipment in the field today operates outside of compliance with existing standards, which impacts reliability and could pose a safety risk.
- Safety standards should be expanded to be more comprehensive. For example, the UL standard requires a latch to ensure the connector remains locked in the car's charging port but does not require redundant safety features beyond the latch. Because the latch is a common point of failure, this may create a safety risk for drivers if those features are not added voluntarily.
- Additionally, these standards will need to be extended to cover North American Charging Standard (NACS) connectors for charging equipment.

Establish Safety Standards for Charging Adapters

Best Practices:

- Adapters that enable access to both CCS and NACS chargers are likely to become more common as automakers adopt the NACS for non-Tesla vehicles. California's Advanced Clean Cars II rule, adopted by a myriad of other states, soon will require that non-CCS vehicles be equipped with a CCS adapter off the lot.
- As adapters become more common, regulations are needed to ensure that adapters meet safety standards, and to prevent the usage of unverified third-party adapters, which may create safety risk for EV drivers and their vehicles as well as impact charging session success rates. Organizations like UL, SAE and IEC should develop more robust safety standards for charging adapters that can be applied by third-party labs.

Standardize Vehicle Port Location

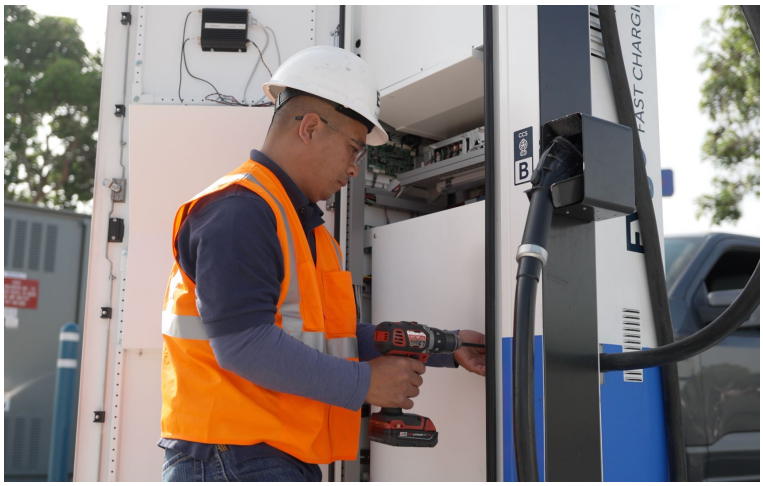
Best Practices:

- Charging stations today must be designed to meet the needs of five different charging port locations on various vehicle models and sizes, meaning charging cables need to be longer—and therefore heavier—to meet all vehicles' charging needs.
- Heavier and longer cables are more likely to be dropped and damaged by EV drivers, increasing the need for repairs. They also require more materials, making them a target for vandalism and decreasing efficiency of charging. Greater standardization of port location across vehicle models, similar to internal gasoline fuel inlets, can simplify station design and improve customer experience, especially for drivers with disabilities.

Extend Preventative Maintenance to Components

Best Practices:

- At a minimum, EVSPs should comply with the manufacturer's requested preventative maintenance schedule to ensure the resilience of their respective networks. However, manufacturer-provided preventative maintenance should be expanded to include specific components, such as cables, connectors, or retractors. The maintenance schedule should also closely align with the actual failure rates in the field for these components to ensure that they are proactively remedied.



Encourage Suppliers to Prioritize Replacement Part Availability to Support Shorter Repair Timelines

Best Practices:

- The time needed to repair a charger depends greatly on whether any new parts are required, and subsequent inventory management to ensure such parts are available. Tracking the failure rates of parts helps to bolster the resilience of a network so that charging network providers and charging equipment manufacturers may predict how often a part might fail and stock inventory accordingly.
- In recent years, inventory management has been impacted by supply chain constraints and resulted in longer lead times for replacement parts. Manufacturers should focus on ramping up production to meet the growing demand.

Build Fault Tolerance and Resilience Into the Charging Process

Best Practices:

- Today, there are multiple factors that can lead to unsuccessful first attempt charging sessions, and more will be discovered in the future of this complex process. Thus, it is best to monitor the process at the micro level to detect where issues arise, and whenever possible, correct them system wide. At a minimum, EVSPs should provide drivers with reasons for charging session initiation issues and steps to correct the error where possible.
- Examples of built-in fault tolerance and resilience include better detection of protocol timeouts or payment failures and development of auto-retry techniques to correct the issues without driver intervention.