Evaluating EV Charger Reliability and Performance

VIRTUAL CHARETTE SUMMARY REPORT

American Association of State Highway and Transportation Officials
AASHTO

NASEO
National Association of State Energy Officials

ATLAS PUBLIC POLICY

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Acknowledgements

The authors would like to thank charette participants who shared their experiences and perspectives, including: Dylan Armstrong [EV Connect], Kandee Bahr Worley [NDOT], Gilbert Botham [NJDEP], Ben Chilcoat [ICF], Rupener Dahiya [FDOT], Andrew Dick [Electrify America], Julia Gold [National Grid], Peg Hanna [NJDEP], John Kodi [FDOT], Dan McMartin [Opinion Dynamics], Matt Mines [CEO], Bill Nguyen [ICF], Tom Ostapchuk [EV Connect], Mikael Pelfrey [KYTC], Hilary Polis [Opinion Dynamics], Raj Ponnaluri [FDOT], Jennifer Robertson [NYDPS], Adam Ruder [NYSERDA], Thomas Santori [Xcel Energy], John Smart [INL], Jeff Springer [Dairyland Power Cooperative], Kara Symonds [WSDOT], Alexa Voytek [TDEC], Francesca Wahl [Tesla], and Jesse Way [NESCAUM], as well as representatives from EVgo, the National Association of State Energy Officials (NASEO), the American Association of State Highway and Transportation Officials (AASHTO), and the Joint Office of Energy and Transportation.

This report was authored by Kelsey Blongewicz, James Di Filippo, and Sophie Latham of Atlas Public Policy in 2023.

Disclaimer

While the contents of this report were informed by discussion among the acknowledged individuals and organizations, nothing is solely attributable to any single participant. Furthermore, participation in the charrette does not imply endorsement of any of the content or conclusions found in this report. Any errors are the sole responsibility of the authors.

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The material is based upon work sponsored by the Department of Energy under Award Number DE-EE0010189. The contents are intended for informational purposes only. The authors are solely responsible for errors and omissions.

Charrette Background

As electric vehicle (EV) adoption accelerates and more drivers interact with public charging infrastructure, issues surrounding the reliability and performance of charging stations have become a common topic in the media and an increasing concern for government funded-programs. Among those funding programs are the National Electric Vehicle Infrastructure (NEVI) program and the Charging and Fueling Infrastructure (CFI) discretionary grant program, which incorporate reliability and performance requirements into program rules.

Despite these rules and widespread agreement of the importance of ensuring reliability and performance of charging equipment, there are no established processes for measuring, verifying, and evaluating charger reliability or performance for states and direct recipients of NEVI and CFI funds to use to meet federal requirements. Moreover, there are substantial challenges to implementing such processes including:

Reporting data from charging networks has historically not included sufficient detail to effectively infer charger reliability or performance.

Charging networks and operators often lack visibility to charger outages caused by physical damage or obstruction.

Charger performance is often opaque to users and factors such as vehicle battery state of charge or ambient temperature can impact charger performance.

Measurement and verification that involves site visits or complex data processing can be expensive and may increase user costs or detract from program budgets.

In an effort to identify processes for measuring, verifying, and evaluating charger reliability and performance, the National Association of State Energy Officials (NASEO) and the American Association of State Highway and Transportation Officials (AASHTO) convened an online *Evaluating EV Charger Reliability and Performance Charrette* on June 13, 2023. The charette was facilitated by Atlas Public Policy staff, and invited participants included a balanced representation of stakeholders from the EV charging industry, state and federal government agencies, including State Energy Offices and State Departments of Transportation, utilities, and consulting firms. The key findings and next steps identified by participants focused on identifying processes, methods, and metrics to measure, validate and evaluate EV charger reliability and performance in an efficient, fair, and cost-effective manner.

The working definitions of reliability and performance used to guide the discussion at the charrette are consistent with requirements for the NEVI program and are as follows:

Reliability: The EV charger is functional and able to charge user vehicles consistently with minimal outages or failures and within specified performance parameters.[1]

Performance: The EV charger delivers the amount of power requested by the user vehicle, up to the rated capacity (maximum capability) of the charger hardware and power supply.[2]

Key Takeaways

Throughout the discussion, several common themes emerged and were generally agreed to by the participants. These themes were identified during the charette and highlighted as key takeaways during the wrap-up portion of the agenda.

1. Data on performance is obtainable (but is not standardly reported by charging equipment). Moreover, a methodology needs to be developed to ensure performance data can be clearly and consistently reported in a summary format. Previous reporting efforts have consolidated power delivery messages that are part of the standard Open Charge Point Protocol (OCPP) charging information into summary measures on peak power use, but a metric that compares vehicle-requested power to provided power and power capacity is needed to fairly and accurately measure charger performance.

2. The award recipient should be responsible for calculating and reporting uptime according to NEVI guidance and states should have methods to verify that data. There is no perfect technological solution to measure and audit charger reliability, and doing so will likely require combining data from multiple sources, including remote monitoring (heartbeat), public charger APIs, site visits, and driver feedback.

3. Driver feedback is useful, particularly regarding the physical condition of the station. However, as with all user-reported data, driver feedback should be used with caution. Such feedback is most useful in the aggregate. User education is necessary for non-technical audiences to understand the difference between the potential power output of the charger and what the vehicle is receiving.

4. Consistency and standardization are critical to contain costs. Charging networks and other providers wish to avoid creating multiple reports based on unique state requirements or designs. Programs should strongly consider adopting standardized means of collecting and processing data, such as the *EV Charging Use Data Specification* (Box 1). Similarly, a common method for assigning and reporting error codes associated with a given session is important to reporting downtime and determining NEVI-granted exclusions.

Box 1. EV Charging Use Data Specification

The EV Charging Use Data Specification is an open-source project by Atlas Public Policy. It contains specific guidelines for collecting data from EV charging equipment for the purpose of program measurement, validation, and evaluation. The specification provides a standard framework and structure for reporting data along with additional guidance for EV charging program funders. For more information see: **https://evchargingspec.org/**

Charrette Discussion

During the charrette, participants were divided into two breakout rooms for in-depth discussion. These discussions were guided by pre-established questions surrounding key players, downtime and responsibility, costs, and measuring performance and reliability. To the greatest extent possible, participants were divided into groups to ensure a balance of perspectives was present in each breakout room.

KEY PLAYERS AND THEIR ROLES

Though individual roles vary, the key players in this effort are state Departments of Transportation (DOTs), State Energy Offices, regulators, electric vehicle service providers (EVSPs), electric utilities, station owners and operators, operations and maintenance subcontractors, and EV drivers. EVSPs are likely to do most of the data reporting and states should be responsible for data collecting. EVSPs are generally best suited to provide upkeep, data on uptime and downtime, and respond to customer input. Customers have a role to play in reporting issues with equipment, particularly physical damage, or vandalism, but it needs to be clear to whom these issues should be reported. In fact, roles and responsibilities should be defined for all key players, and, given that many parties work across state lines, consistency in reporting and fixing issues is critical to smooth functioning of the wider system.

DOWNTIME AND DIFFUSE RESPONSIBILITY

The NEVI Standards and Requirements Final Rule grants exclusions to uptime requirements for reasons beyond the control of the charging station operator, such as vandalism, natural disasters, or utility service interruptions. When presented with the full list of exclusions, state participants noted that they had experienced every issue. The spectrum of reasons that could cause downtime range from issues with the charger to vehicle fault to user error, all of which present unique challenges, solutions, and repair timelines. Whereas software issues are usually remotely identifiable and fixable, hardware issues require ordering parts and dispatching a repair technician. These wait times accounted for as much as 80 percent of downtime in some participants' experience. This raised questions as to what constitutes *temporary* according to NEVI. Similarly, there is little guidance around how to handle extended periods of excused downtime. For example, when a charger is offline due to vandalism, it is unclear how long it would be (if ever) before an unrepaired charger ceases to be excused from uptime requirements.

Regardless of the cause, participants agreed that the multitude of players involved, and disparate responsibility are some of the biggest challenges for resolving downtime and improving reliability. Many States are operating under the assumption that ensuring minimum downtime is their responsibility. Given that states rely on subcontractors, particularly for operations and maintenance, they need to be able to hold these parties accountable and enforce compliance so that they, in turn, can meet federal requirements for reporting downtime. Participants noted that while regulations place responsibility on states, it should be in the EVSPs (and owners/operators) best interest to provide reliable charging to ensure customer satisfaction and ultimately a viable long term business.

Some states have started identifying clear roles and responsibilities for keeping a station online and resolving downtime. There is a spectrum of tasks required to keep an EV charging station online, ranging from public-facing hardware and software maintenance to lower-profile responsibilities such as ensuring relationships with the utility or paying electricity bills. Given all the different parties responsible for these different tasks, as well as addressing different categories of downtime, clearly defined roles and responsibilities is critical.

CONTAINING COSTS

Attempts to minimize reliability compliance costs may come at the expense of the customer experience whereas additional expense meant to ensure reliability could ultimately be passed down to the customer. Either outcome could hinder uptake and threaten long-term viability of EVs. However, because lack of reliability is a threat to the industry and the market, some participants felt that higher costs could mean better quality in the long run. Moreover, part of the goal of NEVI is to give drivers confidence in charging access. Reliability issues would defeat that purpose meaning cost additions for improved reliability measurements could be an effective use of NEVI funding.

MEASURING PERFORMANCE

Drivers arrive at a charging station with expectations about its performance but it is not always obvious when or why a station does not meet its maximum potential power output. There are a variety of reasons for which maximum power might not be supplied. Some are the fault of the charging equipment or power supply, while others fall on the side of the vehicle, which may be limited in the maximum amount of power it can accept or the amount of power it can draw depending on the battery's state of charge. The exact cause is often not transparent to the driver. Two questions arose from this—how to measure performance and how to educate drivers on expected performance.

For the former, there was disagreement as to whether it should fall to the state or the station operator to track a station's performance. Ultimately, however, the biggest issue is with using the available data to inform a performance metric. While in use, chargers track vehicle-requested power and charger-supplied power as part of normal vehicle-charger communications. However, these data are not included in the standard messages communicated from the charger to the central charging management software through OCPP. This means that reporting on those data would require software updates to current charging hardware.[3] Moreover, these data are large, easily reaching into the billions of records for even a short reporting interval, making them unsuitable for direct reporting. In some cases, station providers record data on average or maximum power supplied for 15-minute intervals or over the course of a session. Although helpful information, neither is ideal for measuring or evaluating performance. Participants generally agreed on the need for a session-level metric that compares raw data on power requested and power supplied. A consistent way to calculate, aggregate, and report this metric needs to be defined.

Getting real time data to drivers is also important. One provider has been demonstrating that on the charger's display, giving drivers an understanding of what their car is requesting and what the station is dispensing. However, this is rare and most drivers do not understand the difference between power requested and dispensed, along with the power potential for the their vehicle or the charger. If drivers do not receive the maximum potential power output, they could view that as a failure of the station. Although a driver flag could be a first-level screening for station performance issues, it could also lead to misinformation which then

gets passed to states politicians, the media, and EVSPs. Some participants felt that a strong education campaign would be the best solution for those concerns, and most participants agreed that aggregated driver feedback could provide valuable additional information about charger performance.

MEASURING RELIABILITY

Charging network operators are able to remotely monitor the status of charging equipment which can be used as a basis for establishing when the charging equipment is 'up'. However, remote monitoring may not be adequate to assess the physical status of key equipment such as the user interface, cabling, or connector—each of which can render a charger inoperable if damaged. Moreover, even with limited remote monitoring data, it is challenging to use billions of remote monitoring records to create useful measures of reliability. Condensing data into timed intervals could be an effective way to use these data but many operators do not use or store these data currently and doing so for compliance purposes would require new software development.

Direct solicitation of driver feedback by the implementing agency can provide an additional, important data point, which may be particularly useful as a check to identify when chargers went down due to physical damage or other causes that remote monitoring does not detect. However, those from the EV charging industry urged caution in using driver feedback as a basis for any compliance determinations. Participants generally agreed that any driver feedback should be used in aggregate to detect patterns rather than an individual outage, and that such information should be considered a supplemental source of information. Industry participants noted that they currently scrape user supplied information from public reviews and records on platforms like Rate Your Charge or PlugShare.

Ideally, any system adopted should be consistent across jurisdictions so that charging networks do not need to develop custom software or reporting processes for several programs as they set up nationwide networks. States could spearhead this effort by selecting vendors for projects based on their ability to meet requirements for reliability reporting.

Next Steps

Participants agreed that hosting a charette with key stakeholders in the same room was a valuable use of time. There was rich discussion and several key takeaways. Actionable next steps were identified both to continue discussion as well as to make progress towards developing useful, consistent methods for measuring charger reliability and performance.

NASEO, AASHTO, and Atlas, in cooperation with State Energy Offices and State Departments of Transportation, will continue to host conversations with relevant stakeholders to facilitate the development of standardized methods for measuring reliability of federally funded chargers. Different perspectives and experiences are important to include as recommendations are made in NEVI implementation.

Developing a methodology to measure performance was a key takeaway from the charette. The raw data exist but calculation methods, accepted thresholds, and reporting format need to be developed and standardized.

References

1 23 CFR 680.116(b) Minimum uptime. States or other direct recipients must ensure that each charging port has an average annual uptime of greater than 97%. (1) A charging port is considered ‘‘up’’ when its hardware and software are both online and available for use, or in use, and the charging port successfully dispenses electricity in accordance with requirements for minimum power level

2 23 CFR 680.106(d) Power level. (1) DCFC charging ports…must have a continuous power delivery rating of at least 150 kilowatt (kW) and supply power according to an EV’s power delivery request up to 150 kW, simultaneously from each charging port at a charging station.

3 During the charrette, some participants suggested that these data were already being transferred to providers. During review of this report, it came to our attention that, while some equipment might be transmitting these data, the OCPP only requires charging equipment to transmit data on the power it is delivering.

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