SURFACE VEHICLE INFORMATION REPORT

J2836™/5 MAR2026

Issued 2015-05
Revised 2026-03

Superseding J2836/5 DEC2021

(R) Use Cases for Customer Communication for Plug-In Electric Vehicles

RATIONALE

Electric vehicle (EV) sales account for a rapidly growing portion of the light-duty vehicle market. However, the growth of EV adoption is inherently tied to the reliability and usability of public EV charging. Today, customers of public charging stations, EV drivers, frequently encounter problems, such as lengthy wait times, trouble starting charging sessions, and slow charging speed. It is crucial for the EV charging industry to understand and address these issues to improve the customer experience and ensure a continuing upward trend in EV adoption. This update intends to include material in the ChargeX Consortium's Working Group 1: Defining the Charging Experience into this SAE Technical Information Report.

TABLE OF CONTENTS

1. SCOPE 3
1.1 Purpose 3

2. REFERENCES 3
2.1 Applicable Documents 3
2.1.1 SAE Publications 3
2.1.2 IEEE Publications 3
2.2 Related Publications 4
2.2.1 SAE Publications 4
2.2.2 Connectivity Standards Alliance Publications 4
2.2.3 ChargeX Consortium Publications 4
2.2.4 ISO Publications 4

3. DEFINITIONS 5

4. CUSTOMER INTERFACE ARCHITECTURE 7

5. INTRODUCTION TO KPI 9
5.1 Customer Pain Points as the Basis for Key Performance Indicators 9
5.2 Key Performance Indicators 10
5.2.1 Core Set of KPIs 10
5.2.2 Ideal Set of KPIs 11

6. USE CASE SUMMARY 12
6.1 Use Case: U8 - Customer Convenience Functions 13
6.2 Use Case: U9 - Conflict and Resolution 21
6.3 Use Case: U10 - Core KPI 22
6.4 Use Case: U11 - Ideal KPI 26

7. NOTES 30
7.1 Revision Indicator 30

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2026 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 1-877-606-7323 (U.S. and Canada only)
Tel: 1-724-776-4970 (outside U.S. and Canada)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/J2836/5_202603/

Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

Figure 1 Customer communications interface architecture 7
Figure 2 Defining the charging experience 9
Figure 3 Core set of KPIs 11
Figure 4 Ideal set of KPIs 12
Figure 5 Use case structure and relationships 12

Table 1 Summary of use cases and scenarios 13
Table 2 U8 Scenario A - Customer convenience functions: Customer remote start/stop charging 13
Table 3 U8 Scenario B - Customer convenience: Cabin conditioning 15
Table 4 U8 Scenario C - Customer convenience: Charge status information 16
Table 5 U8 Scenario D - Customer convenience: Setting customer preferences 17
Table 6 U8 Scenario E - Customer convenience: Public charging - Locate and reserve EVSE 18
Table 7 U8 Scenario F - Customer convenience: Public charging - Energy usage history 19
Table 8 U9 Scenario A - Conflict and resolution 21
Table 9 U10 Scenario A - Charge start success 22
Table 10 U10 Scenario B - Charge start time 23
Table 11 U10 Scenario C - Charge end success 24
Table 12 U10 Scenario D - Session success 25
Table 13 U11 Scenario A - Location accuracy 26
Table 14 U11 Scenario B - Wait time 27
Table 15 U11 Scenario C - Extended charge time 28
Table 16 U11 Scenario D - First-time session success 29
Table 17 U11 Scenario E - Visit success 30

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

1. SCOPE

This SAE Information Report establishes the Use Cases for communications and customer-focused Key Performance Indicators (KPI) between plug-in electric vehicles (PEVs) and their customers. The Use Case Scenarios define the information to be communicated related to customer convenience features for charge on/off control, charge power curtailment, customer preference settings, charging status, electric vehicle supply equipment (EVSE) availability/access, and electricity usage, plus customer information resulting from conflicts to charging preferences. It also addresses the KPI that can provide a uniform set of metrics to quantitively assess the charging experience. This document only provides the Use Cases that define the communications requirements to enable customers to interact with the PEV and the KPI to optimize their experience with charging a PEV. Specifications such as protocols and physical transfer methods for communicating information are not within the scope of this document.

1.1 Purpose

The purpose of SAE J2836/5 is to provide a technical information report documenting the Use Cases and requirements to support the development of the SAE J2847 series.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

SAE J1715	Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology
SAE J1772	SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler
SAE J2836/1	Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
SAE J2836/4	Use Cases for Diagnostic Communication for Plug-in Electric Vehicles
SAE J2847/5	Communication Between Plug-In Vehicles and Customers
SAE J2931/4	Broadband PLC Communication for Plug-in Electric Vehicles
SAE J3400	North American Charging System (NACS) for Electric Vehicles

2.1.2 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 2030.5-2018	IEEE Standard for Smart Energy Profile Application Protocol

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Information Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

SAE J2836/2 Use Cases for Communication Between Plug-in Vehicles and Off-Board DC Charger

SAE J2836/6 Use Cases for Wireless Charging Communication for Plug-in Electric Vehicles

SAE J2847/1 Communication for Smart Charging of Plug-in Electric Vehicles Using Smart Energy Profile 2.0

SAE J2847/2 Communication Between Plug-in Vehicles and Off-Board DC Chargers

SAE J2847/3 Communication for Plug-in Vehicles as a Distributed Energy Source

SAE J2931/1 Digital Communications for Plug-in Electric Vehicles

2.2.2 Connectivity Standards Alliance Publications

Available from Connectivity Standards Alliance, 508 2nd Street, Suite 109B, Davis, CA 95616, https://csa-iot.org.

Smart Energy Profile 2.0 Marketing Requirements Document

Smart Energy Profile 2.0 Technical Requirements Document

Smart Energy Profile 2.0 Application Protocol Specification

2.2.3 ChargeX Consortium Publications

Copies of these documents are available online at https://inl.gov/chargex/chargex-publications.

Customer-Focused Key Performance Indicators for Electric Vehicle Charging

Implementation Guide of Customer-Focused Key Performance Indicators for Electric Vehicle Charging

2.2.4 ISO Publications

Copies of these documents are available online at www.iso.org/store.

ISO 15118-2:2014 Road Vehicles - Vehicle to Grid Communication Interface - Part 2: Technical Protocol Description and Open Systems Interconnections (OSI) Layer Requirements

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

3. DEFINITIONS

This document builds on the Use Cases in SAE J2836/1 and should be considered an augment to that document for purposes of defining the customer interaction and information requirements for enabling PEV integration with the smart grid. Terms that are first introduced in this document or that are particularly relevant to customer interaction with the PEV for charging information and smart charging controls are defined in this section. Please refer to SAE J2836/1 and SAE J1715 for the definition of other terms. Additionally, in the customer interface architecture diagram (see Figure 1), there are terms relative to standard protocols and physical mediums that are defined in SAE J2931/4 and in the Connectivity Standards Alliance publications.

3.1 CHARGER

A functional component that can be located on or off the vehicle that supplies electrical power at the correct voltage and current levels for battery charging.

3.2 CUSTOMER-FOCUSED KPI

Metrics that define the charging experience from the perspective of the customer, called customer-focused KPI, a data-driven and measurable approach to understand customers' pain point and to systematically improve the EV charging experience.

3.3 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

This is the generic term used to describe the device that is physically connected and provides energy to the vehicle. EVSEs may take several physical forms, and their logical function may likewise differ substantially. Physical forms include a mobile cordset used for 120 VAC charging, a fixed or wall-mounted 240 VAC charger, or an off-board DC charger. An EVSE may also support reverse power flow (discharging).

3.4 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) NETWORK PROVIDER

The EVSE network refers to the back-office communications system developed or employed by the EVSE product companies to monitor and control their installed network of EVSEs. EVSE network providers have the capability to interface with utility DRMS and facility energy management systems to provide demand response and aggregation services. Customers may subscribe to the EVSE network and will be provided access to charge status data, historical charge data, energy consumption data, etc., through a web portal. EVSE network providers also have smartphone apps for communicating charge data directly to the customer.

3.5 ENERGY PORTAL

An energy portal is any charging point for a PEV. At a minimum, the energy portal is a 120 V, 15 A outlet but can also be a 240 V EVSE outlet connected to the premises circuit.

3.6 HOME AREA NETWORK (HAN)

A HAN is an energy related network contained within a premises used for communicating with devices within the premises. HANs do not necessarily require connectivity outside the premises but may be connected to one or more external communication networks (e.g., utility AMI, Internet, cell phone network, etc.) using gateways, bridges, and interfaces.

3.7 INTEROPERABILITY

This is the condition where components of a system, relative to each other, can work together to perform the intended operation of the total system. Information interoperability is the capability of two or more networks, systems, devices, applications, or components to share and readily use information securely and effectively with little or no inconvenience for the user.

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

3.8 OPEN CHARGE POINT PROTOCOL (OCPP)

The open charge point protocol (OCPP) is an application protocol for communication between EV charging stations and a central management system, also known as a charging station network, like cell phones and cell phone networks. It is an open application protocol that allows EV charging stations and central management systems from different vendors to communicate with each other. It is in use by a large number of vendors of EV charging stations and central management systems all over the world.

3.9 OEM TELEMATICS SERVER

Automobile systems that combine global positioning satellite (GPS) tracking and other wireless communications for automatic safety and security information, navigation, entertainment, and diagnostics. OEMs are now implementing application programming interfaces (APIs) to their telematics servers that are compatible and interoperable with utility standard protocols for the purpose of exchanging data (via Internet protocols) to enable managed or smart charging functionality. Additionally, OEMs have developed smartphone applications for customers to be able to remotely receive real-time PEV charge status information and to set charging preferences based on available modes provided by the OEM.

3.10 OpenADR

Open automated demand response (OpenADR) is a utility industry standard protocol developed by the OpenADR Alliance. The typical use is to send information and signals to cause electrical power-using devices to be turned off during periods of high demand. Automated demand response consists of fully automated signaling from a utility, ISO/RTO, or other appropriate entity to provide automated connectivity to customer end-use control systems and strategies. OpenADR provides a foundation for interoperable information exchange to facilitate automated demand response.

3.11 PLUG-IN ELECTRIC VEHICLE

A plug-in electric vehicle (PEV) plugs into an energy portal at a premises to charge a vehicle. A PEV is also a battery electric vehicle (BEV) that relies only on electric propulsion. A PEV is also a plug-in-hybrid vehicle (PHEV), which also includes an alternative source of propulsion power.

3.12 SEP2

Smart Energy Profile 2.0 (SEP2) is a standard and interoperable protocol that connects smart energy devices in the home to the smart grid. The standard is designed to run over transmission control protocol/Internet protocol (TCP/IP) and is media access control (MAC) and physical layer (PHY) agnostic. A coalition of alliances had been formed (composed of Wi-Fi Alliance, Connectivity Standards Alliance, HomePlug Alliance, and HomeGrid Alliance) to develop the protocol and the certification testing processes. SEP2 is now an IEEE Standard (refer to IEEE 2030.5-2018).

3.13 SMART CHARGING

Smart charging describes a system in which PEVs communicate with the power grid to optimize vehicle charging or discharging rate with grid capacity and time of use cost rates. It also enables load management control of PEV charging for supporting regulation and ancillary services, as well as demand response programs.

3.14 UTILITY

Utility provides electrical energy and typically refers to a collection of systems that includes the customer information system (CIS), the advanced metering infrastructure (AMI), rates, and revenue. The utility makes available to PEV through the ESCI pricing tables or discrete events. The utility also supplies information such as tariff rate, interval for metered kWh consumption, and validation of PEV program for PEV ID, etc.

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

4. CUSTOMER INTERFACE ARCHITECTURE

This section is primarily for information purposes to provide an overview of the major networks and multiple alternatives for interfacing with the customer. The architecture reflects sources of control communications to the PEV and the flow of related information that can be made accessible to the customer directly from these sources or actors. The customer could receive elements of charging information from multiple sources depending on the specific actor and its role in managing or controlling PEV charging. The Use Case Scenarios depicted in 6.1 and 6.2 will incorporate aspects of this interface architecture.

The primary interfaces for customer to PEV communications and control are the PEV, EVSE, EVSE network, utility/EVSP, OEM telematics, and the premise EMS/HAN. The customer interface architecture diagram in Figure 1 delineates all the actors engaged in PEV to smart grid communications, depicts the optional communications paths and sources for customer information, and the possible interconnections and protocols between the communications devices and networks.

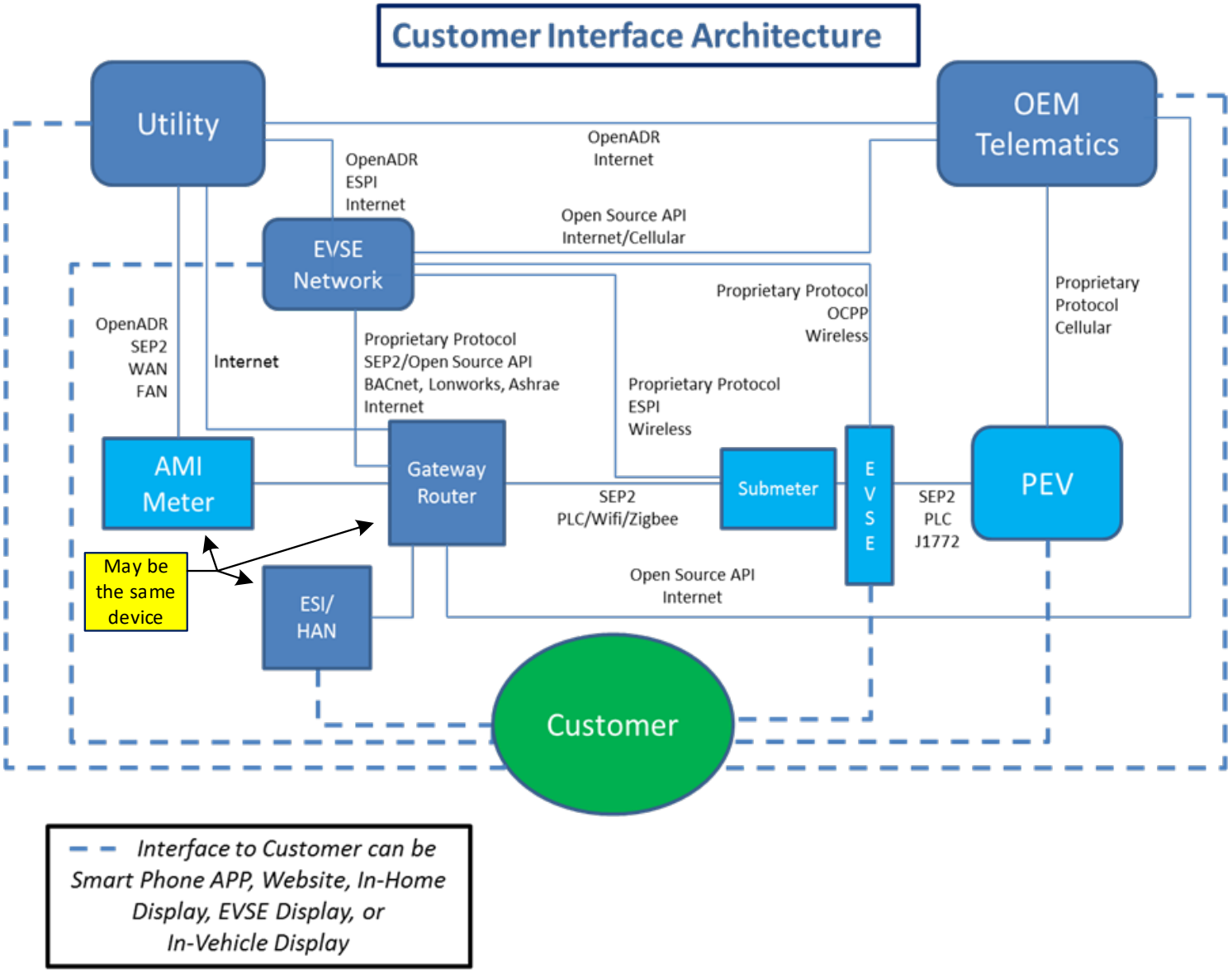


Figure 1 - Customer communications interface architecture

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

Figure 1, the architecture diagram, incorporates four structural communications control networks for processing of PEV load management commands and information related to intelligent charging of the PEV. The four structural communications control networks are described as follows:

1. Utility direct communications pass through the Advanced Metering Infrastructure (AMI) network or Energy Services Interface (ESI), through the Energy Management System (EMS)/Home Area Network (HAN) to the PEV via a PLC connection between the EVSE and the PEV. This supports utility AMI centric communications architectures whereby the utility desires direct control over PEV loads, especially in the residential environment. Alternatively, the utility can process the commands via the AMI or ESI network to the premise EMS/HAN, which is controlled by the premise owner.

2. Utility communications interface between the utility back end and the OEM telematics server, from the OEM telematics server directly to the PEV. Primarily facilitates aggregated utility demand response event requests and critical peak pricing event signals. It also enables utility capability to transmit EV rate tariff schedules for automated scheduling of PEV charging during the lowest priced time of day periods (TOU rates).

3. Customer controls charging information communications through the premise EMS/HAN directly to the PEV via a PLC connection between the EVSE and the PEV. Alternatively, the customer can control the information through the premise EMS/HAN to the EVSE network, which communicates to the PEV through a direct interface with the OEM telematics server. This facilitates the customer or premise owner direct control of PEV charging, especially in conjunction with the other non-PEV loads within the premise. EMS/HAN can interface with the utility AMI/ESI, the EVSE network, and/or the OEM telematics server.

4. Utility direct communications through the EVSE network to the PEV via a PLC connection between the EVSE and the PEV. The EVSE network may be able to process utility commands and information to the PEV through an interface to the OEM telematics server. This is not intended to be a prominent method of communications, but it may be required depending on the premise or facilities owner’s energy management strategy.

It is to be understood that the above-described network structures will be developed and commercially available over time.

There are implications with the architecture, one being there can be multiple sources for the same information. For instance, the interconnectivity between the submeter and the EVSE network, which is to reflect the California Public Utilities Commission’s (CPUC’s) third-party ownership business model for submeters. In this regard, the EVSE Network, if they own the submeter (embedded in the EVSE), is considered the data management owner and is responsible to provide the submeter data to the utility for customer billing purposes and thus controls the data source for PEV energy consumption. Alternatively, the PEV also measures the energy consumption data, but due to variability in the measurement accuracy, this data may not specifically agree with the energy consumption data from the utility or the EVSE network provider. A hierarchy of customer information sources may be required and are to be addressed within the applicable Use Cases. The customer may input information through various methods, and an authoritative device may need to be defined.

Another implication is the processing of customer preferences. There exists the potential for a customer to enter their charging preferences and settings through the EMS/HAN control display, the smartphone app to the PEV, manually via a digital keyboard at the EVSE, or through a smartphone app provided by the EVSE network. These customer interface points need to be synchronized to ensure the customer preferences and settings are unified through all the interfaces. It is recommended that the PEV should be the authoritative device to determine if the preference change is acceptable, i.e., departure time. The ratepayer has the ultimate control over power availability. The customer must receive notification of denial of power requests by the controlling charge host. There is the potential for conflicts in those environments where the owner of the premise EMS/HAN is not the same as the owner of the PEV. The criteria for conflict resolution may be dependent on the charging infrastructure environment based on the charge host restrictions and energy management policies.

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles

5. INTRODUCTION TO KPI

Electric vehicle (EV) sales account for a rapidly growing portion of the light-duty vehicle market. However, the growth of EV adoption is inherently tied to the reliability and usability of public EV charging. Today, customers of public charging stations, EV drivers, frequently encounter problems, such as lengthy wait times, trouble starting charging sessions, and slow charging speed. It is crucial for the EV charging industry to understand and address these issues to improve the customer experience and ensure a continuing upward trend in EV adoption.

To systematically improve the public charging experience, EV-charging-industry stakeholders need to define and measure it precisely. Many stakeholders currently measure aspects of the charging experience, but they typically employ metrics that are either operational in nature, such as charger uptime and mean time between failures, or composite customer-satisfaction indices. To improve the customer experience most effectively, the industry needs metrics that define the charging experience from the perspective of the customer, not business operations. Furthermore, industry practitioners need granular metrics to know what specific aspects of the charging experience need improvement and what data are needed to evaluate those metrics. This report defines such customer-focused metrics, called key performance indicators (KPIs).

Although charging station operators (CSOs) are often perceived as bearing the responsibility for the charging experience, many other stakeholders share this responsibility, including EV manufacturers, charger manufacturers, and electric-mobility service providers (EMSPs, i.e., third-party map and payment app developers). To effectively improve the charging experience, this ecosystem of interdependent companies must uniformly adopt common, customer-focused KPIs and measurement methods to ensure collective understanding. Additionally, no single stakeholder currently generates or has access to all data necessary to provide full visibility of the charging experience. Cross-industry coordination and innovation are required to achieve this. For these reasons, the ChargeX Consortium established Working Group 1: Defining the Charging Experience and published technical report “Customer-Focused Key Performance Indicators for Electric Vehicle Charging.” This group includes representatives from CSOs, charger manufacturers, EV manufacturers, EMSPs, field service providers, national laboratories, consumer-advocacy and non-profit organizations, and academia who specialize in EV charging customer research.

SAE J2836/5 documents the technical content of ChargeX report, aiming to promote developing and implementing of customer-focused KPIs in EV charging industry.

The benefit of adapting customer-focused KPIs includes:

- Provide industry a uniform set of metrics to quantitively assess the charging experience
- Segment the charging experience and identify areas of strength and areas to prioritize for improvement
- Validate claims about the charging experience
- Provide a method for gauging the effectiveness of new protocols, EVSE or EV modifications, etc., in improving the charging experience

5.1 Customer Pain Points as the Basis for Key Performance Indicators

To structure KPI development, six key components of the charging experience that represent major steps EV drivers take or experience to charge their vehicles at public stations were identified. These components are defined as in Figure 2.

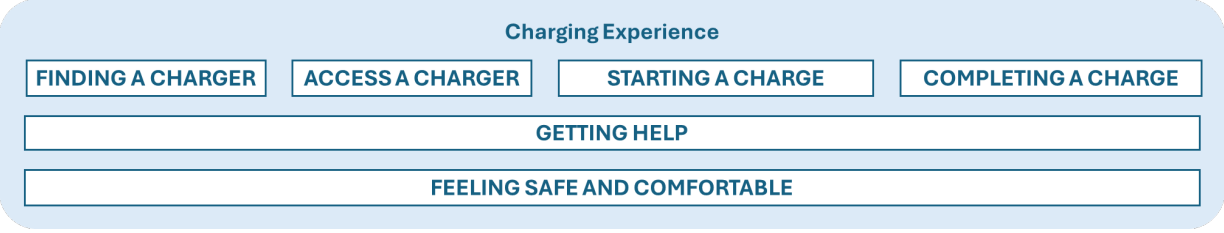


Figure 2 - Defining the charging experience

Documents
Document Sharing Hub
Full document details: SAE J2836/5 MAR2026 (R) Use Cases for Customer Communication for Plug-In Electric Vehicles