SURFACE VEHICLE INFORMATION REPORT

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Use Cases for Customer Communication for Plug-in Electric Vehicles

RATIONALE

PEV charging is very much different from refueling a conventional internal combustion engine vehicle where a customer inserts the gas pump nozzle and in several minutes the vehicle's gasoline tank is full. Standard refueling time for a PEV, especially at 120 V and 240 V charge levels, is several hours. The customer plugs in the EVSE connector and goes about their business for the next several hours, expecting the PEV will be fully charged upon their return. The payment approach is therefore also different, where it varies depending on the particular grid load at a particular time of day and could vary from weekdays to weekends. Payment for charging at residences is also different than at public charging locations. If a residence is a home, it may be merely an addition to the existing home energy bill; if it is a multifamily dwelling, it could be different since assigned parking may not be available; and if it is a rental, some agreements may or may not include electricity with the rent. Conversely, public locations may or may not be able to charge for the energy and may only add a fee to the parking fee at the EVSE to cover the cost of electricity. If the public location charges a fee for the parking spot or for the energy, there needs to be a means to include this, and any authorizations, for the customer. This document is being updated to include the recent documents now published for this payment function.

Customers need an awareness of the charging infrastructure conditions and their vehicle's charging features and capabilities to maximize the utilization of the vehicle for their transportation needs. PEV customers need to be able to remotely access information in the PEV about its charge settings and status, to adjust charging preferences as needed, and to activate the PEV customer convenience features such as cabin temperature pre-conditioning. They need access to charge point operators and/or e-mobility service suppliers and others as they utilize high power charging and need to address roaming and establishing priority, identify energy needs, etc., to a station from a few miles away to ensure they can obtain a charge and continue their journey as planned.

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1. SCOPE

This SAE Information Report SAE J2836/5 establishes the Use Cases for communications 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, EVSE availability/access, and electricity usage. Also addresses customer information resulting from conflicts to customer charging preferences. This document only provides the Use Cases that define the communications requirements to enable customers to interact with the PEV and to optimize their experience with driving 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 provide a technical information report documenting the Use Cases and requirements to support the development of SAE Recommended Practice SAE J2847/5.

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: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1715 Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology

SAE J2836/1 Use Cases for Communication between Plug-in Electric Vehicles and the Utility Grid

2.2 Related Publications

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

2.2.1 SAE Publications

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

SAE J1772 SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler

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 Resource

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

SAE J2931/4 Broadband PLC Communication for Plug-in Electric Vehicles

2.2.2 ZigBee Alliance Publications

These publications are available from ZigBee Alliance, 2400 Camino Ramon, Suite 375, San Ramon, CA 94583, www.zigbee.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

2.3 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

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

2.4 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

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 (Figure 1), there are terms relative to standard protocols and physical mediums that are defined in SAE J2931/4 and in the ZigBee 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 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

The PEV connects to the grid using an electric vehicle supply equipment (EVSE). EVSE is the physical electrical cord and connectors that are specified by applicable SAE standards (e.g., SAE J1772, SAE J2836, SAE J2847, and SAE J2931) that provide transfer of electrical energy from energy portal to PEV. This can be 120 VAC or 240 VAC, depending upon connection. Two types of connections include (1) EVSE cordset, and (2) premises mounted version. The premises EVSE would not include the charger for AC Level 2 energy transfer described in SAE J1772. This would expect the charger to be included on the vehicle. If the EVSE includes an off-board charger, DC energy transfer is expected and the vehicle would by-pass any on-board charger and use the one in the EVSE. This EVSE that includes the charger for DC Level 1 may also be capable of AC energy transfer at both 120 V (AC Level 1) and 240 V (AC Level 2) levels. The larger off-board charger in DC Level 2 systems is not expected to also deliver AC, since these are fast charge stations and extended time at this location is not desired since 10 to 20 minute charges are desired.

3.3 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 smart phone APPs for communicating charge data directly to the customer.

3.4 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.

3.5 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.

3.6 INTEROPERABILITY

This is the condition where components of a system, relative to each other, are able to 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.

3.7 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, similar to cell phones and cell phone networks. It is an open application protocol which 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.

3.8 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 smart phone 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.

3.9 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.

3.10 PLUG-IN ELECTRIC VEHICLE

Plug-in electric vehicle (PEV). Plugs into an energy portal (see actor definition below) at a premises to charge 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.

3.11 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, ZigBee Alliance, HomePlug Alliance, and HomeGrid Alliance) to develop the protocol and the certification testing processes. SEP2 is now an IEEE standard—IEEE 2030.5-2018.

3.12 SMART CHARGING

Smart charging describes a system in which PEVs communicate with the power grid in an effort 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.

3.13 UTILITY

Utility provides electrical energy and typically refers to a collection of systems that include 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.

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 5.1 and 5.2 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.

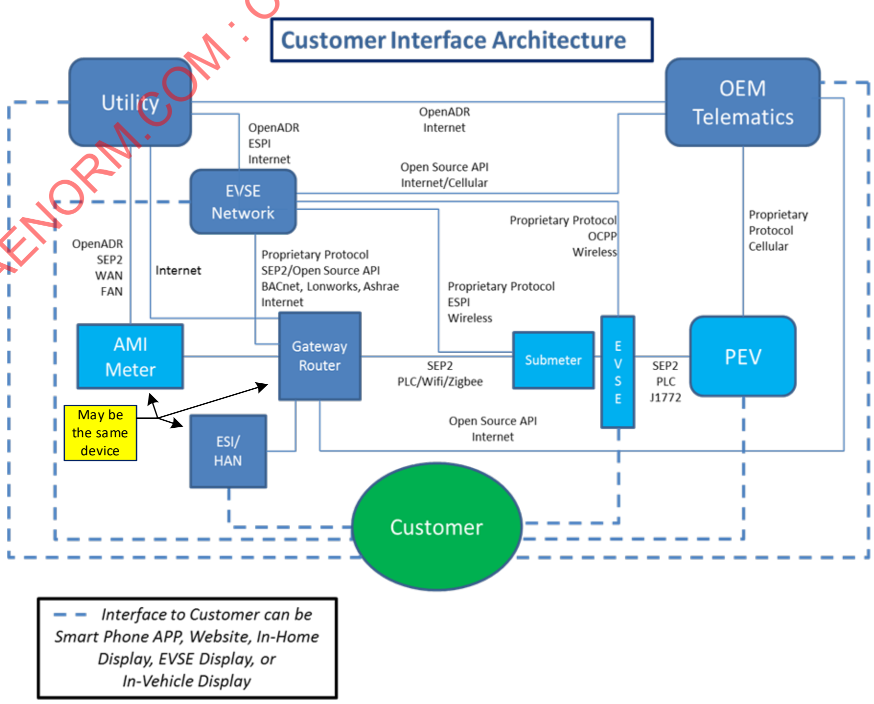

Figure 1 - Customer communications interface architecture

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 passes through the AMI network or ESI, through the EMS/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 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. Customer may input information through various methods and an authoritative device may need to be defined.

Another implication is the processing of customers preferences. There exists the potential for a customer to enter his charging preferences and settings through the EMS/HAN control display, the smart phone APP to the PEV, manually via a digital keyboard at the EVSE, or through a smart phone 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. Recommendation is the PEV should be the authoritative device to determine if the preference change is acceptable, i.e., departure time. Ratepayer has the ultimate control over power availability. 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.

5. USE CASE SUMMARY

There are two primary Use Cases applied to this recommended standard: Use Case U8 ("customer convenience") and Use Case U9 ("conflict and resolution"). Figure 2 delineates the overall Use Case structure with their related SAE document; and depicts the relationship of the U8 and U9 Use Cases within the structure.

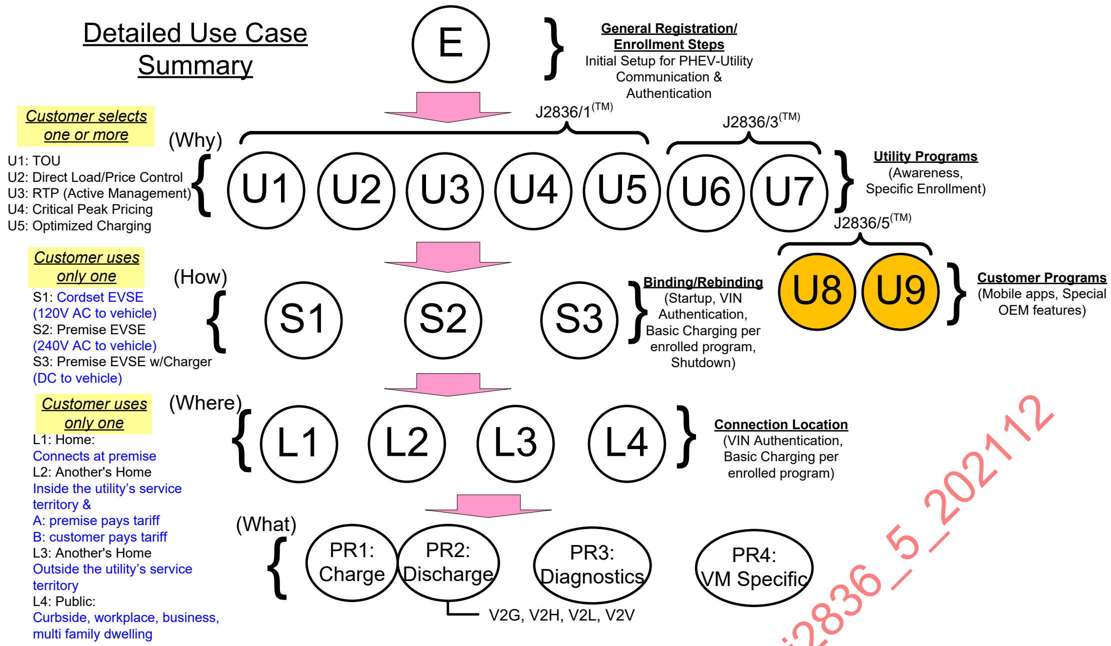

Figure 2 - Use Case structure and relationships

Table 1 provides a summary list of the Use Case and Scenarios for U8 and U9, and is followed by the detailed information for each.

Table 1 - Summary of Use Cases and Scenarios

Use Case	Scenario	Title
8	A	Customer remote start /stop
	B	Cabin conditioning
	C	Charge status information
	D	Setting customer preferences
	E	Locate and reserve EVSE
	F	Energy usage history
9	A	Conflict and resolution

5.1 Use Case: U8 - Customer Convenience Functions

This Use Case addresses customer information requirements and preference discriminators related to control and status of PEV charging sessions. Included is the customer information for remotely controlling charging parameters, specifying PEV charge scheduling preferences, real time charging status, notifications for faults and interruptions, access to EVSE public charging services, and energy usage history. Each of these Scenarios are described with the actors, information requirements and sequence of operation.

Table 2 - U8 Scenario A - Customer convenience functions: customer remote start/stop charging

No.	Type	Description
1.	Use Case Title	Customer convenience: Customer remote start/stop charging
2.	Use Case Element/Scenario ID	U8 Scenario A
3.	Objectives	Customers (PEV driver) will have the capability to remotely start and/or stop charging

No.	Type	Description
4.	Description	This Use Case Scenario addresses the conditions under which the customer will require the convenience and the capability to remotely start or stop charging of the PEV or to curtail the charge power level. Customer remote control access can be via smart phone APP and/or website/HAN or other remote vehicle control device such as a key fob. Note: Capability should be applicable and capable in all charging environments—but may be subject to the commercial/public/workplace facility energy management system control of available power where the PEV customer is not the ratepayer. Actors: Primary actors: Customer, PEV Secondary actors: OEM telematics server, EVSE network provider Scenario/Conditions: The following are potential conditions that would justify the need and convenience for customer capability to remotely start/stop charging. ▪ Charging session is interrupted due to intermittent failure such as local power surge or loss of communications. Customer receives status notification of interruption and has ability to restart charging session. ▪ Charging session is interrupted or power is curtailed due to demand response event or other load management program. Customer receives notification of demand response event activation. Customer has ability to opt out and initiate a start or increase power charging command at the beginning of the event or during the event. ▪ Customer has set delayed charging or time to complete charge setting—customer wants to change preference and immediately start charging. ▪ Customer has access to real time pricing and/or critical peak pricing information notifications and based on price information initiates a remote stop and/or start charging, or curtail charge power command to mitigate energy consumption costs. ▪ Customer has home area network and has ability to schedule charging session (start/stop or charge at low power) periods according to household load control needs. The primary Scenario is that the status of the customer charging session has changed due to any of the above conditions and notification is provided to the customer. Notification of the change in charging status and/or price/cost information is provided by the PEV to the customer via smart phone APP or text message, website, or other rudimentary means such as red light blinking on the key fob signaling charging has been interrupted. Price information notifications may be processed to the customer via smart phone APP or website from the OEM telematics server or the EVSE network provider specifically if customer is a subscriber to either of these available network services. Customer should be notified when a remote start charging signal fails. Error message should be provided per SAE J2836/4.
5.	Prerequisite	Start charging: PEV is plugged into a SAE J1772 compliant EVSE and charging initiation sequence can be activated in response to a PEV wake up signal via the customer PEV communications device. Customer will have capability to review charging session status at any time PEV is plugged into an SAE J1772 compliant EVSE (see Use Case U8 Scenario C). Stop charging: PEV is in an active charging session and customer is able to monitor charge status and pricing information per Use Case U8 Scenario C and Scenario F and can initiate a stop charge signal based on customer reaction to status and/or energy usage information.
6.	Requirements	Customer has access to real time notifications about charging status and energy usage information either through the PEV, the OEM telematics server, or EVSE network provider. Customer has remote control access to PEV charge controller to stop charging or to initiate wake up signal to start charging.
7.	Post Conditions	PEV responds to customer remote start or stop charging command signal. Failure Conditions: PEV does not respond to customer remote start or stop charging command—signal failure notification is provided to the customer. Communications failure.

Table 3 - U8 Scenario B - Customer convenience cabin conditioning

No.	Type	Description
1.	Use Case Title	Customer convenience: Cabin conditioning
2.	Use Case Element/Scenario ID	U8 Scenario B
3.	Objectives	Customers will have capability to set cabin conditioning preferences
4.	Description	Customers residing in inclement weather environments will want ability to precondition vehicle cabin temperature (either cooling or warming) for convenience purposes. Customer will have capability to either preset or immediately initiate cabin conditioning temperature and timing settings via smart phone APP, website/HAN, or in-vehicle display. Actors: Customer, PEV Secondary actors: OEM telematics server Scenario/Conditions: The following are the conditions and applicable Scenarios for customer capability to set cabin conditioning temperature and timing preferences. ▪ PEV is plugged in, charge complete. Customer has access to cabin temperature information. Customer has ability via smart phone APP, in-vehicle controls, and/or website access to remotely enter a temperature setting and activate cabin preconditioning. ▪ Customer will have ability to pre-schedule time and temperature setting—vehicle will automatically initiate cabin preconditioning at prescribed time and terminate automatically when prescribed temperature setting is achieved. ▪ Customer will have access to real time temperature status readings during the cabin preconditioning activity and have the capability to terminate cabin conditioning at his/her discretion. The basic Scenario is the customer has basic knowledge about estimated time of departure and any inclement weather conditions affecting the comfort of the PEV cabin. Pre conditioning is optimal because it utilizes grid power to condition the cabin versus expending excess battery energy for operating HVAC while driving—improves vehicle energy efficiency. Customer enters estimated time of departure and preferred cabin temperature. PEV calculates estimated energy consumption and time required to achieve customer preferred cabin temperature. PEV initiates cabin conditioning at its estimated start time and terminates when customer temperature setting is achieved. Notification to the customer at termination of preconditioning cycle shall be provided. Customer has option to reset preconditioning settings due to changes in departure schedule. Customer shall have real time access to cabin preconditioning status and ability to change settings or terminate at his/her discretion. Customer will have ability to initiate cabin conditioning during a battery charging session based on customer determination SOC is adequate for intended trip and wants to immediately switch to cabin conditioning.
5.	Prerequisite	Typically PEV is at 100% SOC before cabin preconditioning is initiated. PEV is plugged into a SAE J1772 compliant EVSE.
6.	Requirements	PEV charge modes support cabin preconditioning operation. PEV has capability to provide cabin temperature status information through smart phone APP, website/HAN via OEM telematics server.
7.	Post Conditions	PEV cabin is preconditioned per customer settings . Failure Condition: Pre-conditioning is terminated prematurely due to hard fault and will not respond to customer reset signals. Signal failure notification is provided to the customer. Communications failure.

Table 4 - U8 Scenario C - Customer convenience: charge status information

No.	Type	Description
1.	Use Case Title	Customer convenience: Charge status information
2.	Use Case Element/Scenario ID	U8 Scenario C
3.	Objectives	Customers want access to real time charging status during the charging session including automatic notifications of fault interruptions.
4.	Description	Customer with options for setting charging preferences per Use Case U8 Scenario D setting charging preferences and will need ability to monitor the charging status on real time basis to ensure charging preferences have been communicated and processed, and PEV is being charged accordingly. Primary Actors: Customer, PEV Secondary Actors: OEM telematics server, EVSE network provider Scenario/Conditions: The following are the conditions and Scenario for customer access to real time charge status information and fault notifications: ▪ Vehicle is plugged in and actively charging. Customer will have capability via smart phone APP, in-vehicle display, and/or website/HAN access to view real time charging session status: SOC, charge start time, expired charge time, time duration left to charge complete, estimated time charge to complete, amperage, kWh consumption, vehicle electric mile range. ▪ Customer will have real time notifications of interruptions to charging session due to faults, start of demand response event, activation of other load management program events initiated by facility EMS control, etc. Notifications for demand response, other load management control, and facility EMS control events should provide time duration of event and start time of event. ▪ Customer will have option to enroll in renewables energy programs. Charging will be synchronized with renewables generation cycles. Customer will receive notifications of on/off charging status and PEV SOC to be able to follow charge session progress. This Use Case Scenario is a predominant customer interface function that supports the other Use Case U8 Scenarios A, B, and D. In these other Scenarios, the ability to monitor and access real time charge status and to receive fault notifications provides the customer a medium for effectively and efficiently managing charging. Provides process for customer verification of charging system response to charging preferences and notification of premise or grid conflicts with those preferences. This information can provide customer knowledge about the site charging policies and consideration to PEV customer charging needs. Current charging status, historical charge information, and notifications may be processed to the customer via smart phone APP or website from the OEM telematics server or the EVSE network provider specifically if customer is a subscriber to either of these available network services.
5.	Prerequisite	PEV is plugged into a SAE J1772 compliant EVSE. Charging initiation sequence is activated.
6.	Requirements	Communications from PEV to customer is enabled. Triggers for customer notifications are defined and error fault descriptions/codes are prescribed per SAE J2836/4.
7.	Post Conditions	Customer receives charge status information upon request and notifications are processed and successfully communicated to customer. Failure Conditions: Communications failure.

Table 5 - U8 Scenario D - Customer convenience: setting customer preferences

No.	Type	Description
1.	Use Case Title	Customer convenience: Setting customer preferences
2.	Use Case Element/Scenario ID	U8 Scenario D
3.	Objectives	Customers will have ability via smart phone APP, in-vehicle controls, and/or website/HAN access, and EVSE keypad to set prescribed charging preferences.
4.	Description	Customer will have the ability to pre-set preferences and to change preferences on a real time basis for PEV charging. There are to be prescribed options for the multitude of charging conditions and programs afforded the customer within the PEV charge control communications functions and features. Execution of the customer preferences is to be automatic. Note: Customer is not to assume that charging preferences are absolutely considered or activated within the variety of charging station environments such as commercial, public, and workplace whereby local facilities energy usage and demand conditions may take precedence. This issue is addressed in Use Case U8 Scenario C Charge Status Information and Use Case U9 Scenario A Conflict Notification and Resolution Primary Actors: Customer, PEV Secondary Actors: OEM telematics server, EVSE network provider Scenario/Conditions: The following are the conditions and Scenario for customer input of prescribed options for charging preferences: ▪ Customer will have options to set specific charge start preferences such as charge delayed start time, charge immediately, or time charge to be complete ▪ Utilities will provide price tariff schedules such as TOU allowing customer to preset charging session schedule according to lowest price periods ▪ Customers will have access to real time pricing and critical peak pricing information. Customer will have ability to prescribe price threshold preferences - vehicle will have ability to automatically stop charging or curtail charging, according to customer preference, when price threshold is reached or exceeded. ▪ Customer will be able to enroll in utility demand response programs. Customer will receive day ahead DR event notifications with time duration/start time and subsequent notification at start of event. ▪ Customer will have option to enroll in renewables energy programs. Customer will have ability to set charge session accordingly to charge in sync with renewables generation cycles. ▪ Customer has home area network and has ability to schedule charging session start/stop/curtail charging according to aggregated household load offset needs. ▪ PEV fleet customers want ability to remotely start/stop individual PEV charging sessions in response to demand management requirements and other vehicle use scheduling requirements. The Scenario for this Use Case is the customer ability to pre-set charging preferences with the expectation the PEV will automatically adhere. Conditionally, the customer will have the ability to change and/or update charging preferences on a real time basis. Customer shall have the ability to opt out of DR events, RTP, and critical peak programs, albeit there may be a cost penalty to the customer to do so. Customer shall receive notifications from the PEV when preferences are not accepted by the site host or not automatically executed due to a system fault. Customer preferences can be entered through a smart phone APP, website/HAN, in-vehicle controls display, or EVSE keypad. Customer preferences may be processed through the OEM telematics server and/or the EVSE network provider. This assumes the customer is subscribed to the services offered by these networks.
5.	Prerequisite	PEV (and possibly the EVSE) provides customer interactive interface for customer to review and select prescribed automated preference selections.

6.	Requirements	PEV is enabled to receive, store, and process external information such as TOU rate tariffs, DR event schedule notifications, etc. PEV has the ability to process customer selected preferences based on PEV charge control conditions and external data parameters. Pricing information may be provided through the OEM telematics server and/or the EVSE network provider.
7.	Post Conditions	PEV successfully receives and automatically processes the customer selected preferences. Failure Conditions: There is a site host conflict, unfavorable grid conditions, or PEV processor fault. Communications failure.

Table 6 - U8 Scenario E - Customer convenience: public charging - locate and reserve EVSE

No.	Type	Description
1.	Use Case Title	Customer convenience: Public charging - locate and reserve EVSE
2.	Use Case Element/Scenario ID	U8 Scenario E
3.	Objectives	Customers will have ability via smart phone APP, in-vehicle display, and/or website access to locate public accessible charge sites and ability to request a reservation or to schedule a charging session at a particular EVSE at a stipulated public accessible charge site.
4.	Description	Customers want access to information on location, operational status, brand, type, configuration, pricing method, payment method, restrictions, and availability of EVSEs at public charge sites. Customers will further want GPS or driving instructions and charge site reservation capability for trip planning purposes. Optimally would like to have automated infrastructure trip planning capability according to PEV electric mile range and destination Primary Actors: Customer, EVSE network provider Secondary Actors: OEM telematics server, PEV Scenario/Conditions: The following are the conditions and Scenarios for customer access to information about location, status, and availability of public charging: ▪ Customer can access public charge site location information by region, city, street coordinates, points of interest, etc. ▪ Customer can specify preferred EVSE brand, type or configuration. Examples are customer is searching for SAE DC fast charger locations or a particular EVSE brand based on preferred subscription services. ▪ Customer can designate a trip destination and GPS navigation system will provide public charge site locations along the prescribed driving routes, preferably with distances between public charge sites specified. ▪ Customer can select a specific public charge site location and acquire detailed information about the site logistics—number of EVSEs, brand, type, configuration, operational status, availability, restrictions, payment method, pricing method, reservation policy/procedures, etc. ▪ Customer is able to acquire a scheduled reservation for a prescribed site location and specified EVSE slot with planned duration (start to end times). – Note that reservation services may not be feasible at many public sites due to inability to enforce removal of previous PEV, unless site is maintained by an on-site parking attendant. EVSE network providers are the prime actor for providing the public charge site information. Customer information about public charge sites may be processed through the OEM telematics server via an interoperable communications interface to the EVSE network providers. Additionally, OEM telematics providers may integrate GPS Navigation functionality with EVSE network provider GPS/address location data either through an in-vehicle display or smart phone APP interface. Customer may have to subscribe and/or register with specific OEM telematics providers and/or EVSE network providers for these services. The primary Scenario for this Use Case is the customer ability to have access to aggregated EVSE network providers public charge site information, and to not have to access individual brand website or APP information. This is an issue that is not to be addressed under this Use Case.