ChargeX Consortium Overview and Progress Update

CHARGEX consortium

LED BY

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CHARGEX consortium

Vision

Any driver of any EV can charge on any charger the first time, every time

Mission

Bring together EV charging industry members, national laboratories, consumer advocates, and other stakeholders to measure and significantly improve public charging reliability and usability in North America **by June 2025**

Scope

Focus on complex issues that require multi-stakeholder collaboration and national lab support to solve and simplify

Scope of Work

Defining the Charging Experience

- Define KPIs
- Develop and verify implementation instructions

Reliability/Usability Triage

Create fixes for:

- Communication
- Hardware

Solutions for Scaling Reliability

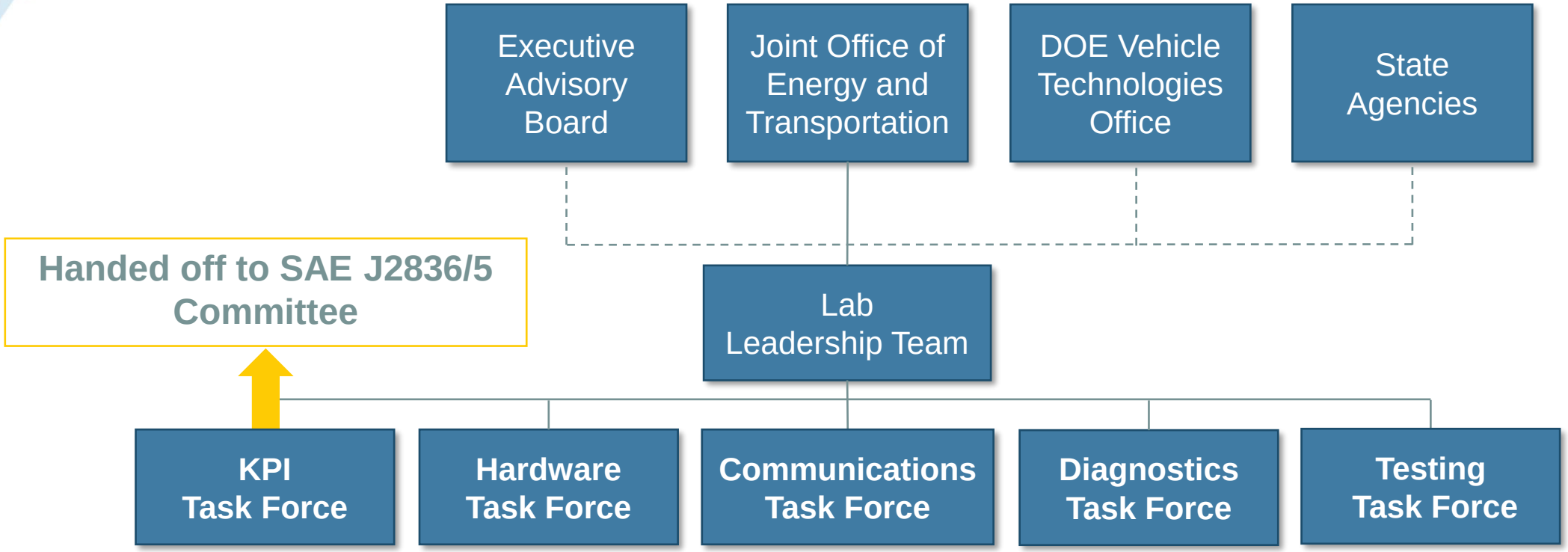
Improve:

- Diagnostics
- Interoperability testing methods

Outcomes

- Labs produce recommended practices, prototype tools
- Industry adopts practices and tools, improves standards

Structured Industry Engagement



Payment & UI Task Force - Discontinued Sept 30, 2024

Participants (90 as of 12/31/2024)

Charger Manufacturers and Suppliers	ABB e-Mobility, Amphenol, Autel, Bosch, BTC Power, ChargeTronix, Dover Fueling Solutions, Eaton, Evalucon, Heliox, IoTecha, Qualcomm, Siemens, SK Signet,Tritium, Wallbox
Customer-Facing Charging Station Operators	Apple Green Electric, Blink Charging, bp pulse, ChargePoint, Electrify America, EVgo, FLO, Francis Energy, HeyCharge, KIGT, Koulomb, Lynkwell, NovaCHARGE, NYPA, Rove, SWTCH, Xeal Energy
Charging Network and Software Providers	ampcontrol, AMPECO, ampUp, ChargeMate, Driivz, EV Connect, Noodoe, PIONIX, Switch
Auto Manufacturers	American Honda, BMW of North America, Ford Motor Company, General Motors, Lucid, Mercedes-Benz North America, Rivian, Stellantis, Subaru of America, Tesla, Toyota Motor North America, VinFast Auto, Volvo Car USA
3rd-Party Roaming Hubs and eMSPs	AeonCharge, Bluedot, ChargeHub, Emobi, Hubject
Field Services and Analytics Firms	Atlas Public Policy, ChargerHelp!, Energetics, EVSession, Field Advantage, ReliON, Uptime Charger, WattsUp
Consumer Advocates	Cool the Earth, Consumer Reports, EVinfo, J.D. Power, Plug In America
Fleets	Hertz
Payment Industry Stakeholders	Nayax, Payter, WEX
Standards Organizations and Technology Alliances	CharIN North America, COVESA, NEMA, Open Charge Alliance, SAE Sustainable Mobility Solutions
Research Organizations and Universities	American Center for Mobility, EPRI, Transportation Energy Institute, University of California, Davis; University of Washington
State Agencies	California Air Resources Board, California Energy Commission, Caltrans

Project Updates

Defining the Charging Experience

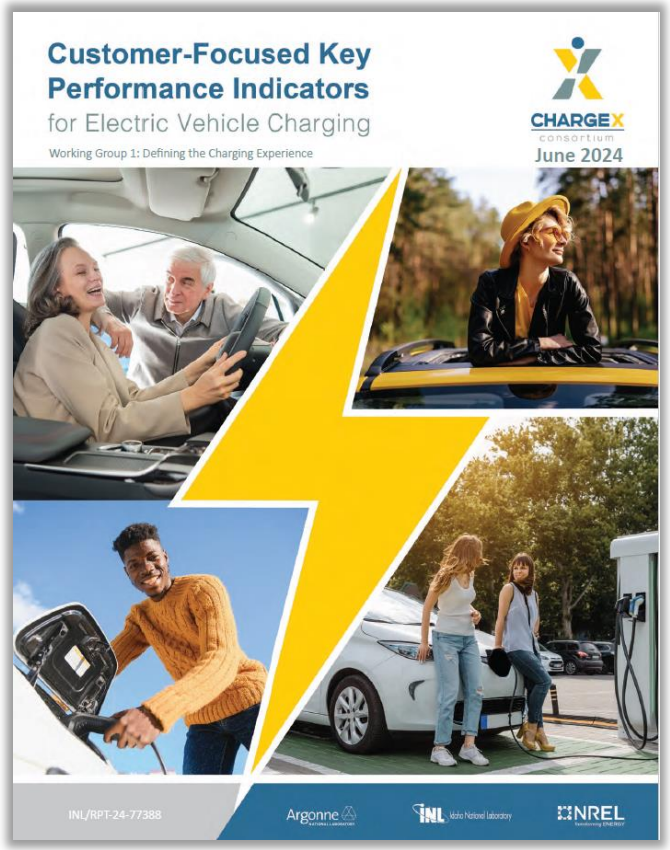
Goal: Establish customer-focused key performance indicators (KPIs) to provide industry with standard methods to measure the customer charging experience

Progress:

- Handed off to SAE. Reopened J2836/5 to add KPI definitions
- Collaborated with major CSO to pilot and validate KPI implementation guide
- Published KPI Implementation Guide

Next steps:

- Finalize KPI implementation code and publish to public-facing Github site (target Q1 CY25)



Improving Payment System Reliability

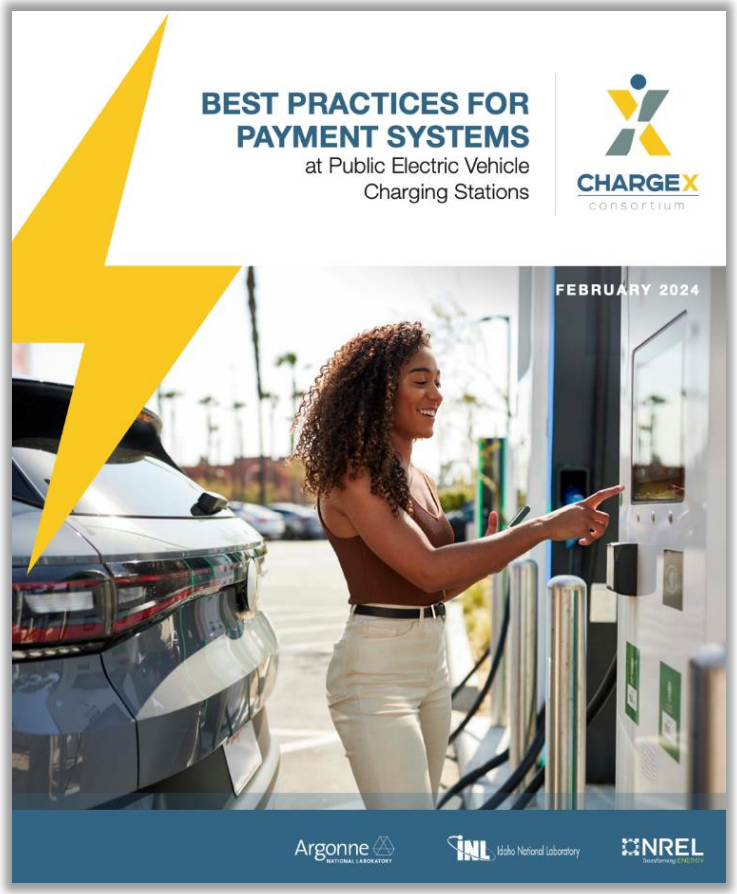
Goal: document problems and recommend solutions for wide range of payment system issues seen in the field

Progress:

- Published a best-practices report documenting problems and recommending solutions for wide range of payment system issues seen in the field

Next Steps:

- Project complete



Increasing Charge Start Success with Seamless Retry

Goal: institute process to automatically retry session initialization after failure to prevent customer from needing to unplug and replug if issues arise during session startup

Progress:

- Published Seamless Retry Best Practices Report

Next Steps:

- Develop Seamless Retry 2.0 (target Q2 CY25)
  - Improve error handling and recovery of EV/EVSE communications and fallback mechanisms
  - Start by gathering input and developing best practices with the industry task force

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Streamlining Timeouts

Goal: identify timeout issues in EV-EVSE communications and document industry best practices

Progress:

- Identified root causes of timeout issues in EV-EVSE communication and drafted recommended-practice report
- Main timeout issues only persist with legacy equipment
  - Still relevant for ongoing development but not pushing to SDOs
- Smaller portion relevant to push to SDOs

Next Steps:

- Publish recommended-practice report (target Q1 CY25)

Improving EV/EVSE Information Exchange

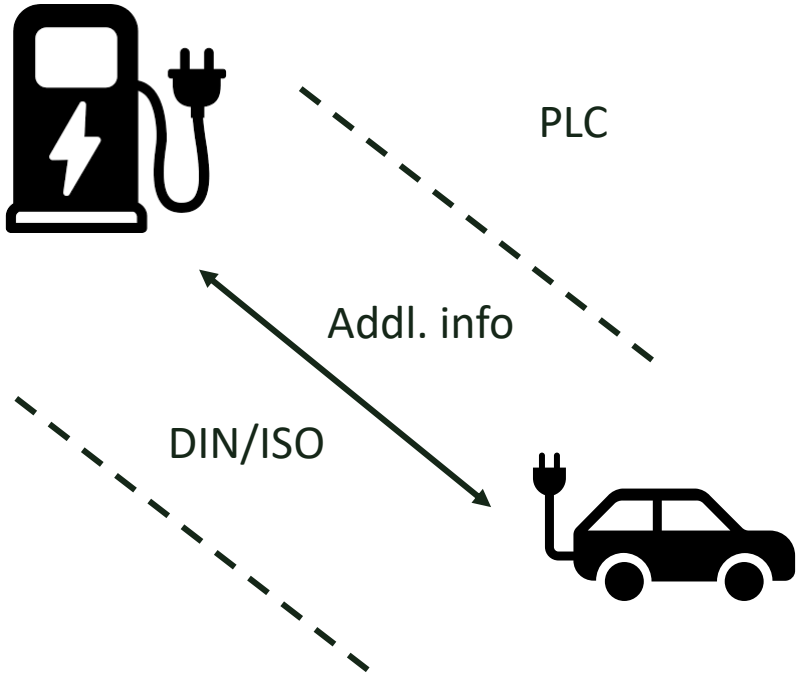
Goal: support the creation and adoption of ISO 15118-202 to enable flexible exchange of additional signals between EV/EVSE

Progress:

- Identified scope for implementation: co-identification, adapter detection, ongoing current/power limits, error codes
- Successfully demonstrated initial national-lab implementation of ISO 15118-202 in EVerest framework at Nov 2024 CharIN Testival

Next Steps:

- Finalize implementation in EVerest and share lessons learned formally with ISO 15118-202 working group (target Q1 CY25)
- Partner with industry for testing and demonstration



ISO 15118-202 standard defines extended SECC discovery protocol (eSDP) and event notification protocol (ENP) for additional information exchange, such as power delivery

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Quantifying and Reducing Time to Start Charge Sessions

Goal: Quantify current performance and identify methods to reduce charge session start time

Progress:

- Identified several sources of communications log files to analyze to quantify session start time

Next Steps:

- Collect industry feedback on time to charge and possible improvements (target Q1 CY25)

Ensuring Adapters are Reliable and Safe

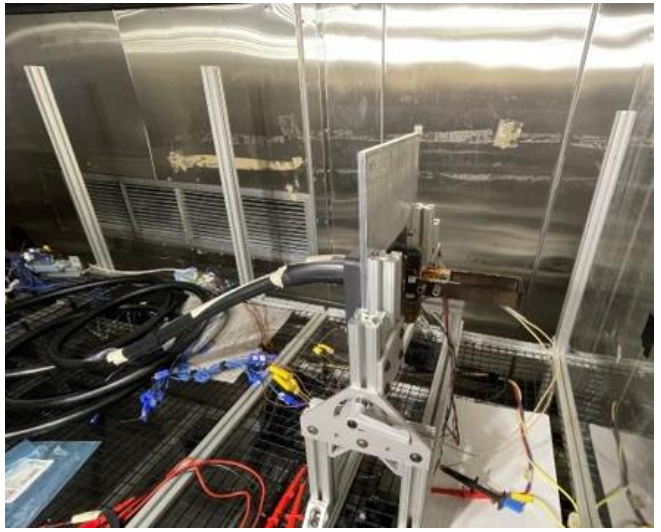
Goal: ensure performance standards (J3400/1), conformance standards (UL 2252), and industry practices catch all major failure modes

Progress:

- Adapter FMEA results provided to UL2252 and J3400/1; participating in the consensus process
- Developed reference inlet; tested thermal performance of inlets, connectors and adapters

Next steps:

- Compile, share results of thermal testing (target Q1 CY25)
- Conduct pin-cap and side-load testing ((target Q2 CY25)
- Develop evaluation approach for DC arc detection/mitigation
- Continue SAE and UL engagement on safety and reliability



Thermal evaluation of J3400 connector and reference inlet

Minimum Required Error Codes

Goal: Institute common set of error codes and supporting diagnostic information across industry to accelerate problem resolution

Progress:

- Published charger-focused Minimum Required Error Codes (MRECs) and implementation instructions on developer-friendly website (inl.gov/chargex/mrec)
- EVgo demonstrated subset of MRECs at CharIN North America Testival in Nov 2023 and MRECs were a part of the prescribed testing at the Nov 2024 Testival
- Supported MREC implementation in EVerest for OCPP 1.6J and 2.0.1

Next Steps:

- Develop MRECs for OCPI 2.2.1 and 3.0, focusing on VGI applications
- Standardize MRECs in SAE J2953/3 (target Q2 CY25)

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Diagnostic Information Sharing

Goal: Develop, verify, and publish Minimum Required Diagnostic Information (MRDI) for diagnosing the root cause of faults communicated by MRECs

Progress:

- Minimum Required Diagnostic Information (MRDI) parameters finalized with the Diagnostic Taskforce
- Published MRDI report

Next Steps:

- Recruit auto OEM and CSO partners to demonstrate diagnostic information sharing
- Integrate MRDI with eSDP (extended SECC discovery protocol) and ENP (event notification protocol) in ISO 15118-202 (target Q2 CY25)

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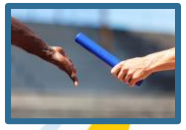
Interoperability Test Cases

Goal: Develop comprehensive set of interoperability test cases to accelerate EV and charger product development

Progress:

- Completed report on current testing practice
- Completed EV-EVSE Interoperability Test Plan (EEITP) ver1
- Executed Prescribed Testing Program (PTP) at June 2024 CharIN Testival, published outcomes report
- Executed PTP at November 2024 CharIN Testival

Next Steps:



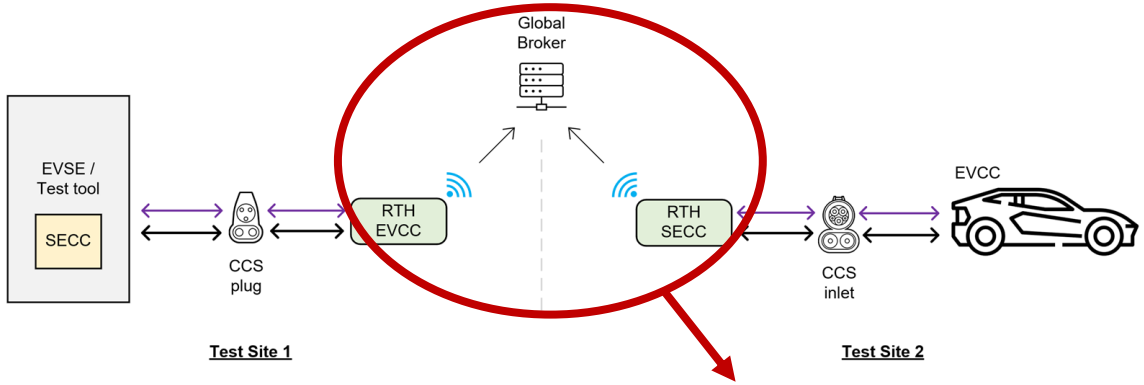
- Publish Nov 2024 CharIN Testival PTP outcomes report
- Hand off PTP administration to industry for incorporation into future industry testing event (target Q1 CY25)
- Develop EEITP ver2, hand off to industry (target Q2 CY25)

Creating Remote Test Harness (RTH)

Goal: Develop first-of-a-kind testing system to conduct remote interoperability testing with EVs and EVSE at separate locations

Progress:

- Completed system design specification and feasibility testing
- Finished test plan
- RTH-to-RTH Proof of Concept built and functional
- Completed proof-of-concept live/video demonstration



Next Steps:

- Build RTH using commercial-off-the-shelf controller
- Complete RTH minimum viable product and technology transfer for industry implementation (target Q3 CY25)

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Ensuring Smart Charging is Reliable

New VGI projects:

- Communications TF
  - Ensure reliable AC communication while charging via pilot wake
- Outside of ChargeX Task Forces

VGI 1. Develop V1G state machine and sequence diagrams for EV, EVSE, and OCPP

VGI 2. Develop performance metrics for AC Level 2 smart charge management

VGI 3. Perform failure mode and effects analysis for smart-charging use cases

VGI 4. Conduct V1G EV benchmarking for 80% of available U.S. makes/models

Communications Task Force - Pilot Wake

Goals: Accelerate smart charge management (SCM) based on open standards by:

- Ensuring reliable AC communications while charging via pilot wake
- Demonstrating scheduled AC charging via ISO 15118

Progress:

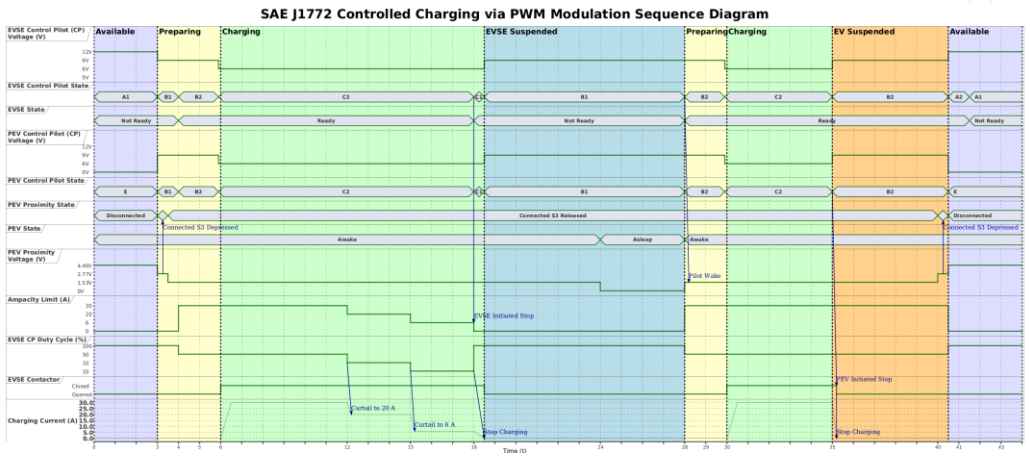
- Searching for demonstration partners

Next Steps:

- Bring topic into the Communications Taskforce meetings to gather input and discussion
- Identify one EV and one EVSE partner for demonstration
- Engage with industry to determine barriers for scheduled charging implementation

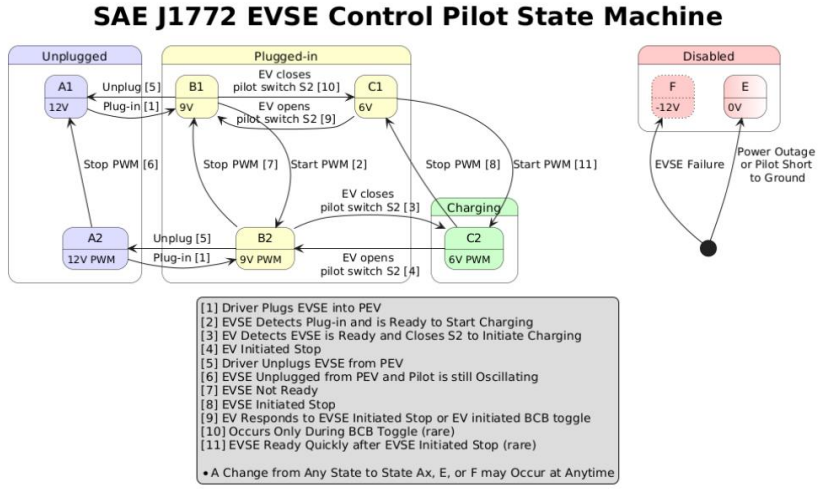
VGI 1 – Sequence Diagrams

Goal: Develop state-machine and sequence diagrams for EV, EVSE, and OCPP for managed charging scenarios



Progress:

- Controlled charging (PWM control, no HLC)
  - PWM control sequence draft is complete – ready for review
  - EVSE Pilot State Machine draft is complete – ready for review
- Scheduled Charging (ISO15118 enabled EV and EVSE)
  - Draft sequence diagram in process.



Next Steps:

- Complete scheduled-charging sequence diagram
- Manage industry feedback – execute consensus revisions

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VGI 2– Performance Metrics

Goal: Establish key performance indicators (KPIs) for AC Level 2 SCM that measure its performance and effectiveness from the perspective of different stakeholders for the SCM use cases/objective functions in VGI Tasks 1 and 3

Progress:

- ChargeX will focus on performance metrics at the hardware level to complement aggregate-level performance metrics being developed by EVs@Scale
- Began outreach to industry to identify groups starting to implement VGI leveraging EVSE control (e.g., utility, EV driver, CSO, EV OEM, aggregator)

Next Steps:

- Publish report that defines the performance metrics and provides insights into data requirements for calculating the metrics

VGI 3 – Reliability Analysis

Goal: Analyze two smart-charging use cases that employ communication per open standards to understand reliability issues and recommend resolutions

Progress:

- Identified relevant smart charging strategies and objective functions developed by EVs@Scale Consortium and corresponding inputs and outputs
- Understanding user experience, stakeholders, pros and cons of each strategy is currently underway

Next Steps:

- Identify possible communication pathways for each strategy
- Select two use cases (combination of strategy and communication pathway) using this information
- Perform Process Failure Mode and Effect Analysis of the two use cases using sequence diagrams created by VGI Task 1

Strategy Name	Objective Function: EV Charging…
Distribution Transformer	Scheduled to reduce coincident charge/overloads, this includes first come first served and equal split, and their variations
Day-ahead Pricing	Scheduled to minimize costs per PJM LMP (Locational marginal price)
TOU (Time-Of-Use) Random	Randomly distributed within dwell during lowest TOU
Random Start	Randomly distributed within dwell
Feeder Peak Avoidance	Distributed within dwell to limit feeder peak
Demand Response	Curtailed based on non-transportation loads
TOU Immediate	Begins immediately at start of TOU within dwell
Volt/VAR	Provides reactive power support
Volt/Watt	Power adjusted to support local voltage quality
BTM Depot DER	Schedule to avoid transformer upgrade with PV/ESS
Renewables/Emissions	Scheduled to coincide w/ renewables/low-emissions

Smart charging strategies and objective functions defined by EVs@Scale Consortium

VGI 4 – EV Benchmarking

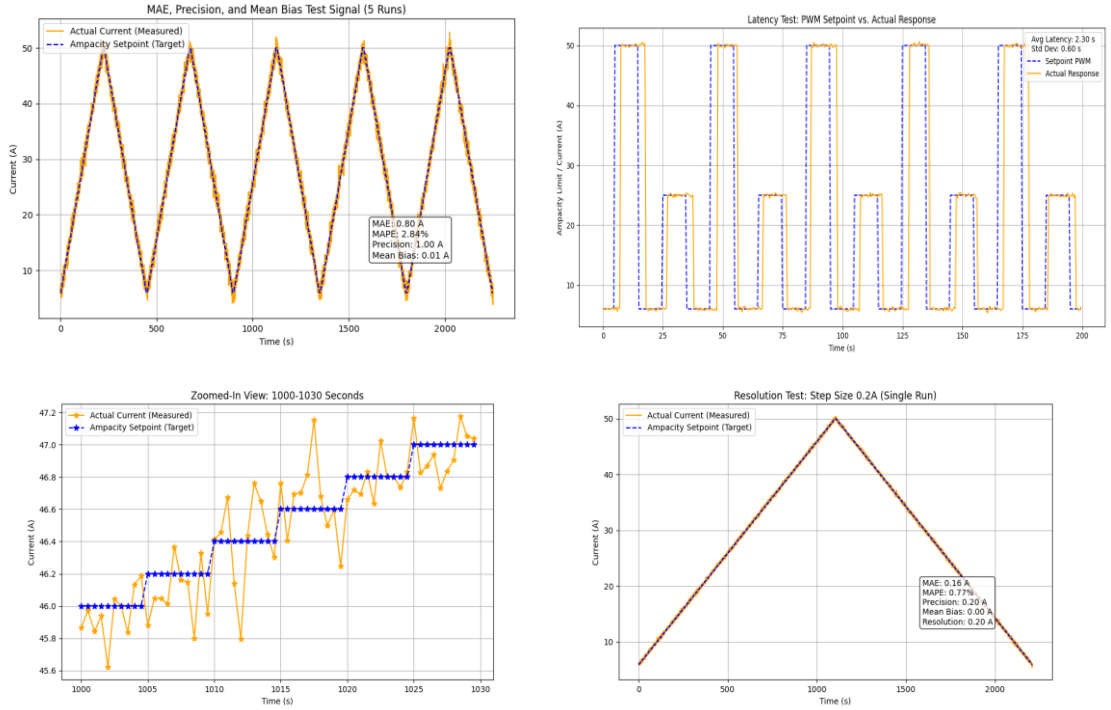
Goal: Benchmark large fraction of US available EV makes to understand charge control capabilities via SAE J1772 PWM modulation

Progress:

- Drafted charge control benchmarking test plan
  - Charge control accuracy and precision, latency, and resolution
  - PWM-based charge control response: PJM RegD response score
  - EV Pilot Wake response – timeout tests

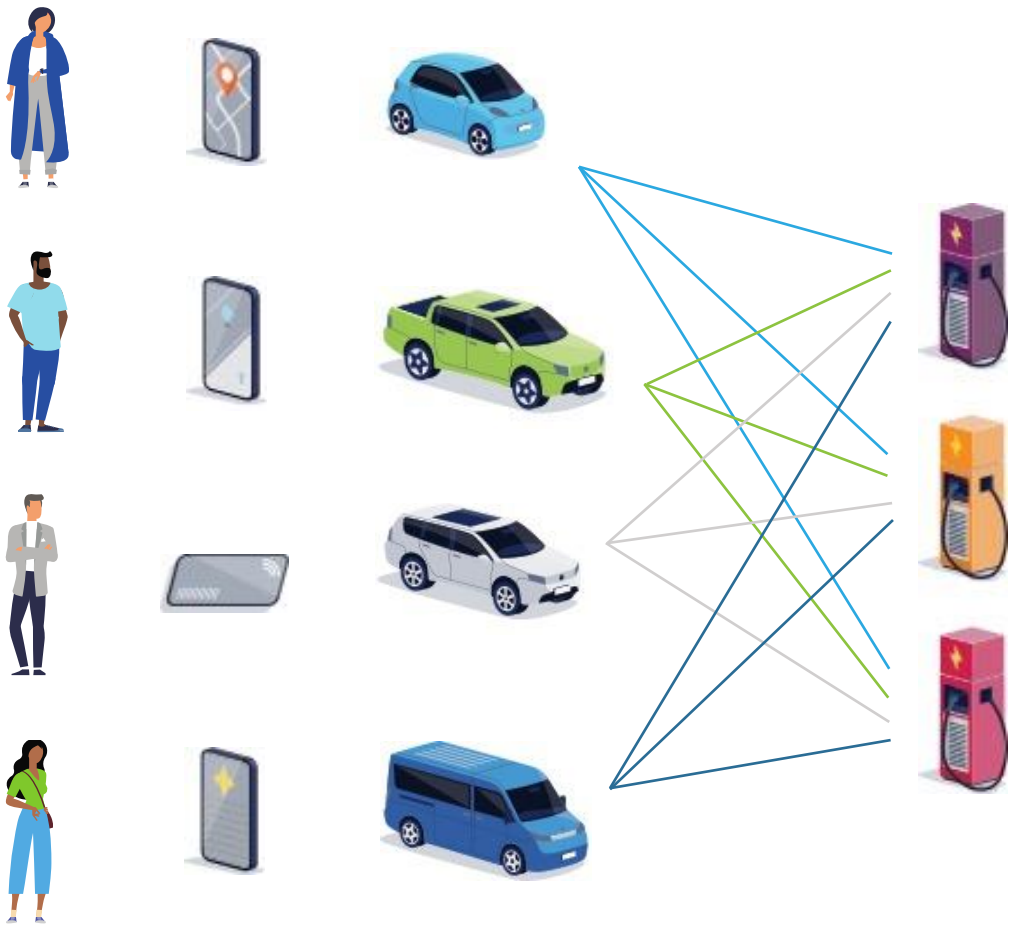
Next Steps:

- Validate test plan with R&D EV assets
- Execute scheduling and benchmarking
- Deliver internal test results and industry summary



Example results of charge control accuracy, precision, latency, and resolution tests

Any Driver, Any EV, Any Charger



FIRST TIME,

EVERY TIME

chargex.inl.gov

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