Vehicle to Grid (V2G): What You Need To Know In 2026

Live Webinar

February 11, 2026

QualityLogic®

Presenters

Steve Kang, GM, Smart Energy, QualityLogic

- Steve is a leading technical expert on IEEE 2030.5, SunSpec Modbus, IEEE 1547, AU/NZ 4777, EN 40459 and other smart energy protocols and grid codes. He has contributed to development of industry standards for testing smart energy protocols and grid codes. He teaches QualityLogic's IEEE 2030.5 CSIP, CSIP AUS and IEEE 1547/EN 50549 workshops to engineering teams around the globe. He is the General Manager of QualityLogic's smart energy division and is responsible for delivering leading testing products and services for the Smart Energy industry.

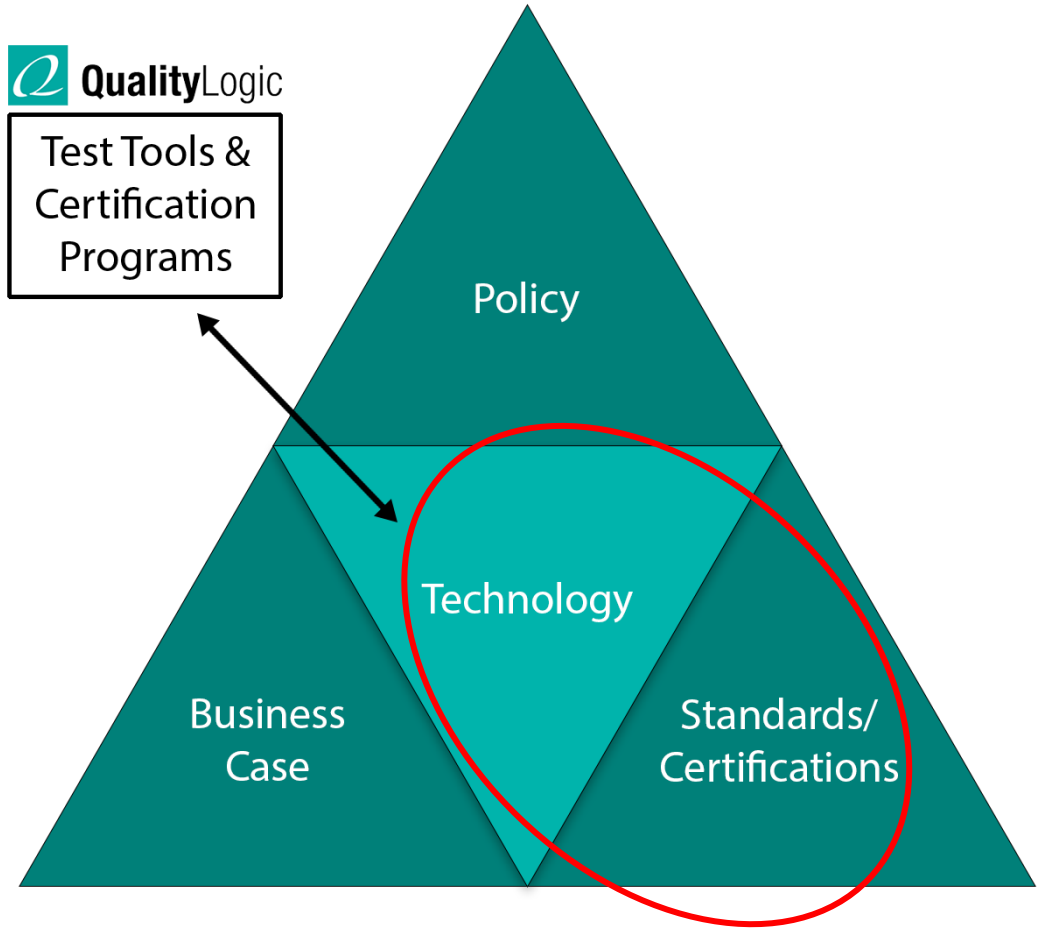
James Mater, Director of Strategy, Smart Energy QualityLogic

- James is one of the industry-leading experts on smart grid standards, interoperability, and the maturity of eco-systems of products based on these standards. James has given dozens of presentations and authored multiple papers on interoperability in the smart grid. He is a member of UL 1741 SC, SunSpec J3072 Profile and Task53 WGs and more. He co-founded and co-chairs the V2G Forum. His current focus has been on V2G standards, V2G implementation testing and ISO 15118 interoperability.

Contributing to International Standards and Alliances

- IEEE 2030.5, CSIP and Related Standards
- IEEE 1547 and UL 1741 STP Working Groups
- Founding member of V2G Forum – Industry Group Harmonizing V2G
- Member of IEA Task53 Initiative – International Bidirectional Charging
- SunSpec Specifications and Work Groups
- OpenADR Alliance
- CharIn Member

Critical Factors in Scaling V2G-AC



Critical Factors

- Standards (grid codes and communications)
- Technology Built on Standards
- Business Drivers: OEMs need a market
- Policy Drivers: creates markets and market rules
- Test and Certification Programs: assure Grid Operators of safety and interoperability

Webinar Agenda

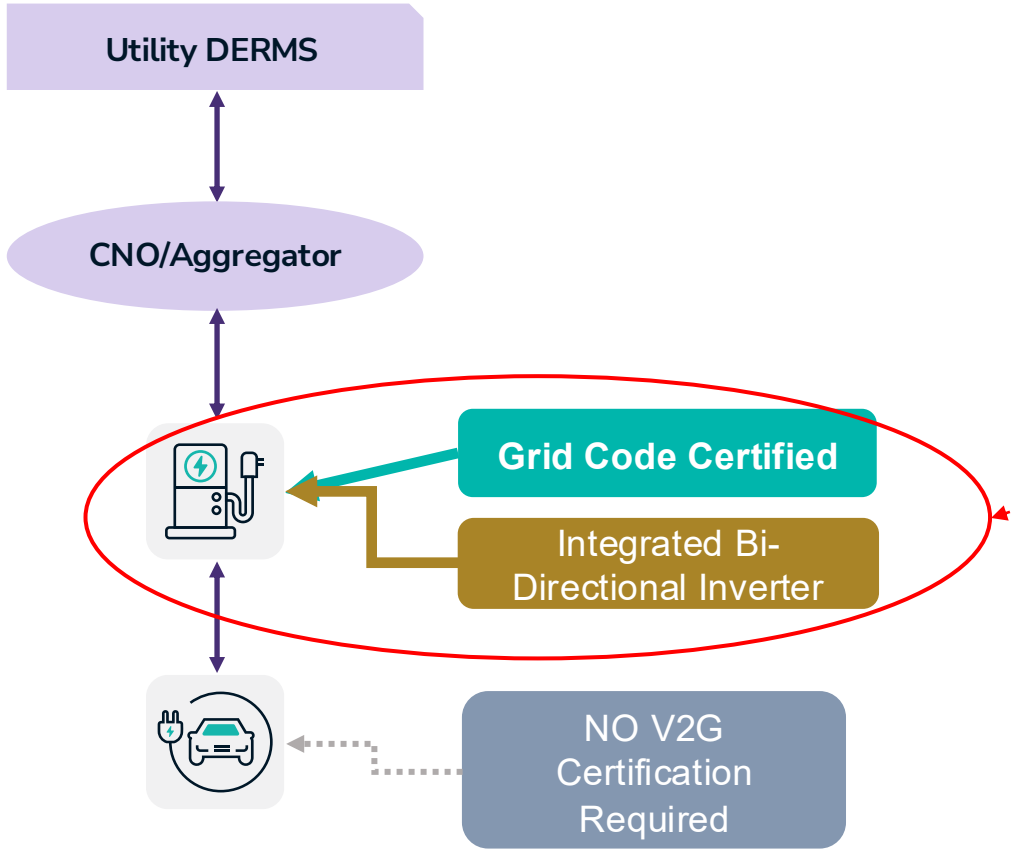
- Models for V2G Standardization
- US V2G Standards in 2026
- EU V2G Standards in 2026
- A Case for V2G-AC
- Testing and Certification of V2G Systems in 2026
- Want to Learn More?

What to Know About V2G in 2026

- Utilities, Regulators and OEMs are getting serious about V2G
- V2G-DC is already here, and V2G-AC is growing in 2026
- The V2G-AC use case is compelling for multiple reasons
- Charging interoperability is a pre-requisite for V2G
- End-End standardization and interoperability is recognized as a critical challenge
- Testing and certification are here for V2G-DC, but just starting for V2G-AC
- Scalable V2G technology is coming together: Now we need scalable policy

Three Basic V2G Models

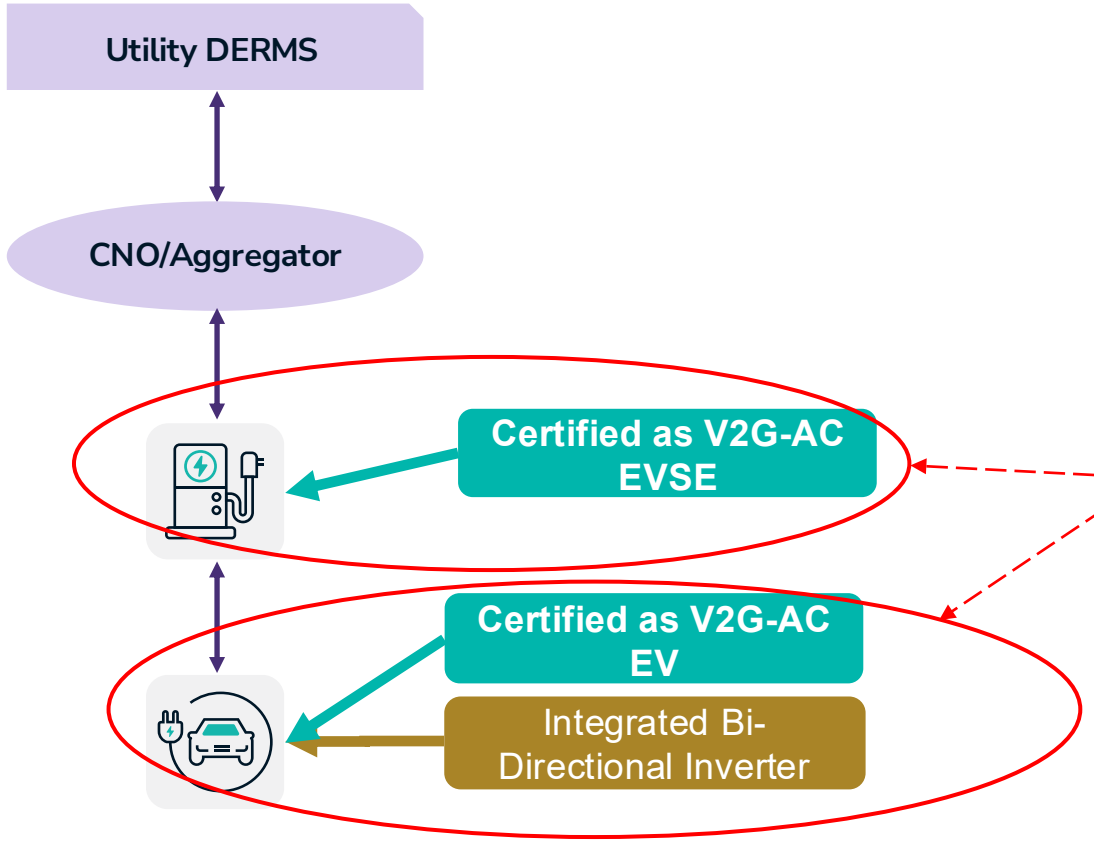
V2G-DC: Grid Code Functions in the EVSE Inverter



V2G-DC Charging + Energy + Power Export

- Bi-directional EVSE Inverter
- Grid interactions – charge/export time, power settings, Grid Code curves and controls
- Interconnected to the electrical grid at the EVSE
- Certified EVSE only

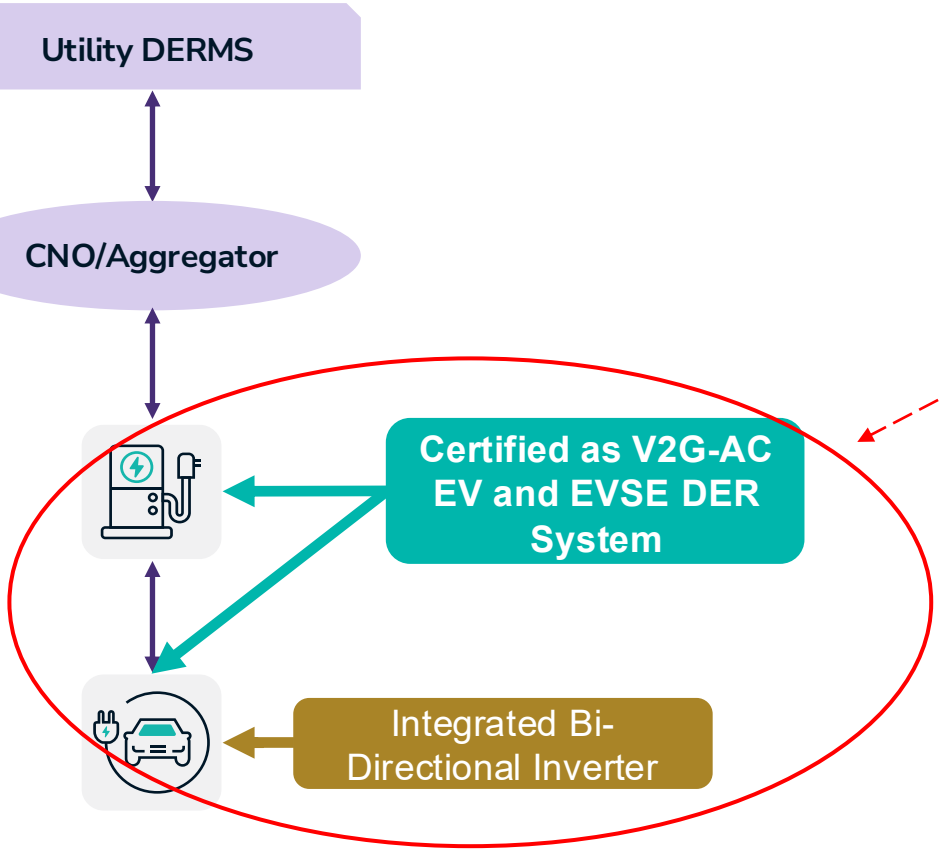
V2G-AC: Grid Code Functions in the EV Inverter



V2G-AC Charging + Energy + Power Export

- Bi-directional EV Inverter
- Interconnection at a V2G-AC Certified EVSE
- Grid code functions on the V2G-AC Certified EV
- Independently certified EV and EVSE

V2G-AC DER System: Grid Code Functions in the EV Inverter

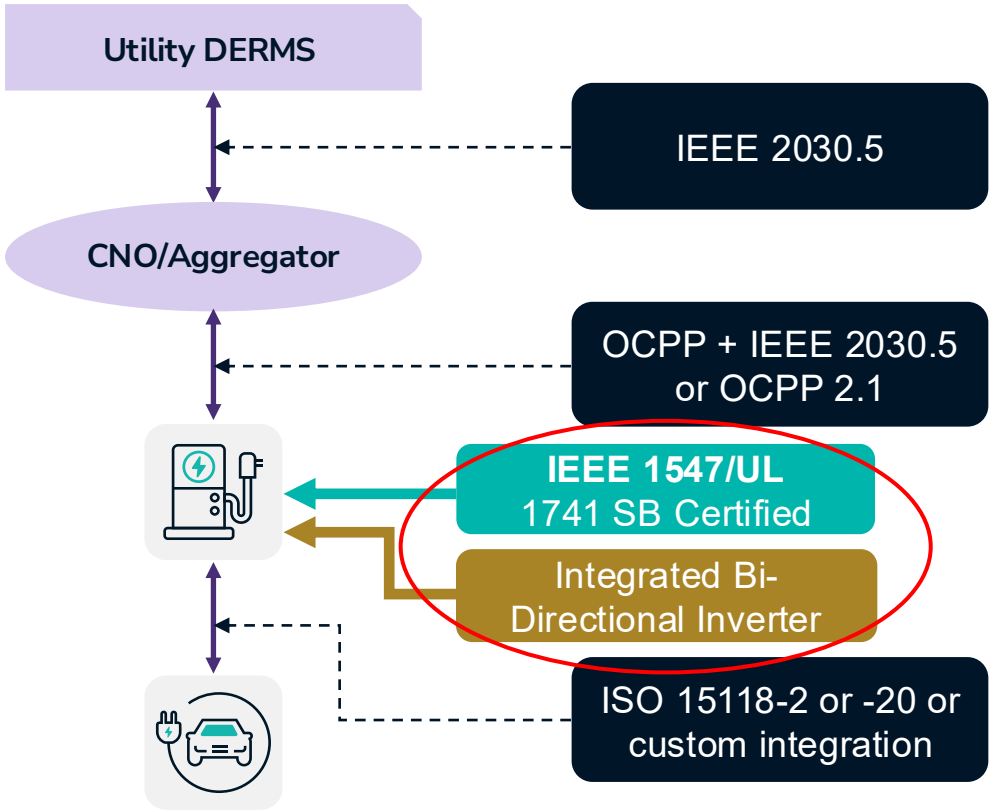


V2G-AC Charging + Energy + Power Export

- Bi-directional EV Inverter
- Interconnection at the Bi-directional EVSE
- Grid code functions on the EV or split between EV and EVSE
- Certified EV and EVSE combination

V2G Standards US in 2026

US V2G-DC Standards



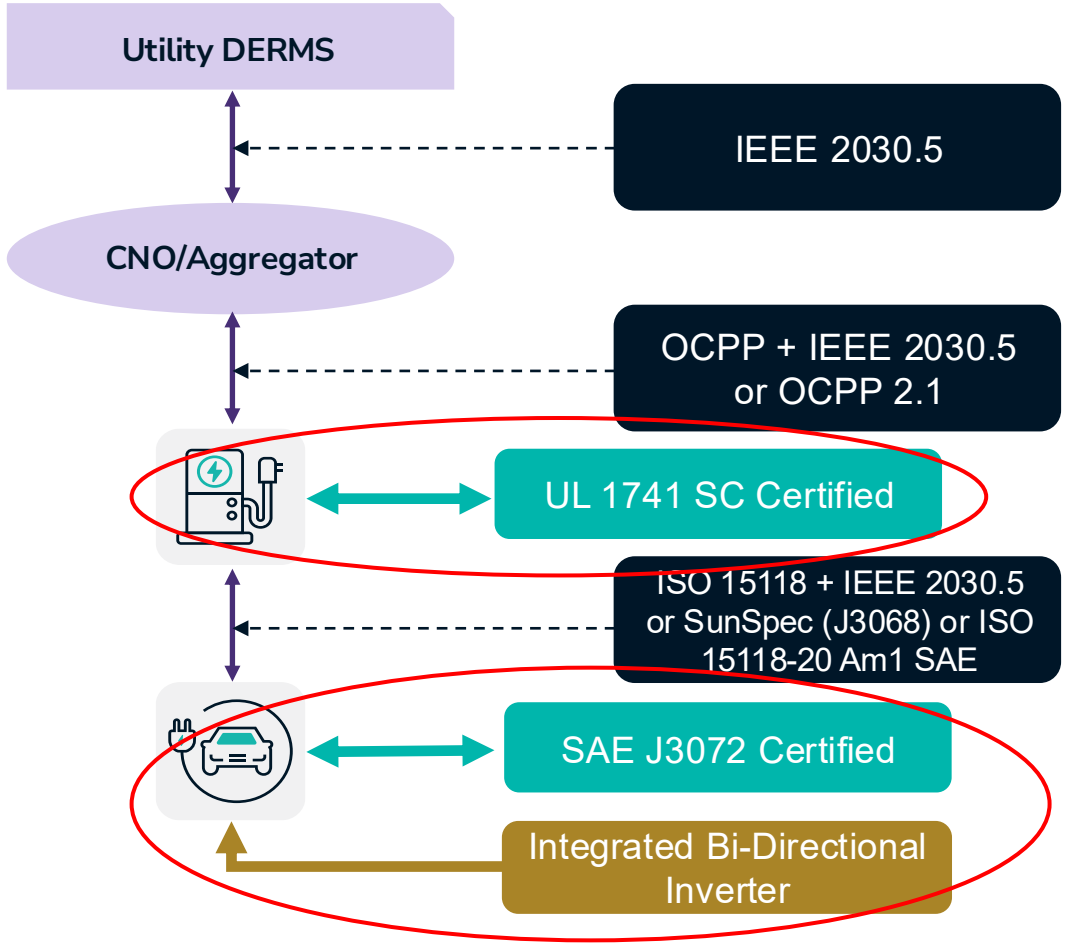
V2G-DC Charging + Energy + Power Export

- Bi-directional EVSE Inverter certified to UL 1741 SB (CEC already has listings).
  - CA Rule 21 (September 2020 CPUC D.20-09-035) requires UL 1741 SB Certification of any DER systems exporting power to the grid.
  - CA Rule 21 requires IEEE 2030.5 CSIP certification for any devices/systems interfacing directly to utility DERMS.
- EVSE-EV communications not specified in interconnection rules in general. However, IEEE 1547 specifies interoperability protocols for certification.
- OCPP not recognized in IEEE 1547 but may be used by mutual utility-aggregator agreement.
- EV-EVSE communications not specified and are typically custom based on ISO 15118-2.
  - ISO 15118-20 may standardize the EV-EVSE interface.

US V2G-AC Standards

V2G-AC Charging + Energy + Power Export

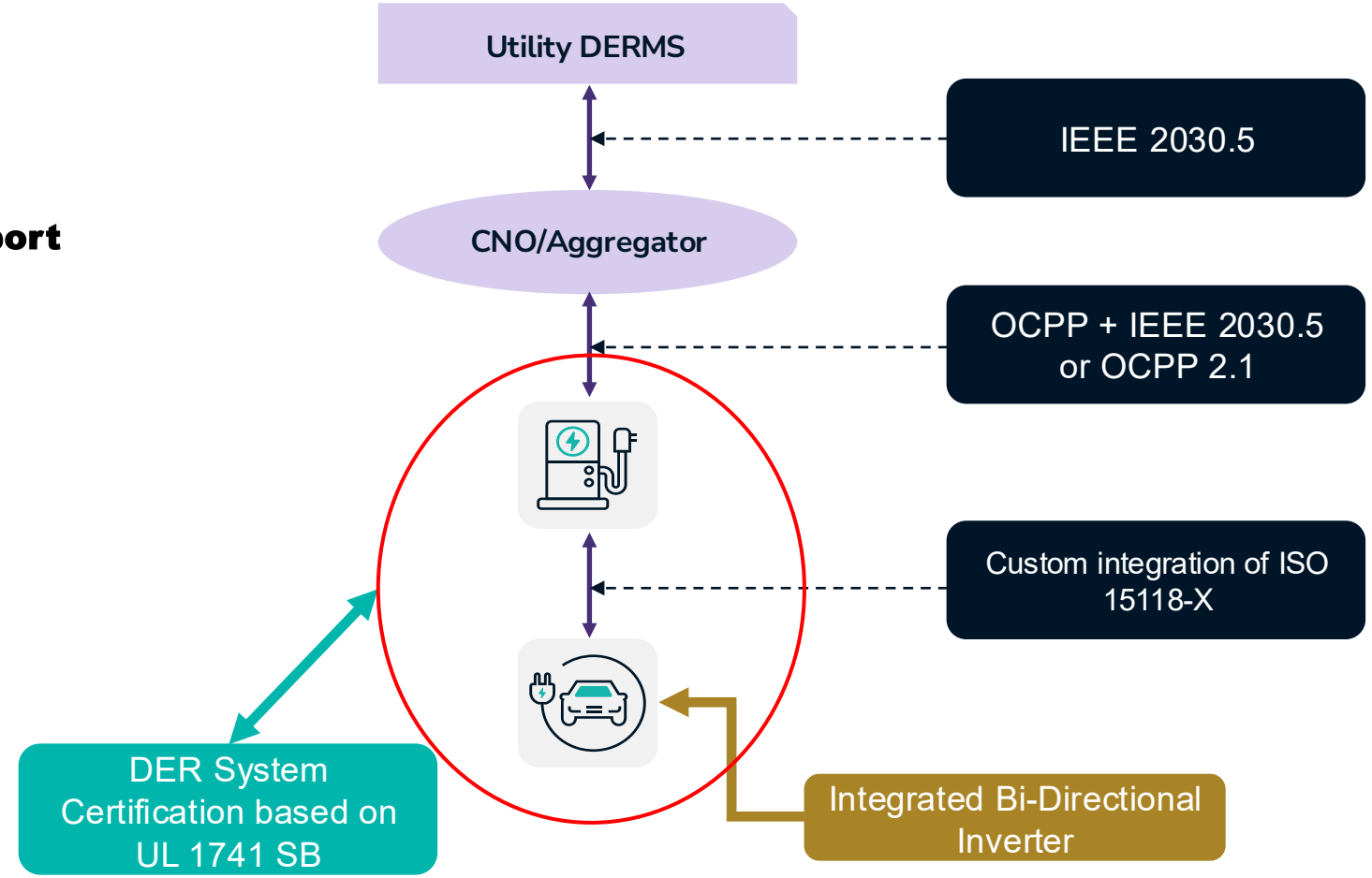
- Independent certifications of EV and EVSE
- Bi-directional J3072 EV with Inverter certified to SAE J3072
- Interconnection at a UL 1741 SC Certified EVSE
- Most recent version J3072 published in 2024
- UL 1741 SC anticipated to be published in 2026



V2G-AC DER System Standards

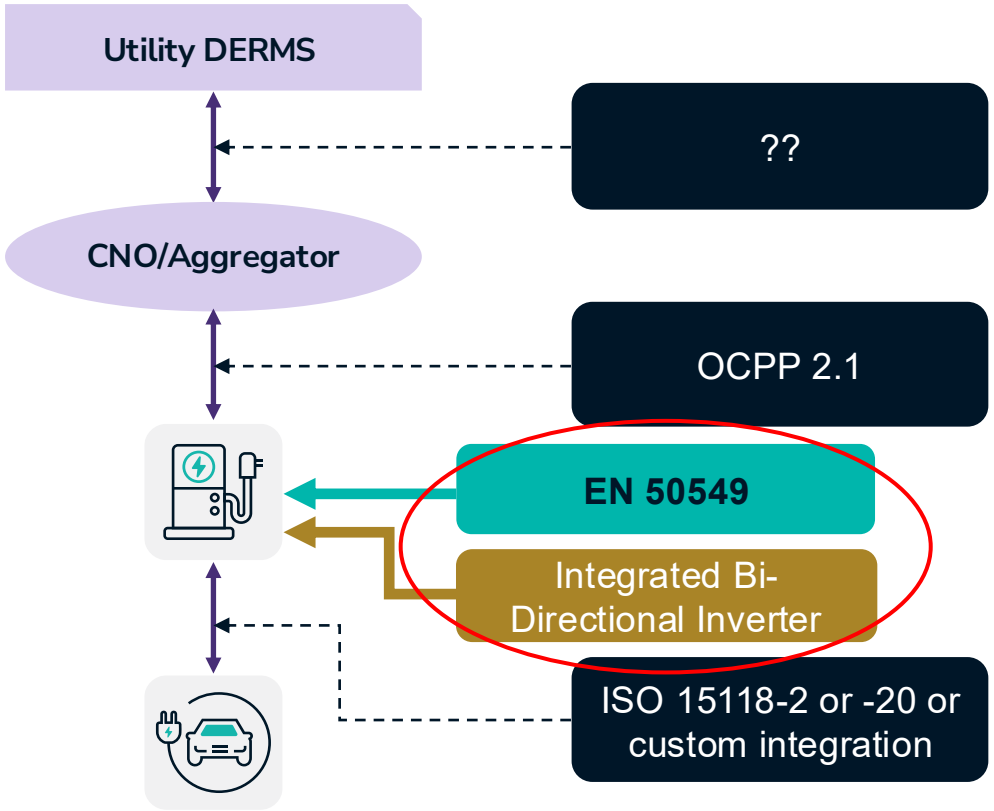
V2G-AC Charging + Energy + Power Export

- Certifications of EV and EVSE as a pair
- Bi-directional EV with Inverter
- Interconnection at EVSE
- Based on UL 1741 SB certification of a DER system
- EV-EVSE communications
- New UL 1741 SB CRD to be published soon



V2G Standards EU in 2026

EU V2G-DC Standards



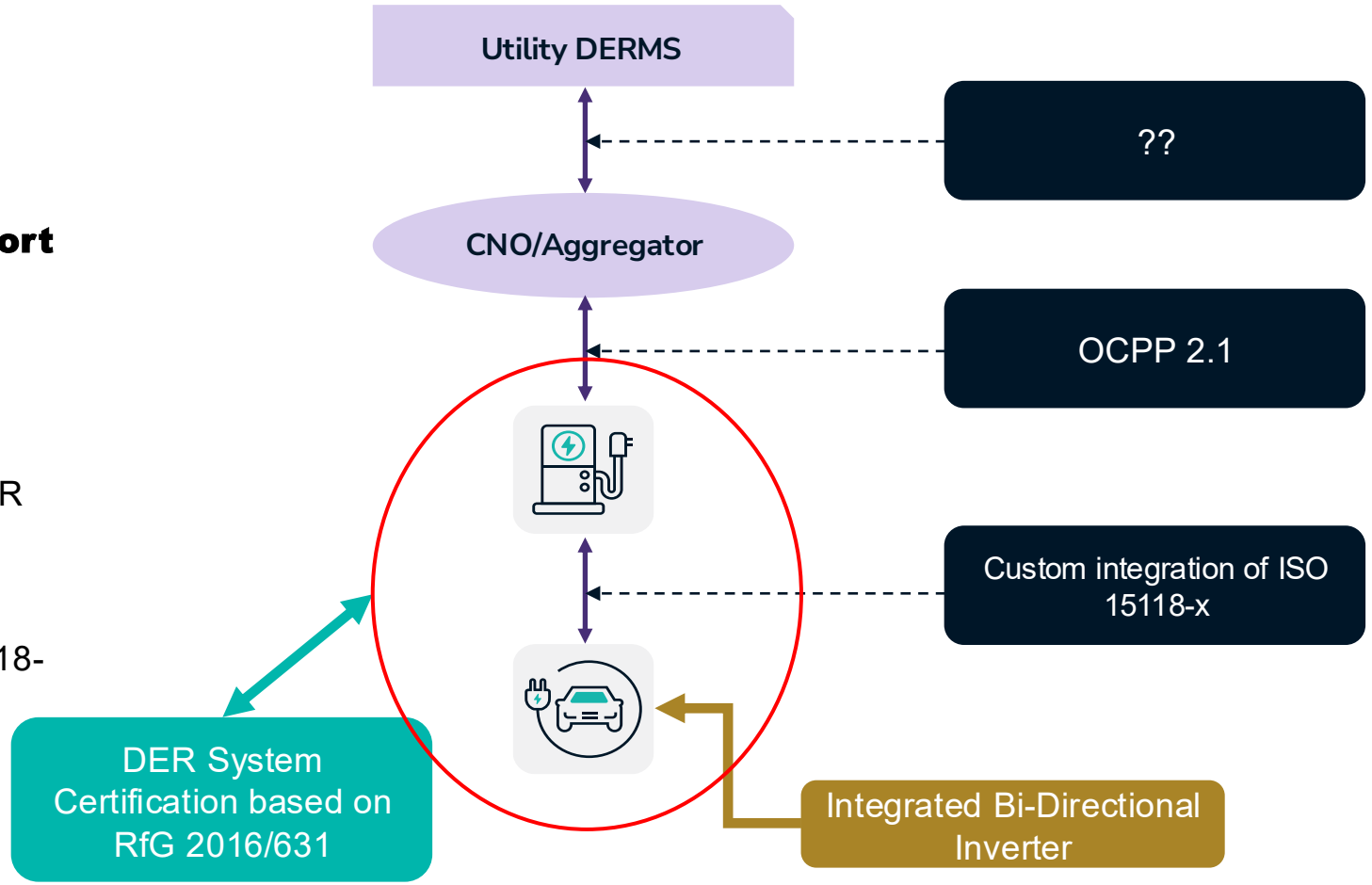
V2G-DC Charging + Energy + Power Export

- Bi-directional EVSE Inverter certified to EU DER Grid Code.
  - EN 50549 plus country grid codes.
- Communications not specified in grid codes or interconnection rules in general.
- OCPP 2.1 CNO-EVSE protocol of choice for communications but not mandated.
- EV-EVSE communications not specified and are typically custom based on ISO 15118-2.
  - ISO 15118-20 may standardize the EV-EVSE interface

EU V2G-AC DER System

V2G-AC Charging + Energy + Power Export

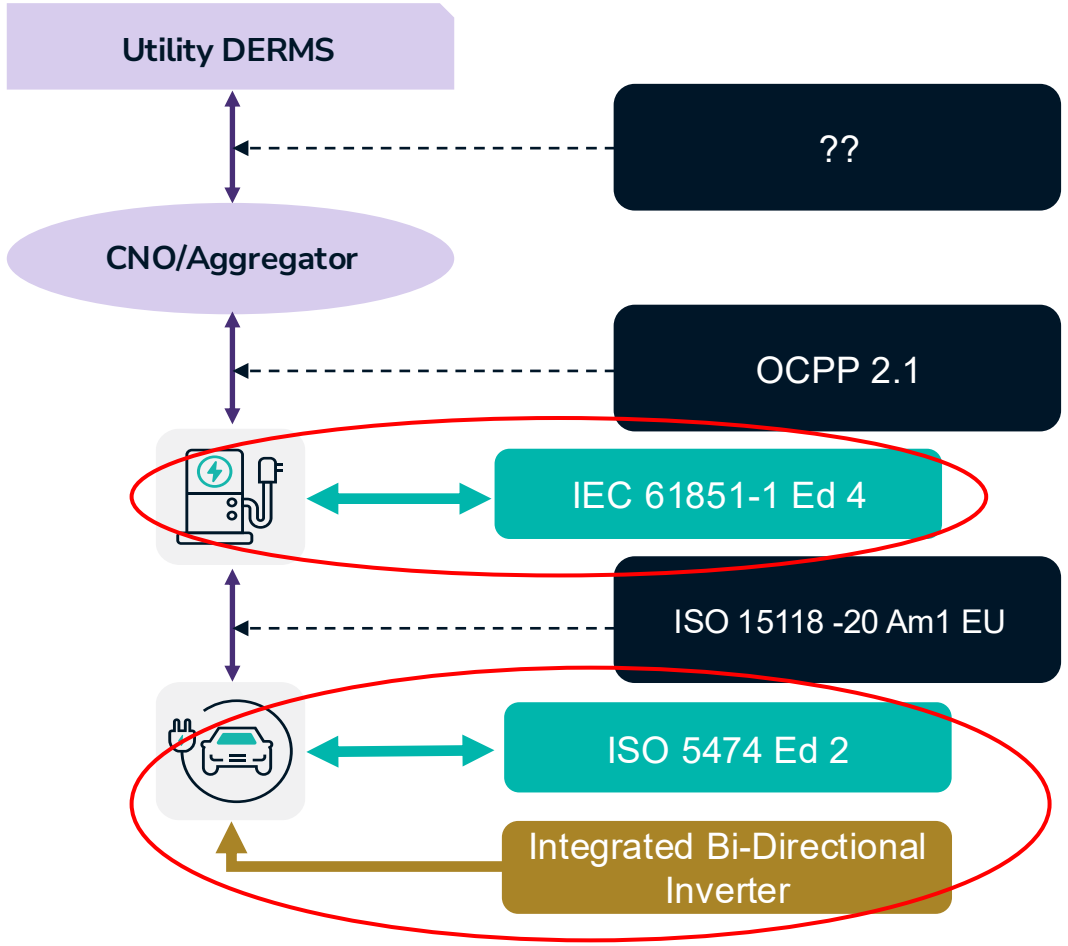
- Certifications of EV and EVSE as a pair
- Bi-directional EV with Inverter
- Interconnection at bi-directional EVSE
- Based on RfG 2016/631 requirements of a DER system
- Grid code EN 50549 plus country codes
- EV-EVSE communications should be ISO 15118-20



EU V2G-AC Proposed Standards

V2G-AC Charging + Energy + Power Export

- Independent certifications of EV and EVSE
- New EU standards expected adoption in 2026
- Bi-directional EV with Inverter certified to ISO 5474 Ed 2
- Interconnection at an IEC 61851-1 Ed 4 Certified EVSE
- EV-EVSE Communications = ISO 15118-20 AM1 EU



EU Proposed RfG EV and EVSE Roles

Function	EVSE	EV	
Store local grid code parameters	✓ (interface protection)	✓ (V/F disturbance response)	Communicated to EV every session
Grid Frequency/voltage measurement	✓	✓	Communicated to EV every session
Compute Active/Reactive Power Setpoints		✓	Communicated to EV every session
4 quadrant inverter		✓	
Interface protection UV/UF	✓		
Active Islanding Detection	✓		
Immunity (ride-through) to voltage/frequency disturbances	✓	✓	
Power quality emissions (harmonics)		✓	
EU Safety Standard	IEC 61851-1 Ed 4	ISO 5474-2 Ed 2	
EU Protocol Standard	ISO 15118-20 Am 1 EU	ISO 15118-20 Am 1 EU	

Key V2G Factor: Certification for Grid Support

Electric grid support for a distributed energy resource (DER) is codified by regulation and law in "Grid Codes"

- The US Grid Code standard is IEEE 1547
- The EU Grid Code standard is EN 50549

These describe how DERs react to changes in the grid voltage and frequency

- When they should disconnect (trip) and reconnect
- Other subtle changes in electrical power behavior that support grid stability

The power electronics that create the DER reactions are generally based on where the AC/DC inverter is located

- V2G-DC it is in the EVSE
- V2G-AC it is on the EV
- Hybrid or Split V2G-AC can split functions between the EV and EVSE to a limited extent

A Compelling Case for V2G-AC

V2G-AC EVSE Market Drivers: US

Why are OEMs investing in V2G-AC technology and standards?

- Economics: V2G-AC is lower cost than DC; is residential oriented (best V2G use case); potential EV lease offset revenues from utilities.
- Emerging Utility Programs: mostly V2G-DC school bus fleets but MD (BGE + Sunrun + Ford F-150 Lightning) piloting residential V2G. CA IOUs are working on similar programs.
- CA Rule 21 will require UL 1741 SC certification for V2G-AC and likely SAE J3072 certification for grid support EVs. Other states are creating their own V2G requirements leveraging IEEE 1547/UL 1741 SB and emerging V2G-AC standards.
- EU Regulations: EU Commission focus on enabling V2G in the EU.

When will certifications be needed by OEMs?

- When states/utilities start mandating certifications to UL 1741 SC and J3072: CA likely to adopt V2G-AC standards in 2026.
- When countries/states enable monetization of V2G-AC as an incentive to EV customers to participate. Starting to happen now.

V2G-AC EV Market Drivers: US and EU

The market drivers for V2G-AC EV are essentially the same as for EVSEs with standards' nuances

- The standards are different but aligned with the EVSE standards.
- IEEE 2030.5 is the default EVSE-EV V2G-AC communications protocol in the US but a version of ISO 15118-20 is in development and likely to also be used in the US.
- ISO 15118-20 is the default EVSE-EV V2G-AC communications protocol of choice in the EU but needs an Amendment for AC.
- OCPP2.1 is geared toward EU CNO-EVSE V2G communications and may also end up being used in the US along with IEEE 2030.5.

Certifications of EV for V2G-AC is still evolving in each market but there will be some form of requirements to satisfy utilities for interconnection of a new EV acting as a DER.

Point 1: V2G-AC vs V2G-DC Simple Economics

V2G-AC Advantages

- Simpler EVSE; lower cost and maintenance (not clear what the SC requirements will do to costs)
- Autonomous power source for V2X (V2X off grid without EVSE)

Lower overall costs: V2G-AC ~ 50% of V2G-DC

- 100,000 V2G Systems =
  - $83,000,000 AC
  - $175,000,000 DC

Estimates based on a 15kW residential V2G system.

Element	V2G-DC	V2G-AC
EV Onboard Inverter	$0	$300
EVSE Hardware (15kW)	$5,000	$1,500
Installation, wiring, panel	$10,000	$5,000
Interconnection/compliance	$2,500	$1,500
Total Hardware & Installation	$17,500	$8,300

Source: ChatGPT 5o Prompt: Summarize the overall costs (per item and total) to purchase, install and maintain a V2G-AC vs V2G-DC system using the best data or estimates available. (Multiple sources cited)..

Point 2: One Size Does Not Fit All: Where V2G-AC Makes Sense

- **Residential and Workplace V2G good AC Applications**
- **Workplace could be either AC or DC, depending on specifics.**
- **Largest potential V2G = Residential**

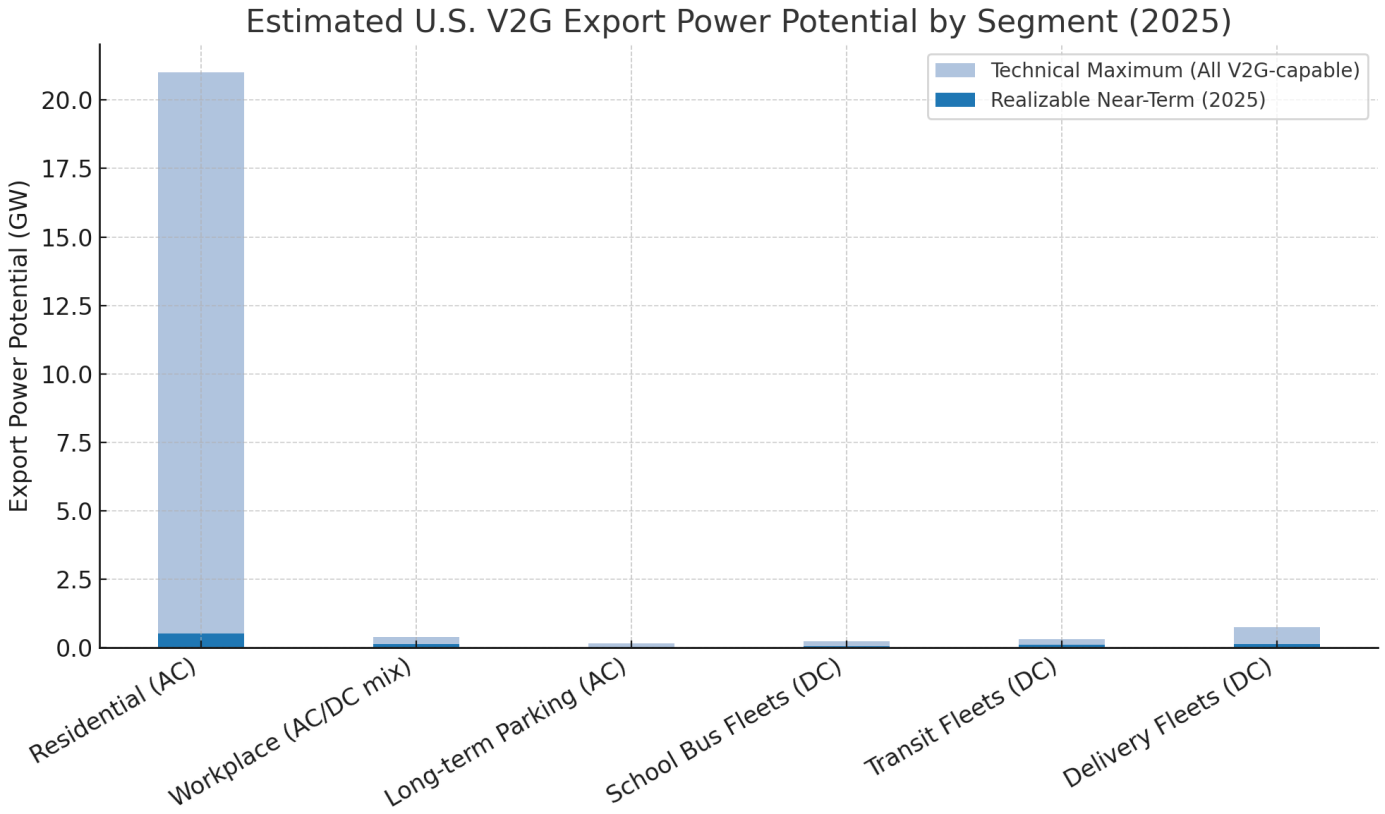
Point 3: Where is the biggest V2G Potential? V2G-AC

US V2G Potential and Realizable in 2025 (ChatGPT estimates)

- Residential V2G-AC dominates potential (≈21 GW technical, ≈0.5 GW near-term).
- Fleet depots (school, transit, delivery) represent the next-largest contributors (hundreds of MW).
- Workplace and long-term parking offer smaller but steady daytime capacity.

Notes:

- Another reason to focus on V2G-AC
- UL 1741 SB CRD can be a factor in enabling scale



Testing and Certification of V2G-AC in 2026

V2G-AC Challenges

There is *mounting market pressure* to get certified, standardized, V2G-AC products into the market.

- Pushing all parties to accelerate the implementation and certification of the new standards.

The *standards themselves*, in the US, the EU and elsewhere, *are just being finalized* and the initial versions published.

- New standards will have gaps and ambiguities.
- Standards that exist vary from country to country, creating additional challenges for OEMs and certifiers.

Industry standard *test specifications are also either just being published* – e.g., ISO 15118-21 – *or have yet to be developed*

- For example, there is not an SAE J3072 industry standard test specification.

There are no commercial tools available to conduct development and certification testing based on the new V2G-AC standards.

- Some components such as Grid and EV/EVSE Simulators are available commercially, but key protocol and functional tests are missing.
- Early adopters are developing their own: expensive and creates interoperability challenges.

Charging technologies need to work seamlessly for V2G to succeed.

- A prerequisite of V2G based on an immature standard ISO 15118-20 that needs to mature to support interoperable V2G.

***V2G end-end interoperability* includes the utility and CNO DERMS/CMS systems.**

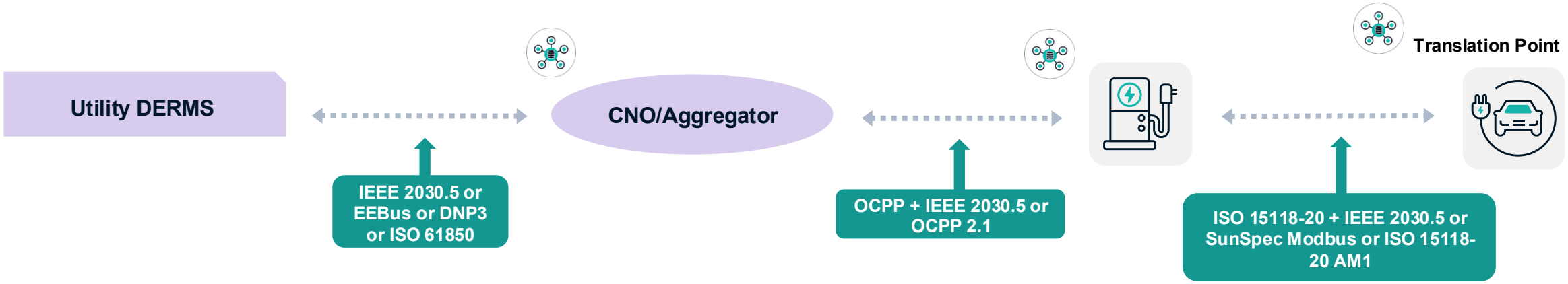
- Just starting to be addressed by the Task53 Initiative and the V2G Forum.

End-End Interoperability Testing

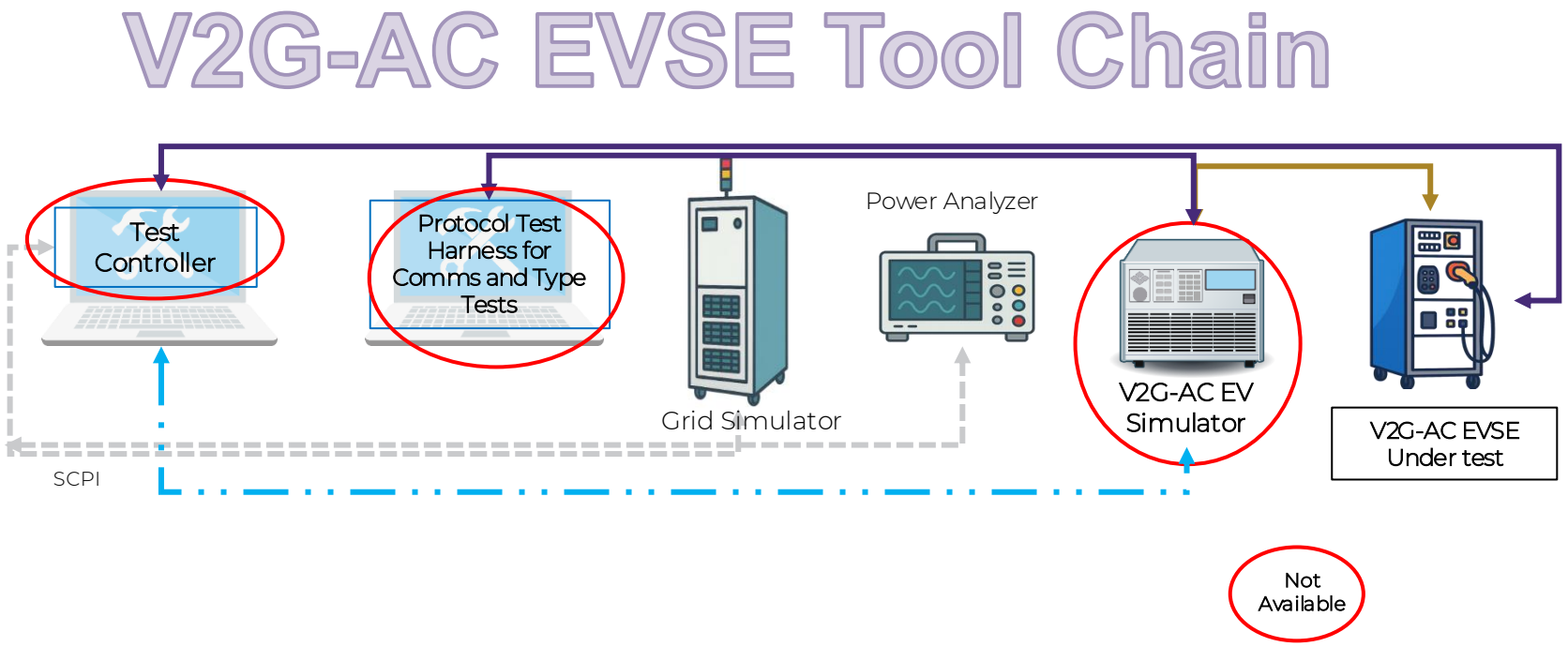
No industry standard for end-end interoperability certification

End-End Interoperability testing principles.

- Each V2G system (EV, EVSE, CMS, DNO) should be independently tested and, if available, certified..
- EVSE and EV simulators should simulate both compliant protocol and electrical behaviors.
- Testing should be automated as much as possible to reduce time, costs and improve interoperability.
- Translation points or gateways which must translate between protocols should be validated for correct translations.
- Test tools should be validated if a program exists – e.g., CharIN's Validated Test Systems for CCS Conformance Certification.
- Simulated and devices/systems to be tested should pass any available certifications for protocols and safety standards.
- Interoperability can start as bilateral but should move to multiple systems and end-end test scenarios.
- It would be useful to have some form of V2G End-End test bed and certification program to insure complete V2G system interoperability and performance.



V2G-AC EVSE Test/Certification Tool Chain



Test Controller

- Manage EVSE Under Test, Grid Sim, Power Analyzer and EV Simulator

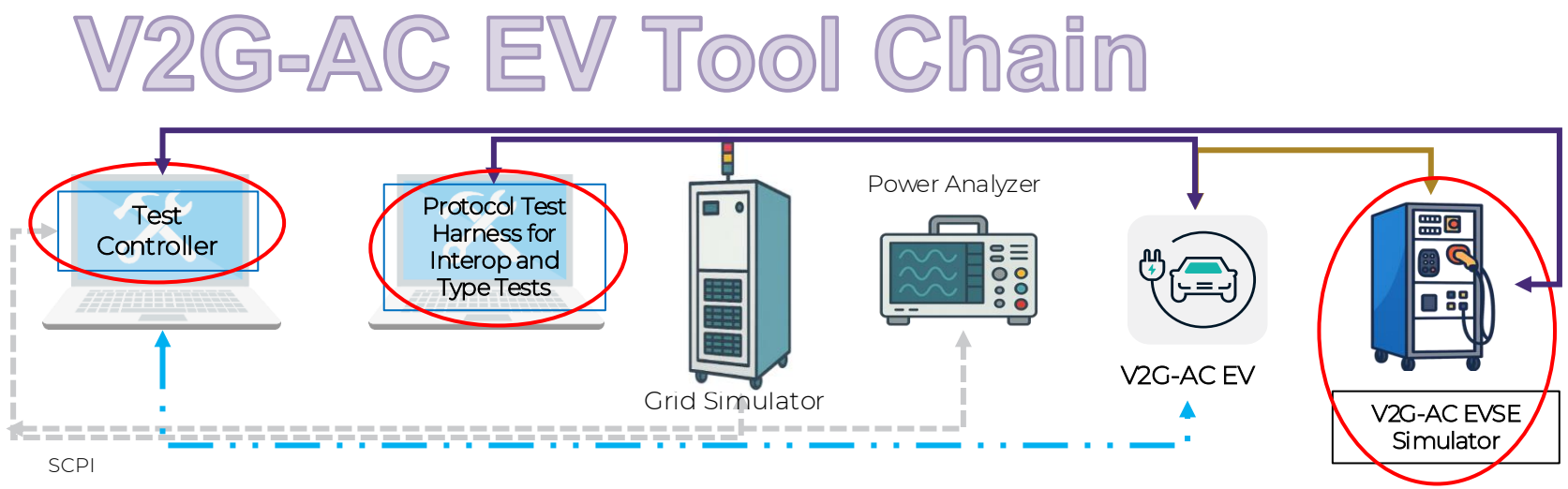
Protocol, Interop Type Test Harness Executes

- ISO 15118-20 AM1/J3072 Protocol Test Analysis
- OCPP2.1/1547 Interop tests
- UL 1741 Oversight tests
- Analyzes/Reports results
- Integrated with Test Controller

V2G-AC Simulator

- Limited Grid Code Power functions for Oversight testing
- EV-EVSE Protocol test execution (server tester)
- CMS-EVSE Comms test validation
- ISO 15118-20 charging and export simulation
- PLC modem (single phase) or LIN-CP modem (3 phase)

V2G-AC EV Test/Certification Tool Chain



Test Controller

- Manage EVSE Under Test, Grid Sim, Power Analyzer and EV Simulator

Protocol, Interop Type Test Harness Executes

- Comms Protocol Tests
- Grid Code Type Tests
- Analyzes/Reports results
- Integrated with Test Controller

V2G-AC EVSE Simulator

- Protocol test execution (client tester)
- Grid Code tests pass-through
- ISO 15118-20 charging and export simulation
- PLC modem (single phase) or LIN-CP modem (3 phase)

Want to Learn More?

Summary

- **Utilities, Regulators and OEMs are getting serious about V2G**
- **V2G-DC is already here, and V2G-AC is growing in 2026**
- **The V2G-AC use case is compelling for multiple reasons**
- **End-End standardization and interoperability is recognized as a critical challenge**
- **Testing and certification are here for V2G-DC, but just starting for V2G-AC**
- **What's Next**
  - V2G-AC Certifications
  - Task53 End-End
  - V2G Forum Work End-End

QualityLogic V2G-Related Products & Services

Smart energy training courses for IEEE 2030.5, IEEE 1547.1, and OpenADR 2 give your team:

- Provides your team with practical and technical understanding of these important standards
- Taught by experts who helped create these standards
- ***Full V2G Technical Workshop coming soon***

Testing Products and Consulting

- Verify grid support functions that are central to V2G technology IEEE 1547.1 and EN 50549
- Verify DER protocol implementations for conformance and interoperability IEEE 2030.5/CSIP, SunSpec Modbus and ISO 15118/CCS
- Leverage our standards and testing expertise through consulting

QualityLogic Executive Workshops

Executive Workshops

- Introduction to Communications Standards for Vehicle-to-Grid Integration
- Introduction to IEEE 2030.5 for DER and EV Integration
- Introduction to IEEE 1547-2018 Interoperability
- Introduction to OpenADR for Demand Management

Final Remarks

- **Video Recording, Presentation and Questions/Answers will be shared with all those registered after today**
- **Q&A**
  - **Please post any questions in the Q&A Panel only**
- **Thank you for attending today's V2G Webinar**
- **Please email smartenergynews@qualitylogic.com to contact the QualityLogic Team**