Customized Energy Solutions

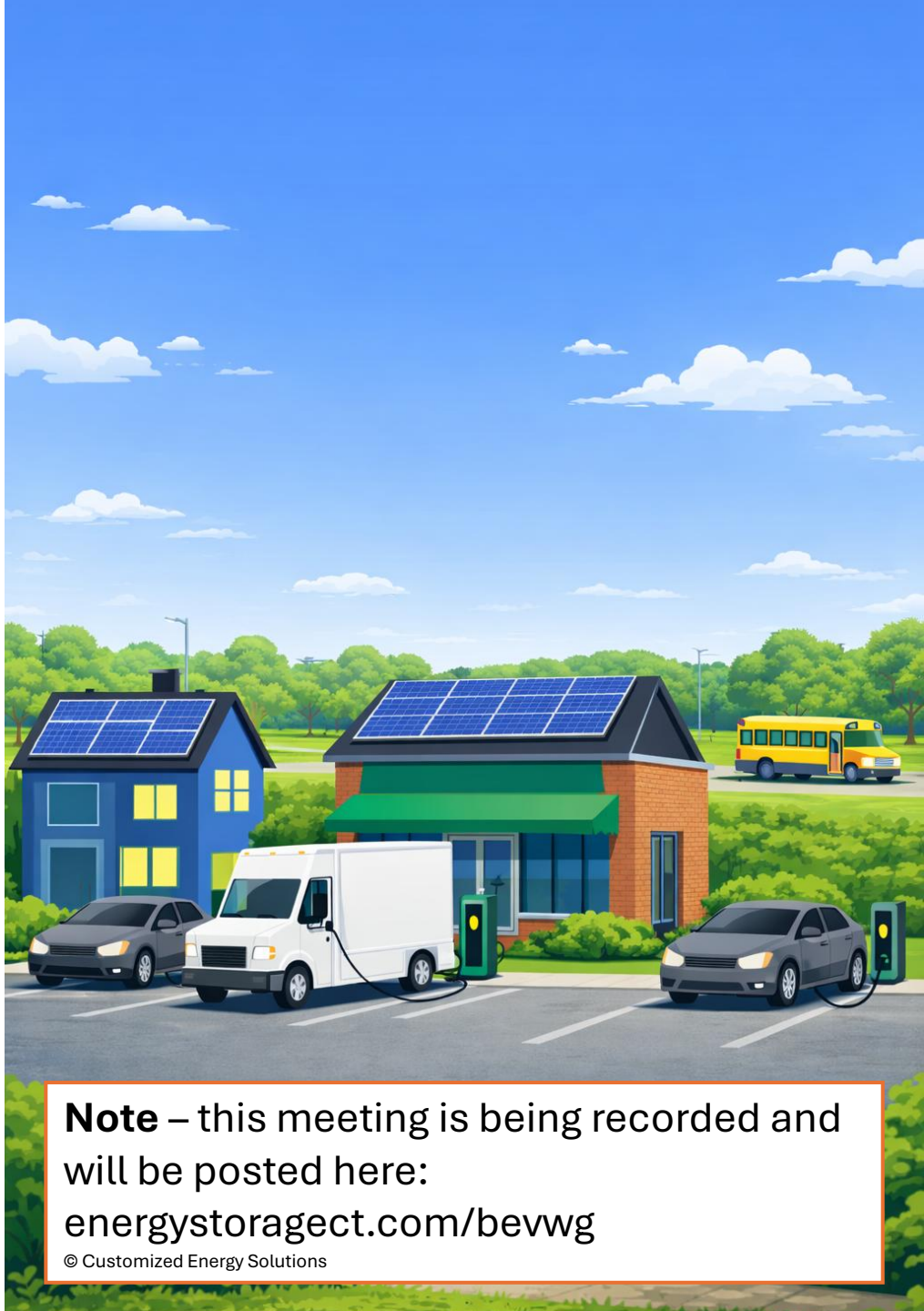
Bidirectional EV Working Group

Meeting #3: Technical Integration of EVs into ESS

energy storage SOLUTIONS

CONNECTICUT GREEN BANK EVERSOURCE UI An AVANGRID Company

April 16, 2026



Note – this meeting is being recorded and will be posted here: energystoragect.com/bevwg

Meeting Agenda – Meeting #3: Technical Integration Topics

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Agenda

1. Welcome & Overview
2. Device Enrollment Approach
3. Qualified Product List
4. Standards and Certifications
5. Metering and DERMS Integration
6. Wrap-Up & Next Steps

Objectives

- Discuss enrollment approach, the use of a qualified product list (QPL), required certifications, and metering and distributed energy resources management system (DERMS) integration for bidirectional EVs
- For each of the above items, draft a proposal that is sufficiently defined ahead of a consensus vote during Meeting 4

Logistics

- For clarifying comments and questions, please use hand raise function.
- There will be discussion periods during each section

Additional Information

- The WG Charter, meeting notes, slides, presentations and other resources are accessible at: https://energystoragect.com/bevwg/

Device Enrollment

Device Enrollment Approach

For bidirectional EVs, <u>what</u> should be enrolled?

- Relevance:
  - Decision on what is enrolled (e.g., **EV**, vs. **EVSE**, vs. **combination**) may have implications for other decisions, such as which standards may be applicable
  - Implementation considerations:
    - If an EV itself is enrolled, what happens if a customer replaces their bidirectional EV? Would they need to be re-enrolled? Would they be subject to new compensation rates if they'd changed since original enrollment?
    - What if a customer has two EVs at the same site with a single EVSE? Would only one vehicle be able to discharge? Would they both need to be enrolled?
- Current ESS approach:
  - Enrollment is based on a specific piece of equipment (including information on inverter and Battery Energy Storage System BESS) at a specific site associated with a specific account number.

EVSE Only	EVSE + Specific EV	Vehicle Only
Charger at a fixed location	Charger plus a named vehicle	EV via telematics where available
Vehicle-agnostic; no re-enrollment if vehicle changes	More precise data (e.g., info on kWh of EV); re-enrollment needed on vehicle change	Location-independent; complex for PA dispatch; may conflict with approach to interconnection.

Proposed Enrollment Approach

Proposal

- Enroll the **EVSE** at a specific location and account, including equipment details (make/model, number of chargers, ports, kW capacity per port)
- Program Administrators may optionally collect information on the primary associated vehicle(s), but vehicle changes would not trigger re-enrollment

Rationale: EVSE is the fixed, grid-connected asset; vehicle flexibility preserves customer experience without compromising program oversight. Likely to align with approach to interconnection.

Discussion:

- Does this approach work across customer segments — residential and non-residential?
- AC vs. DC coupled?
- Unintended consequences?

Qualified Product List

Qualified Product List - Purpose and Current ESS Approach

- Objectives/Purpose of a QPL:
  - Provides greater clarity to customers and contractors and helps them more quickly select equipment
  - Streamlines enrollment process; equipment on the QPL already screened for applicable technical eligibility requirements
- Current approach
  - Qualification is based on combination of battery and inverter
  - To be added to list, resources must meet receive certifications for UL 1973, UL 1741 SA, and UL 9540
  - To be added to list, applicants fill out the New Technology Application

Residential/Small Business:

Manufacturer	Energy Storage System Model
Briggs & Stratton	SPHI-B-6.6-L0 (6.65 kWh), SPHI-B-13.2-L0 (13.3 kWh), SPHI-B-19.8-L0 (19.95 kWh) batteries with select EG-4, Sol-Ark, and Solis inverters
Cadenza Innovation	CI48400-I-2P, CI48500-I-2P, CI48600-I-2P, CI48700-I-2P, CI48800-I-2P, CI481600-O-2P, CI481600-O-3P
Canadian Solar	EP Cube (9.9, 13.3, 16.6, 19.9 kWh)
Discover Energy Systems	Helios ESS (16.1 kWh) batteries with select Sol-Ark, Solis, EG4 inverters
Duracell Power Center	DURA 5 (5.12 kWh) Stackable Batteries with Max Hybrid 15 (12 kW) Inverter
Dyness	Tower T7 (7.1 kWh), Tower T10 (10.65 kWh), Tower T14 (14.2 kWh), Tower T17 (17.75 kWh), and Tower T21 (21.3 kWh) batteries with select Solis inverters
Eguana Technologies	Evolve LFP (14.2 kWh)
EG4 Electronics	FlexBOSS18 (13 kW), FlexBOSS21 (16 kW) inverter with WallMount 280 Ah Indoor (14.3 kWh), WallMount 280 Ah All Weather (14.3 kWh), and select Briggs & Stratton and Discover Energy Systems batteries

Extract from current ESS QPL; not the full list
https://energystoragect.com/submitted_ess_system_status_list/

California Energy Commission V2G Equipment List

- The California Energy Commission maintains a list of bidirectional-capable EVSE
- Aside from being V2G capable, only other criterion is 1741 certification
- Application also collects other relevant information (e.g., supported communication protocols, whether resources has power control system, etc.)
- Currently, 20 EVSE models listed from the manufacturers listed below
- Screenshot shows other provided fields
- Few other existing, dynamic lists of bidirectional EVSE

Manufacturer
Borg Warner
dcbel inc.
Fermata Energy
InCharge Energy
Nuvve Holding Corp.
Power Electronics
Tellus Power
Wall Box Chargers

Manufacturer	Model	Description	RatedPower	ACVoltage	SA	SB	PCS	CSIP
Borg Warner	RES-DCVC125-480-V2G	125kW Bi-directional DC Fast Charger for 100% BEV vehicles, 270-920Vdc, 200Amps, 480Vac, 3-phase input, outdoor use	125	480	True	False	Import Only	True
Borg Warner	RES-DCVC60-480-V2G	60kW Bi-directional DC Fast Charger for 100% BEV's. 270-870Vdc, 200Amps, 480Vac, 3-phase 60Hz input for outdoor use	60	480	True	False	Import Only	True
Wall Box Chargers S.L.U.	Quasar 2	Quasar 2 bidirectional charger enables vehicle-to-grid and vehicle-to-home charging. Advanced energy management and sustainable.	12.48	240	False	True	Import Only	True
Fermata Energy	FE-15	15-kW bidirectional, offboard DC charger with Distributed Energy Resource capabilities	15	480	False	False	None	False

https://v2gel.energy.ca.gov/Home/ProcessView

Applying the QPL to Bidirectional EVs: Key Questions

Key Questions on QPL:

- What is on the list? E.g., just EVSE? EVSE+EV pairings? Does this differ by AC vs. DC coupling (and or by which UL standard it's certified under, i.e., 1741 SB vs. 1741 SC)?
- Is the EVSE the correct piece of equipment to consider? Or, is it the asset controller? How do we know what the right piece of equipment is if not the EVSE itself. E.g., is it whatever piece of equipment is UL 1741 certified?
- Does the list attempt to indicate EV/EVSE interoperability?
- Does the existing new technology application process map cleanly onto V2G applications? Who is responsible for submitting new technology applications? E.g., can an aggregator submit a specific EVSE model to be reviewed?

Proposed QPL Approach

Proposal

- QPL is just for eligible EVSE (or, based on discussion above, other stationary pieces of equipment installed at the site), not for the EV. This would still be the case, even in instances in which EVSE/EV are 1741 SB certified as a composite distributed energy resources (DER).
- Would be based on applicable standards (next agenda item).
- QPL does not attempt to address interoperability; the Program Administrators can refer to other existing resources and/or to OEMs and aggregators for documentation on interoperability.

Rationale: EVSE is the fixed, grid-connected asset; vehicle flexibility preserves customer experience without compromising program oversight. Doesn't require PAs to determine vehicle interoperability, which can be challenging to determine, especially for MHDs.

Discussion

Standards and Certifications

Overview of Standards and Certifications

Ways of categorizing standards and certifications

What does it apply to?

- Equipment (e.g., battery cell, integrated pack, inverter, EVSE, EV)
- Installation (e.g., building codes)
- Process/organization

What function does it pertain to?

- Safety
- Power quality/grid integration
- Communication protocols/interoperability
- Privacy and data security

- In addition to ESS, a number of other processes/powers may introduce their own required standards and certifications, such as:
  - Interconnection (e.g., UL 1741)
  - Building/electrical code (e.g., 2023 NFPA 70 National Electrical Code)
  - National Highway Traffic Safety Administration (e.g., Federal Motor Vehicle Safety Standards 305/305a)

Standards/Certifications in Current ESS Program Manual

- The ESS Program Manual specifies that systems "should adhere to all applicable standards including, but not limited to, the following list" (see table to right)
- As noted above, the new technology application explicitly requires technologies be certified to the following standards:
  - UL 9540
  - UL 1973
  - UL 1741 SA (w/ reference to IEEE 1547-2018 2nd Edition)
- Primary standards/certifications referenced in Eversource Guidelines for Interconnection of Residential Single Phase Certified Inverter-Based Generating Facilities of 50 kW (AC) or Less:
  - UL 1741 – latest version, including PCS certification for limited-export systems
  - IEEE 1574
  - "Local codes"

Standard	Category
ANSI C62.41	Power Quality
ANSI C12.1	Metering
IEEE 519	Power Quality
IEEE 1547	**Interconnection**
UL 1741 SA	**Inverter/Grid**
UL 62109	Inverter Safety
UL 1642	Battery Cell
UL 1973	**Battery System**
UL 9540	**ESS System**
UL 9540A	Fire Testing
NFPA 855	Fire Code
NEC	Electrical Code
CT Building Code	Building Code
Local Codes	Building Code
FCC Part 15	Electromagnetic interference
NIST 800-171	Cybersecurity
ISO 27001	Cybersecurity

Applicability of Existing ESS Standards

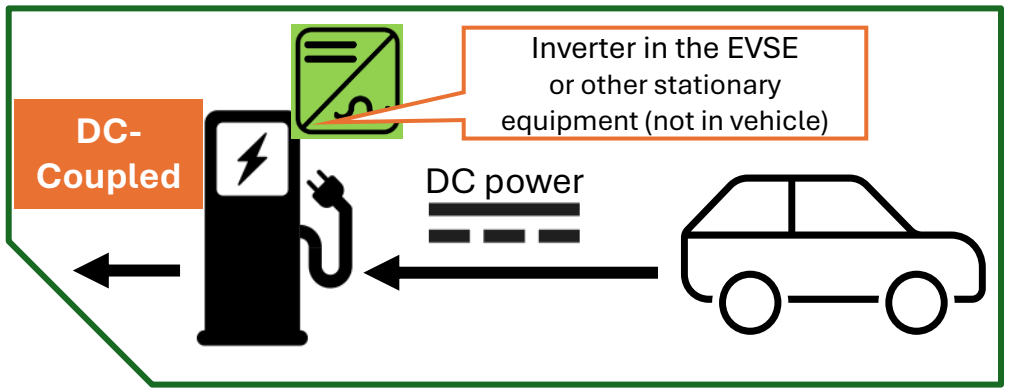
- Table to right shows responses received from WG participants on applicability of existing ESS requirements to EVs and EVSE
- Rows with borders are certifications currently required in new technology application
- **Takeaways:**
  - Many, but not all, existing standards will not apply to EVSE or to EVs – this may be ok, given program manual language: “as applicable”
  - UL 1973 and 9540 requirements in new technology application may not apply to EVSE
  - Consensus that UL 1741 and IEEE 1547 applicable to EVSE

Standard	Category	Currently in ESS?	Applicable to EVSE?	Applicable to EV?
IN CURRENT ESS PROGRAM				
ANSI C62.41	Power Quality	Yes	—	—
ANSI C12.1	Metering	Yes	✓ Yes	✗ Disagree
IEEE 519	Power Quality / Harmonics	Yes	✗ Disagree	✓ No
IEEE 1547	Interconnection	Yes	✓ Yes	~ No (split)
UL 1741 SA/SB	Inverter/Grid	Yes	✓ Yes	~ No (split)
UL 62109	Inverter Safety	Yes	~ No (split)	✓ No
UL 1642	Battery Cell	Yes	~ No (split)	~ No (split)
UL 1973	Battery System	Yes	~ No (split)	~ No (split)
UL 9540	ESS System	Yes	~ No (split)	✓ No
UL 9540A	Fire Testing	Yes	~ No (split)	✓ No
NFPA 855	Fire Code	Yes	~ No (split)	✓ No
NEC	Electrical Code	Yes	✓ Yes	✓ No
CT Building Code	Building Code	Yes	✓ Yes	✓ No
Local Codes	Building Code	Yes	✓ Yes	✓ No
FCC Part 15	EMI	Yes	✓ Yes	✓ No
NIST 800-171	Cybersecurity	Yes	—	—
ISO 27001	Cybersecurity	Yes	—	—

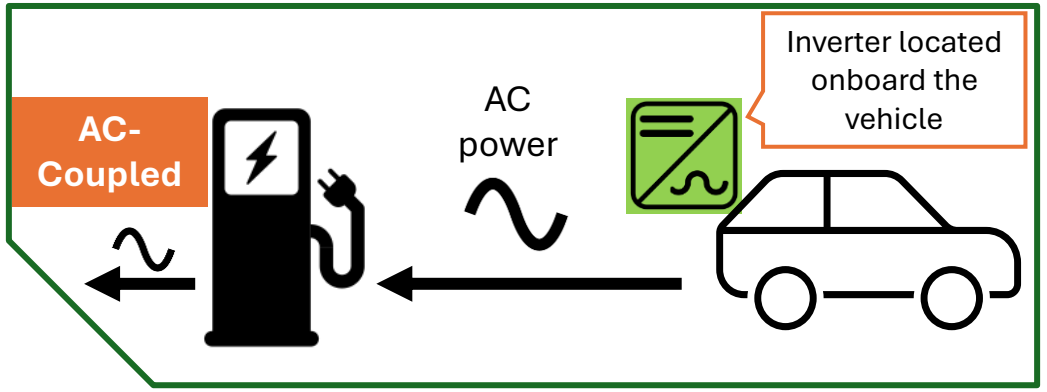
✓ All responses agree (not all participants responded to all fields)
~ Partial agreement (2 of 3 agree); majority position shown
✗ Two conflicting responses

UL 1741 – Applicability by AC vs. DC Coupling

- UL 1741 establishes safety, performance, and grid-interconnection testing requirements for inverters, converters, charge controllers, and interconnection system equipment used with distributed energy resources in stand-alone or grid-connected power systems)
- It is the primary certification requirement for interconnecting inverter-based distributed resources



- DC-coupled systems, in many technical respects, similar to stationary storage
- UL 1741 SA or SB (which are current requirements for ESS and interconnection) could apply to DC coupled bidirectional EVs



- AC-coupled systems don't fit into existing 1741 framework as cleanly
- Two main options for 1741 certification for these resources:
  - **Charger certified to UL 1741 SC; Vehicle certified to SAE J3072 -** Each side is certified independently. The long-term benefit is interoperability once SC publishes, any J3072-certified vehicle can export power through any SC-listed charger. This is the pathway designed for scale. 1741 SC has not been finalized, but anticipate approval this year.
  - **Charger and vehicle jointly certified to UL 1741 as a composite DER system through the Certification Requirement Decision (CRD) pathway.** The pair is tested together under the existing SB framework. This pathway is available right now, while SC is still being finalized, and gives manufacturers a clear route to market today.

Considerations for Required Standards

Considerations for potential new required standards:

- Is this requirement covered elsewhere (and is there the potential to create conflicting requirements)?
- Is the standard likely to affect customer experience? Improved safety, better use experience, improved interoperability, etc.
- Related – does it provide some insurance for future business failure (e.g., bankruptcy of equipment manufacturer)?
- Will the certification exclude some equipment, either on the market or already installed?
- How should standards that have not been finalized or are not yet widely adopted/implemented but could become relevant?

Potential Bidirectional EV-Specific Standards - Communications

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Discussion

- **Does it apply?**
- **Should it be an ESS requirement?**
  - Residential vs. non-residential?

Standard	Category	Applicable to EVSE?	Applicable to EV?	Recommended as ESS Requirement?	Description
ISO 15118-X	Communications	✓ Yes	~ Yes (split)	—	International standard series for vehicle-to-grid communication interfaces, covering plug-and-charge authentication, smart charging, and bidirectional power transfer protocols. 15118-20 standards includes specific consideration of bidirectional flows.
OCPP X	Communications	✓ Yes	~ No (split)	✓ Yes	Open Charge Point Protocol — an open communication standard between EV charging stations and central management systems for monitoring, control, and billing. Latest version (2.1) incorporates bidirectional functionality, but not yet widely adopted. OCPP a fairly common requirement for public EVSE (esp. Level 3), e.g., CALeVIP 2.0.
IEEE 2030.5	Communications	✓ Yes	✓ Yes	✓ Yes	Smart Energy Profile application protocol used by some utilities for demand response, distributed energy resource management, and grid-interactive device communication.

✓ All responses agree (not all participants responded to all fields)
~ Partial agreement (2 of 3 agree); majority position shown
X Two conflicting responses
— No response, or no yes/no response

Potential Bidirectional EV-Specific Standards - Safety

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Discussion

- **Does it apply?**
- **Should it be an ESS requirement?**
  - Residential vs. non-residential?

Standard	Category	Applicable to EVSE?	Applicable to EV?	Recommended as ESS Requirement?	Description
UL 9741	Safety	✓ Yes	✓ No	✓ Yes	Safety standard for bidirectional electric vehicle supply equipment (EVSE) capable of supplying power back to the grid or premises.
UL 2594	Safety	✓ Yes	✓ No	✓ Yes	Safety standard covering the installation and use of electric vehicle supply equipment (EVSE) for charging, including personnel protection and connector requirements.
UL 2202	Safety	✓ Yes	✓ No	—	Safety standard for electric vehicle (EV) charging system equipment, covering the electrical components and assemblies used in stationary EVSE.
UL 2580	Safety	✓ No	✓ Yes	—	Safety standard for rechargeable battery packs used in electric vehicles, addressing electrical, mechanical, and environmental testing for propulsion batteries.
ISO 26262	Safety	✓ No	✓ Yes	—	International standard for functional safety of electrical and electronic systems in road vehicles, defining safety integrity levels (ASIL) and development processes.

✓ All responses agree (not all participants responded to all fields)
~ Partial agreement (2 of 3 agree); majority position shown
✗ Two conflicting responses
— No response, or no yes/no response

Potential Bidirectional EV-Specific Standards - Other

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Discussion

- **Does it apply?**
- **Should it be an ESS requirement?**
  - Residential vs. non-residential?

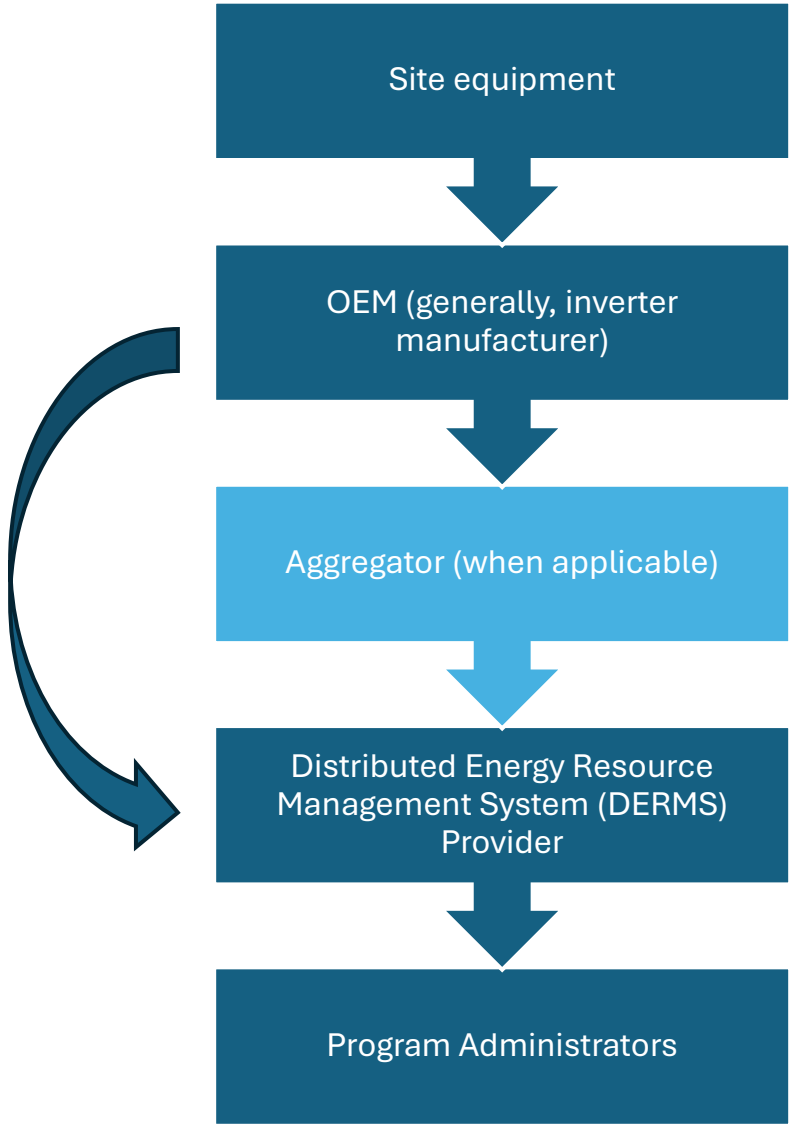
Standard	Category	Applicable to EVSE?	Applicable to EV?	Recommended as ESS Requirement?	Description
SAE J3072	Other	**~ No (split)**	**~ Yes (split)**	—	Defines requirements for the interconnection of plug-in electric vehicles with external power systems, including bidirectional energy transfer between the vehicle and the grid.
ISO/SAE 21434	Other	**✓ Yes**	**✓ No**	—	Joint ISO/SAE standard for cybersecurity engineering of road vehicles, defining a framework for threat analysis, risk assessment, and secure development lifecycle.

	✓ All responses agree (not all participants responded to all fields)
	~ Partial agreement (2 of 3 agree); majority position shown
	✗ Two conflicting responses
—	No response, or no yes/no response

Metering and DERMS Integration

Current ESS Approach: Metering and DERMS Integration

- Data flow - see visual to right for high level flow of data
- Metering – performance based on inverter data; no dedicated production meter required
- DERMS integration and dispatch
  - Integration with PAs' DERMS providers (currently two DERMS providers in the ESS program) a central requirement; there is not currently a specific communication standard/protocol (e.g., OpenADR) required
  - DERMS providers do not directly dispatch resources; instead, they provide event notifications and aggregate telemetry data
- Required telemetry data
  - Required fields:
    - Site/resource information: customer name, site address, utility account number, battery OEM, device universal unique identifier, BESS kW and kWh nameplate capacities
    - Telemetry data: kW discharged, stored kWh (or State of Charge)
  - Telemetry data – 15 minute intervals, latency of no more than 1 month
- Parties integrating (e.g., Original Equipment Manufacturer OEMs vs. aggregators)
  - Currently – almost exclusively OEMS; this may change as more C&I customers come online.



Discussion

- **Metering**:
  - Primary telemetry data collected/used: 15 minute interval, kW charged/discharged, and stored kWh
  - **Discussion:** any concern with collecting this data at the vehicle or port level?

- **DERMS integration:**
  - **Discussion:**
    - Should the program require aggregators/OEMs to meet a certain communication protocol for DERMS integration (e.g., OpenADR)? If not, what other approach should be considered to ensure reasonable integration costs (especially for low-volume new market entrants) and accuracy of data?
    - What requirements (if any) should there be around the *type* of entity that integrate with the DERMS and enroll customers? E.g., providers that use app login credentials instead of using approved integration with OEM?

Wrap-Up & Next Steps

Review of Meeting Topics

Meeting	Theme	Key Questions & Focus Areas
2	**Bidirectional EV Technology Requirements by Vehicle Class**	• Technical characteristics of bidirectional EVs by vehicle class; ESS participation readiness. • Vehicle, charger, and site-level requirements for bidirectional operation. • Integration of IES pilot early lessons. • Potential for phased inclusion of bidirectional EVs into ESS by vehicle class
3	**Technical Integration of Bidirectional EVs into ESS**	• How ESS technical requirements must adapt for bidirectional EVs; data, telemetry, and verification needs. • DERMS capabilities, constraints, and potential workarounds. • Privacy, cybersecurity, and data access considerations.
4	**Cross-Program Participation**	• Overlap between ESS Program and other state EV programs, particularly managed charging. • Distinguishing load reduction vs. energy discharge across programs. • Considerations across programs to avoid double-counting. • Identification of relevant tariffs (enabling and/or potential conflicts)
5	**Bidirectional EV Incentives**	• Appropriate incentive structure for bidirectional EV participation in ESS. • Upfront versus performance-based incentives. • Incentives tied to EVSE, vehicles, or integrated systems.
6	**Draft Recommendations Review**	• Present draft findings; identify consensus vs. minority views; confirm alignment with PURA's five directives. • Document consensus positions and non-consensus items. • Alignment with Interconnection Working Group recommendations.

Meeting Schedule

Meeting	Topic	Date
1	Kickoff & Framing	Friday, March 6th: 9:00-10:30AM ET
2	Bidirectional EV Technology Requirements by Vehicle Class	Tuesday, March 31st: 9:00-10:30AM ET
3	Technical Integration of Bidirectional EVs into ESS	Thursday, April 16th: 9:00-10:30AM ET
4	Cross-Program Participation	Thursday, May 7th: 9:00-10:30AM ET
5	Bidirectional EV Incentives	Friday, May 29th: 9:00-10:30AM ET
6	Draft Recommendations Review	Friday, June 12th: 9:00-11:30AM ET