CALIFORNIA BUILDING OFFICIALS

63rd Annual Business Meeting

Advancements in Clean Energy Technologies & Sustainable Energy Systems

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Panel Moderator: John Taecker - Taecker Codes

Pete Jackson - City of Bakersfield

Mike Stone - NEMA

Duncan Cleminshaw - GAF Energy

Agenda

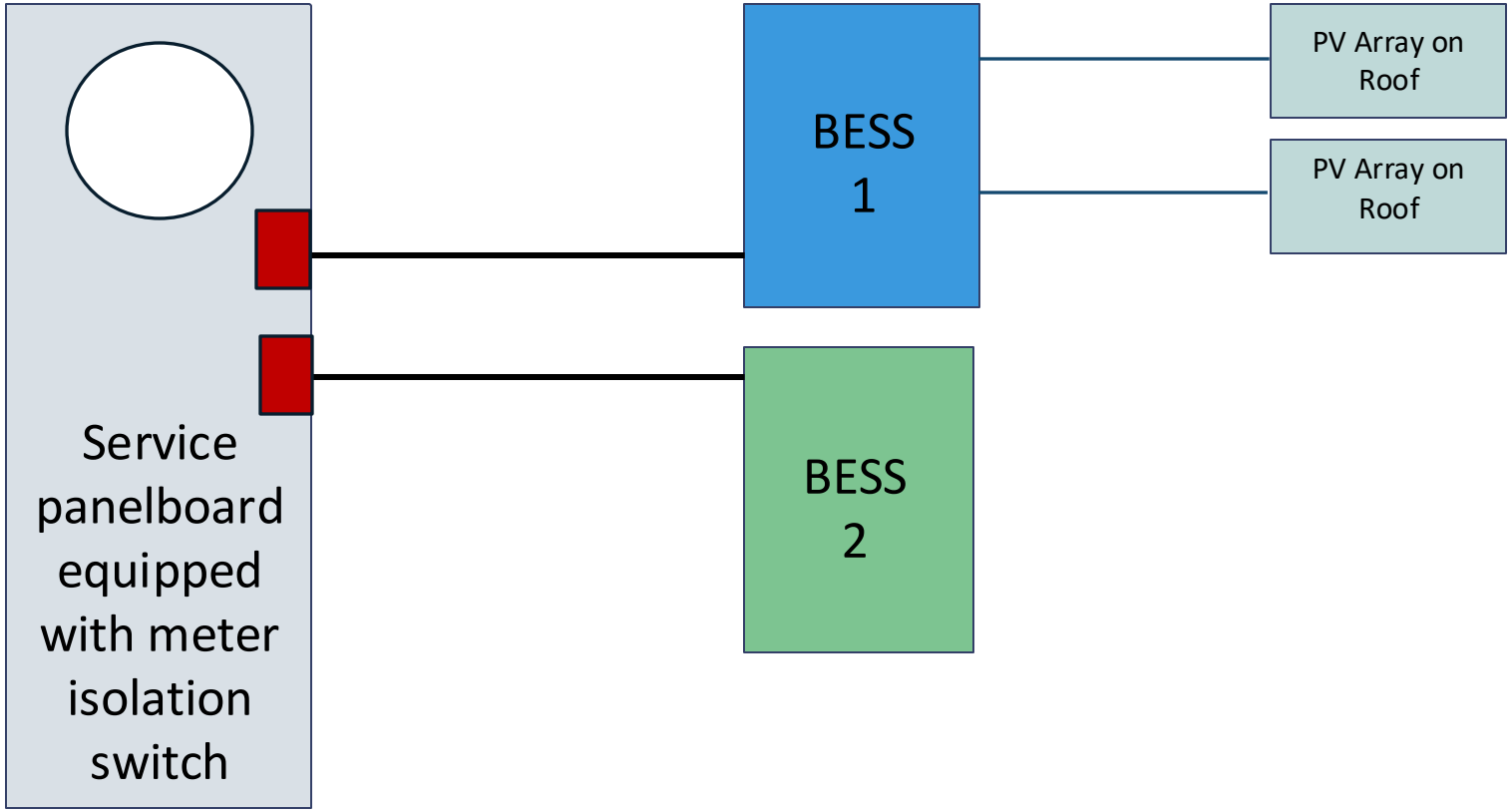
Common correction notes
Electric vehicles
Rapid shutdown
Flashing for rooftop mounted PV
BIPV roofing
Power control systems
Energy storage systems
Portable power packs
Batteries and battery powered equipment/devices

Common Correction Notice

Install correct additional fastener for back fed circuit breakers per CEC 110.3, 408.36, & 705.12

Back fed plug-in style circuit breakers will still be energized by the attached conductors even after removed from the panelboard

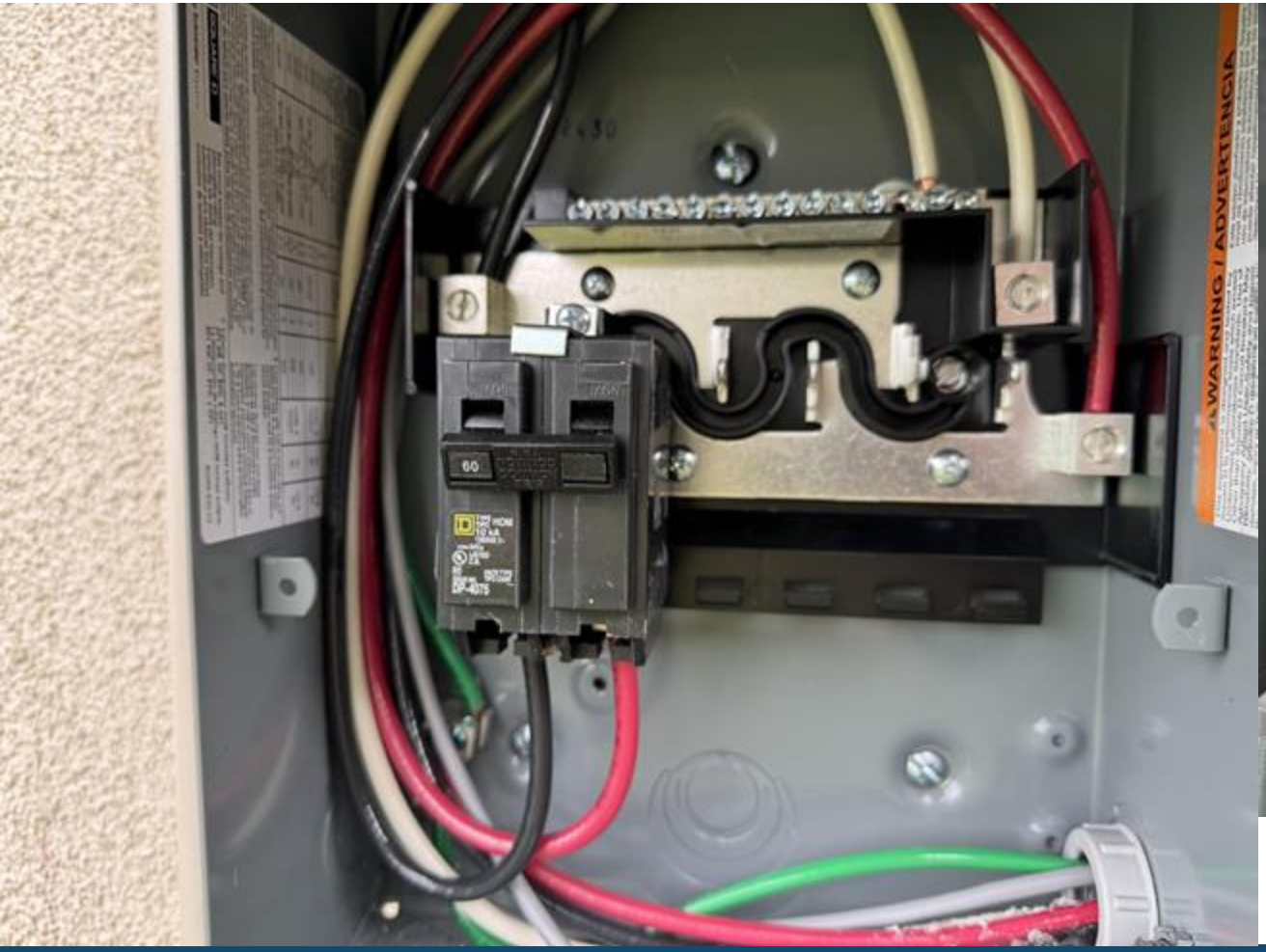
= Back fed plug-in circuit breakers

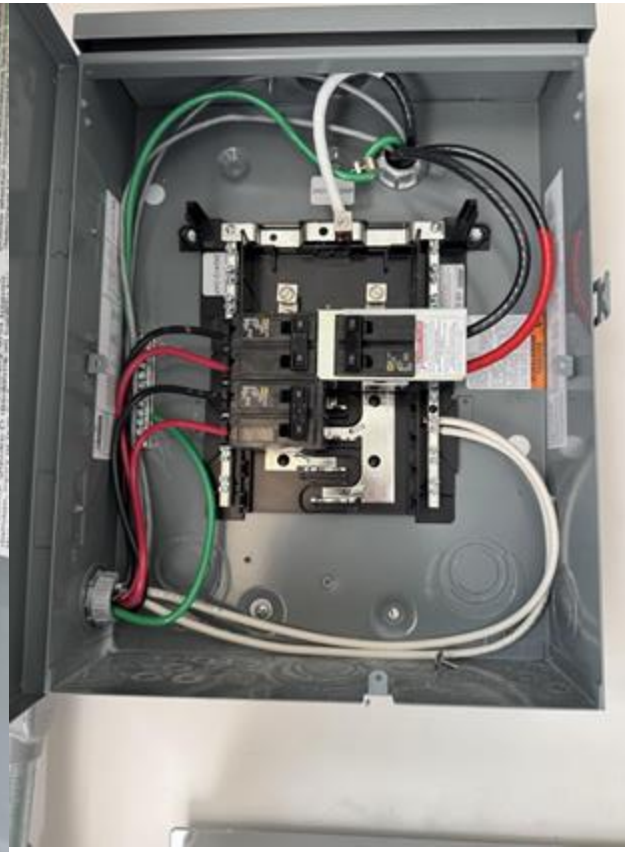


Meter switch (MID) that isolates the utility during an outage


CAUTION:

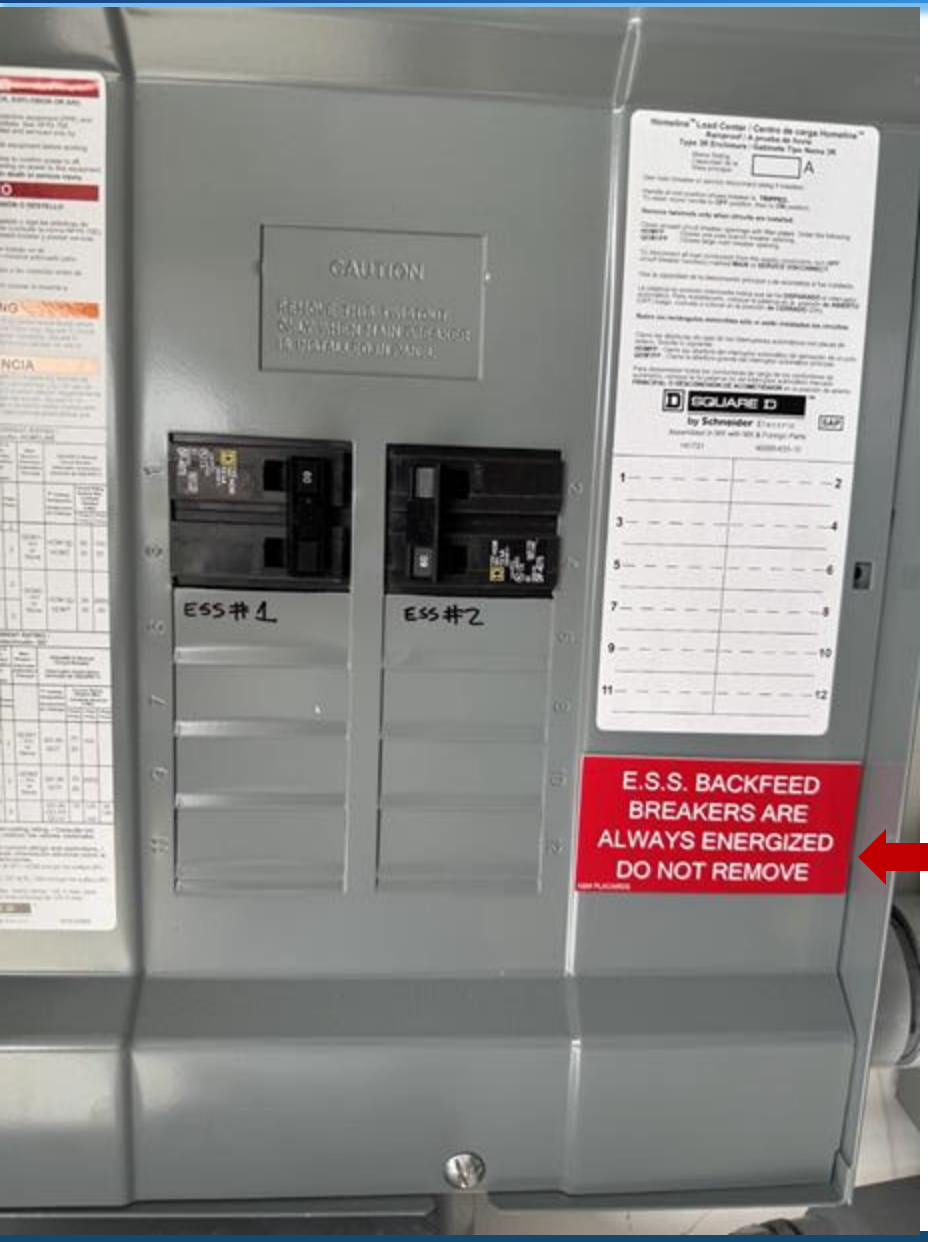
Are the correct fasteners available?





Correct fasteners not available? Options?

- CEC 90.4 permits alternative methods when required equipment is not available
- Warning label?
- Recognition of future code allowances?
- Field fabricated fastener?



Warning Label?

ESS BACKFEED
BREAKERS ARE
ALWAYS ENERGIZED
DO NOT REMOVE

2026 NEC 705.30(E)

Public Comment No. 1791-NFPA 70-2024 [Section No. 705.30(E)]

(E) Fastening.

Where power output circuits ~~can only operate in interactive mode,~~ are connected to the load side of plug-in-type circuit breakers, the circuit breaker shall be permitted to omit the additional fastener normally required by 408.36(D) where the power source has either of the following settings:

(1) the power source only operates in interactive mode

(2) the power source has open-phase detection when operating in island or stand-alone mode.

Statement of Problem and Substantiation for Public Comment

This change in the first draft may be too limiting. There are many multimode inverters that have loss of phase detection that automatically shutdown if a plug-in breaker were to unlatch from the busbar. This comment allows for two methods to meet the requirements. Many inverters are not multimode so those inverters that only work in interactive mode comply without additional information. Multimode inverters may respond differently to loss of phase so there may be a need for additional information on the certification of the multimode inverter to comply with this section. Several ESS and PV inverters have the capability to respond to a loss of phase while in island mode.

Related Item

- FR-8710

Use of future code rules?

(E) Fastening.

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(1) the power source only operates in interactive mode

(2) the power source has open-phase detection when operating in island or stand-alone mode.

EV

- Electric vehicle charging equipment – UL 2202.
- Electric vehicle supply equipment – UL 2594.
- Electric vehicle wireless power transfer equipment – UL 2750.
- Electric vehicle power export equipment – UL 9741

- Proposals to 2027 editions of the IBC, IFC and IRC

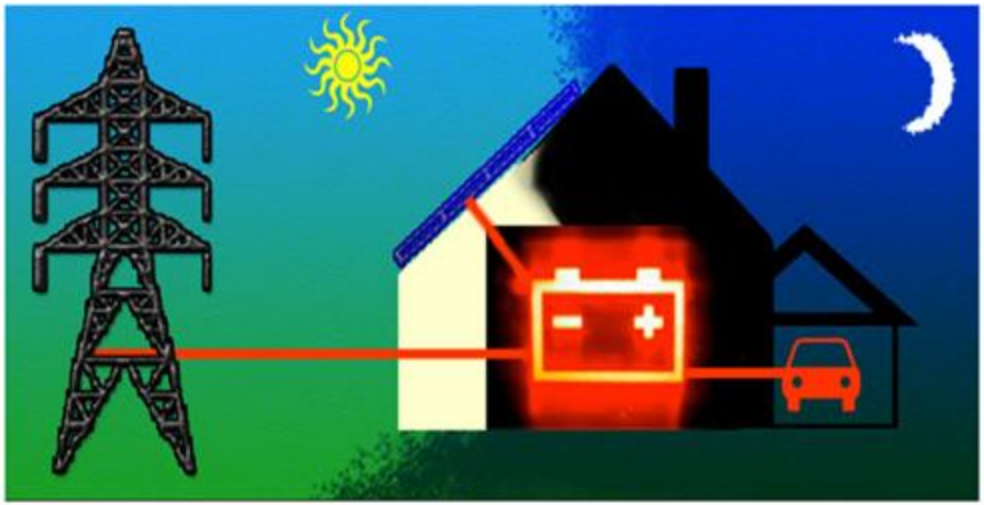
- Electric vehicle wireless power transfer equipment – UL 2750

CXP23EVCS717204

FFTN. Guide Info - Electric Vehicle Power Export Equipment (EVPE).

This category covers electric vehicle power export equipment (EVPE) that can be unidirectional or bidirectional. Unidirectional EVPE equipment exports power from the vehicle to an offboard load, such as a receptacle bank. Bidirectional equipment provides power to the vehicle for charging of the onboard battery, and exports power to the grid, premise or load, but export and charging do not occur at the same time. This equipment is intended to be installed in accordance with NEC.

The basic standard used to investigate products in this category is UL 9741 Electrical Vehicle Power Export Equipment, or "Outline of Investigation for Electric Vehicle Power Export Equipment."



Note: UL 9741 Outline of Investigation will no longer be effective 2027-08-31

"Products are identified by the specific standard-ORD/edition/latest revision date in the individual certifications."

UL Solutions

California EVSE Overview

- CALGreen vs. NEC
- Changes coming to 2025 CALGreen
- Automatic Load Management Systems (ALMS)
- Electric Vehicle Power Export

CALGreen vs. NEC

CALGreen specifies where EVSE is to be installed, number of charging spaces and chargers to be provided, some parameters for installations. I.E., where and when to install EVSE.

NEC specifies safety code requirements, i.e., how to do it.

Significant Changes to 2025 CALGreen

- Residential MFD – distinctions between Assigned Parking, Unassigned Parking, and combined Assigned/ Unassigned Parking
- 100% of dwelling units must be provided with an EV-ready circuit (40% in 2022 CALGreen)
- J1772 or J3400 (NACS/Tesla) connector configurations are allowable (at least one to be J1772)
- Nonres – number of required EV spaces has increased

Courtesy of

little monsters

chargepoint.

CALGreen Definition
Automatic Load Management System (ALMS)

"A system designed to manage load across one or more electric vehicle supply equipment (EVSE) to share electrical capacity and/or automatically manage power at each connection point"

Similar definition in 2023 NEC Article 100 for "Load Management"

ALMS can be used for a single charger installation or multiple chargers

NEC and CALGreen ALMS/EMS requirements

2020 NEC Section 625.42 allows an energy management system (EMS – equivalent of ALMS) to manage EVPTS loads. The load is calculated at the maximum load permitted by the EMS, i.e., set point.

2023 NEC 625.42 refers back to Section 750.30 (Energy Management Systems) for specific requirements

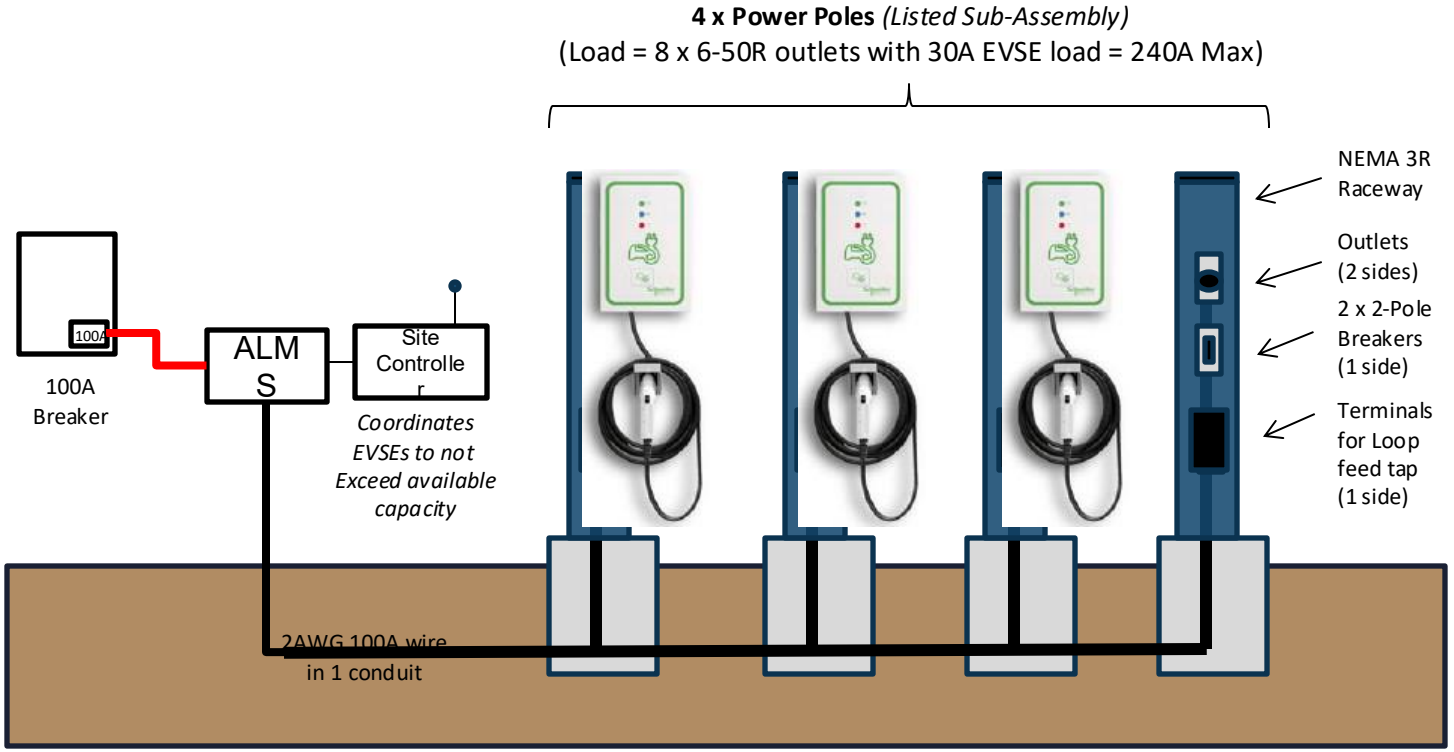
CALGreen allows ALMS for EVSE installations but has minimum requirements for the set point.

ALMS, EMS, PCS are important components of an electrical system to accommodate increased loads from EVSE and building electrification

Automatic Load Management System (ALMS)

Overview

8 x 30A smart plug-able EVSEs share 100A of capacity



EVSE Power Export Standards

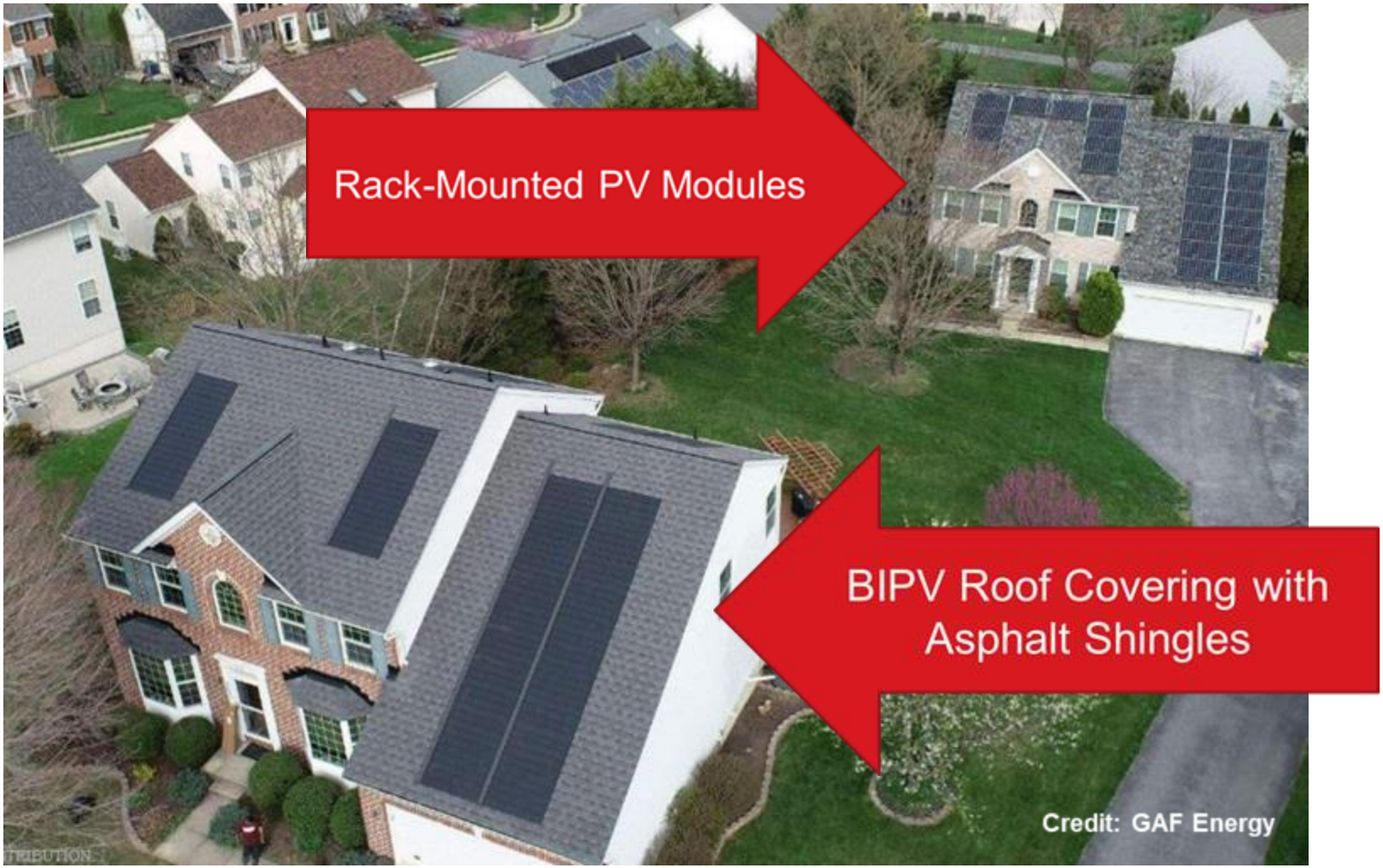
2020 NEC – Title of Article 625 changed from "Electric Vehicle Charging System" to "Electric Vehicle Power Transfer System".

September 29, 2023 – UL publishes UL Standard 9741 for Electric Vehicle Power Export Equipment (EVPE)

February 19, 2025 - "Today, NEMA announced the publication of its Electric Vehicle Supply Equipment (EVSE) Power Export Permitting Standard, defining the technical parameters to allow electric vehicle owners to utilize their vehicles as mobile energy storage units and sell excess energy back to the grid."

Often referred to as vehicle to grid (V2G) and vehicle to building/home (V2B, V2H)

BIPV Roof Coverings in the Residential Code



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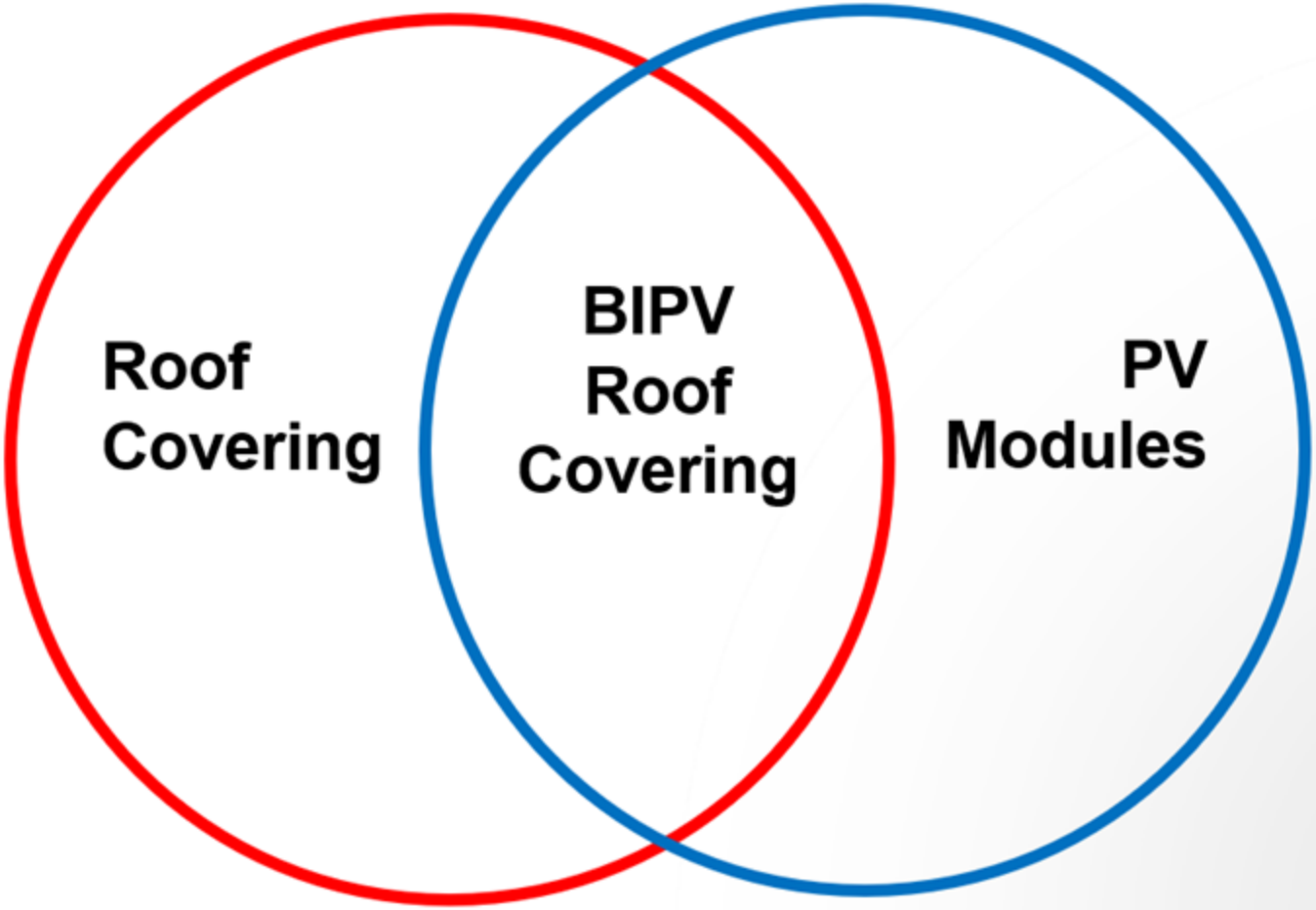

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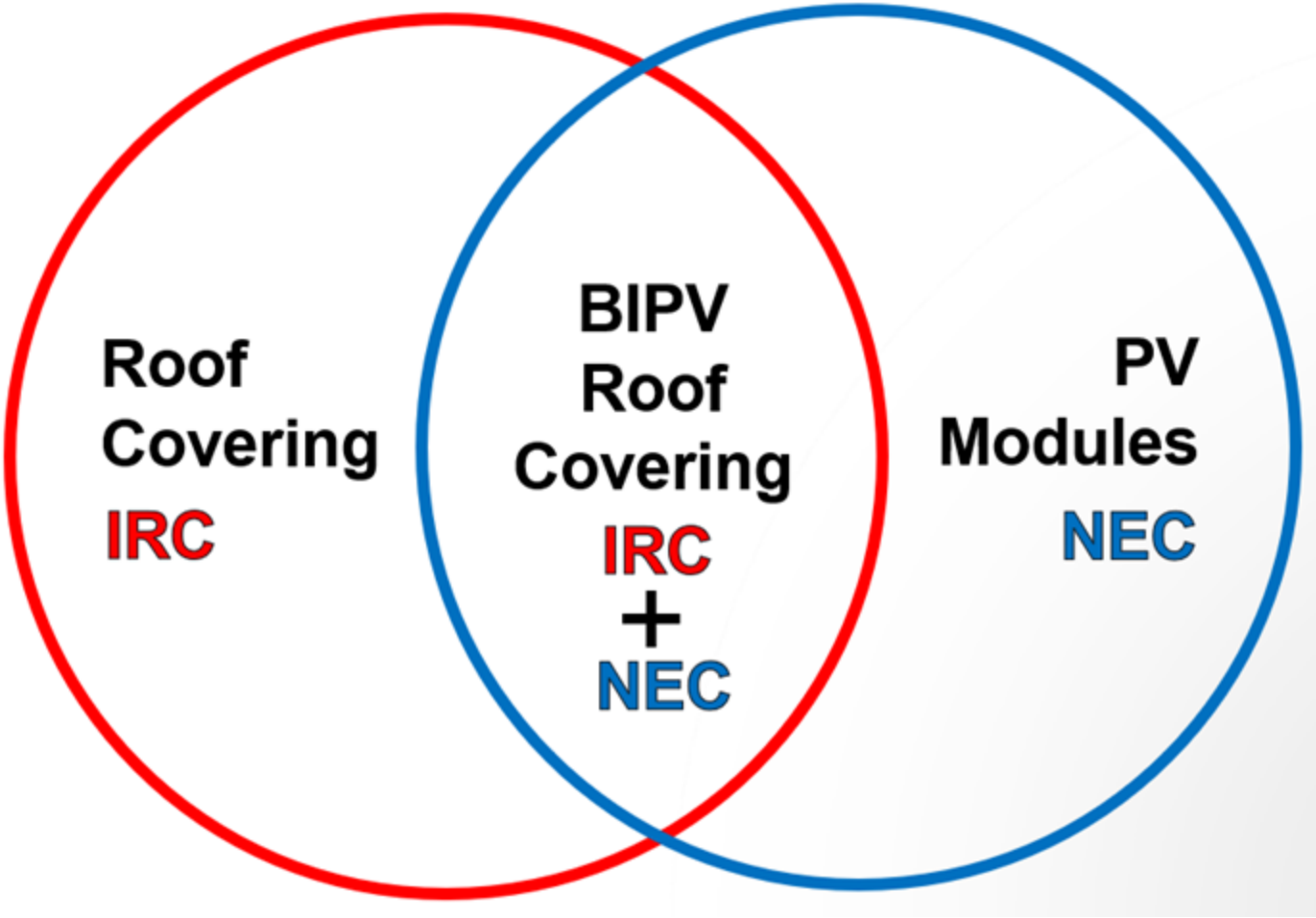

BIPV Roof Coverings & UL 7103

UL 7103 BIPV Roof Coverings

- **NEW:** UL standard created specifically to cover BIPV roofing
- Added to IBC & IRC in 2021 Code Cycle
- ICC ES AC 365 no longer needed
- In the code now: Chapter 9 (CRC) and Chapter 15 (CBC)
- Addresses every requirement for BIPV Roof Coverings including…
  - Material standards
    - Roofing
    - Photovoltaics
  - Fire classification
  - Wind resistance
  - Impact resistance
  - Wind-driven rain
- Guess the author, win valuable prizes

UL 7103 the new standard for building integrated photovoltaics

Architectural designs drive standards development

As solar photovoltaic (PV) technology matures it is increasingly being integrated into building construction and used to replace conventional materials in parts of the building envelope such as roofs, curtain walls, and windows. As conventional roof installations continue to increase and PV prices decrease, Building Integrated Photovoltaics (BIPV) are gaining popularity. Architects are now integrating the technology into their designs for the aesthetic value while helping building owners save on their cost of electricity with environmentally friendly generation. Furthermore, BIPV is a means to achieve compliance with energy conservation and sustainability requirements, and helps in achieving a LEED Building certification.

What is BIPV?

BIPV are products incorporating photovoltaic modules that also function as a component of the building envelope, and have been designed for both the basic requirements for both photovoltaic products and construction materials they are intended to replace. BIPV products are intended for mounting integrally to the structure or protective surfaces of a building in one of two primary installation methods:

- to serve as the roof, or as a major component of the roofing system of a building
- to serve as part of a structural or non-structural component of a building, such as a curtain wall, facade, atrium, or skylight.

What is different about BIPV testing?

Currently, BIPV systems and their mounting means for roofing systems are evaluated separately for compliance to UL 1703, as well as UL 790 and either ASTM D3161 or UL 1897. The safety evaluation includes electrical, temperature, mechanical loading, wind resistance, impact and fire tests. The product's output wiring system is also investigated for conformance with the provisions of the National Electrical Code (NEC).

Having one standard to address all aspects of concern - electrical, fire, wind resistance, weather protection, impact resistance and durability - of this new type of building material makes it far easier far easier to demonstrate code compliance.

Coming soon from….

SEAC's BIPV Task Group

Plan Check & Permitting Guidelines

SEAC
Sustainable Energy Action Committee

- Key Code articles
- Safety Standards
- BIPV vs rack-mounted solar
- Structural considerations
- Trades to install

Feature or Function	*Typical Rooftop-Mounted PV Panel System*	*Typical BIPV Roof Covering*
Method of Attachment	Racking on stand-offs attached to rafters or trusses at *widely-spaced* intervals	Fastened directly to sheathing or battens at *frequent* intervals
Grounding / Bonding / EGC of module frames & racking	Yes	No
Installed above existing roof assembly	Yes	No
Imposes concentrated wind & snow loads into individual rafters / trusses	Yes	No
Wide variability of wind & snow loads into the structure that		

CRC Roadmap for *PV Shingles*

[RB] PHOTOVOLTAIC SHINGLES

A roof covering that resembles shingles and that incorporates photovoltaic modules.

Characteristic	*Code Article*	*Related Codes & Applicable Standards*
Definition	*Ch. 2*	*None*
Photovoltaic systems	*R324.3*	*NFPA 70 (NEC)* *UL 1703* *UL 61730-1 & UL 61730-2*
Building-Integrated Photovoltaic Systems	*R324.5*	*Various*
Fire Classification	*R324.5.2*	*R902.3* *UL 790/ASTM E108* *Per UL 7103*
Photovoltaic Shingles	*R324.5.1*	*R905.16*
Roof Access and Pathways	*R324.6* *Exception 4*	*NEC 690.12(B)(2)* *UL 3741*
Emergency Escape and Rescue Openings	*R324.6.3* *Exception*	*NEC 690.12(B)(2)* *UL 3741*
Deck requirements	*R905.16.1*	*Various*
Deck slope	*R905.16.2*	*2:12 or greater*
Underlayment	*R905.16.3*	*R905.1*
Ice barriers	*R905.16.3.1*	*R905.1.2*
Material standards – Equipment listings	*R905.16.4*	*UL 7103* *UL 61730-1 & UL 61730-2*
Attachment	*R905.16.5*	*Per Manufacturer*
Wind resistance	*R905.16.6*	*ASTM D3161* *Per UL 7103*

CRC Roadmap for *BIPV Roof Panels*

[RB] BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) ROOF PANEL

A photovoltaic panel that functions as a component of the building envelope.

Characteristic	*Code Article*	*Related Codes & Applicable Standards*
Definition	*Ch. 2*	*None*
Photovoltaic systems	*R324.3*	*NFPA 70 (NEC)* *UL 1703* *UL 61730-1 & UL 61730-2*
Building-Integrated Photovoltaic Systems	*R324.5*	*Various*
BIPV Roof Panels	*R324.5.3*	*R905.17*
Fire Classification	*R324.5.2*	*R902.3* *UL 790/ASTM E108* *Per UL 7103*
Roof Access and Pathways	*R324.6* *Exception 4*	*NEC 690.12(B)(2)* *UL 3741*
Emergency Escape and Rescue Openings	*R324.6.3* *Exception*	*NEC 690.12(B)(2)* *UL 3741*
Deck requirements	*R905.17.1*	*Various*
Deck slope	*R905.17.2*	*2:12 or greater*
Underlayment	*R905.17.3*	*R905.1*
Ice barrier	*R905.17.3.1* *R905.17.4*	*R905.1.2* *R301.2*
Material standards – Equipment listings	*R905.17.5*	*UL 7103* *UL 61730-1 & UL 61730-2*
Attachment	*R905.17.6*	*Per Manufacturer*

CEC: Solar Panels vs BIPV Roof Coverings

Credit: Longi

≈

Credit: GAF Energy

What's the same?

- Look different, but work the same
- Treated identically in the CEC
- Even definition of "BIPV" got removed from the CEC - no code articles
- Everything from the edge of the array down to the ground is the same as current plan check

What's different?

- No racking & no metal frames means less to ground & bond (EGC)
- Lower voltage = ***many more*** modules in each system (*typically*)
- MLPE not common (SolarEdge, Enphase, etc.)
- Rapid shutdown compliance to UL 3741 *PV Hazard Control*
- May meet exceptions for *Access Pathways & Setbacks* (R324.6)

Coming in January 2026…

- **<u>Definitions are consolidated</u>**:
  - *"Photovoltaic Shingles"* & *"BIPV Roof Panels"* become…
  - *[RB] Building-integrated photovoltaic (BIPV) roof covering - A BIPV system that also functions as a roof covering. Coverings include, but are not limited to, shingles, tiles and roof panels.*

- **<u>Code articles move</u>**:
  - R324 *Solar Energy Systems* moves to R329
  - R905.16 *PV Shingles* moves to R905.15 ***BIPV*** *Shingles*
  - R905.17 *BIPV Roof Panels* moves to R905.16 *BIPV Roof Panels* ***Applied Directly to the Roof Deck***

Rapid Shutdown

- NEC 690.12
- IFC 1205
- UL 3741, Standard for Photovoltaic Hazard Control

Flashing devices, materials and methods

- Flashing for rooftop-mounted PV panel systems
- IBC 1503.2
- IRC R903.2
- UL 2703A, Outline of Investigation for Flashing Devices and Systems for Rooftop-Mounted Photovoltaics
  - Materials
  - Durability
  - Wind-driven rain testing

Power Control Systems (PCS)

- Monitors the output of power sources
- Regulates or limit current or power within predefined limits
- Can be a single device or a complex array of devices working in concert
- Unlike the energy management system (EMS), which focuses on optimizing energy usage and cutting costs, the PCS addresses the essential aspects of load control and safety

PCS Components

- Generation devices, including inverters and engine generators
- Load control applications, such as electric vehicle (EV) charging management
- Energy storage systems
- Loads
- Circuit controllers
- Additional equipment managing current flow

Power Control Systems (PCS)

- UL 3141, Outline of Investigation for Power Control Systems
- Defines requirements for the safety and reliability of PCS products and components
- Essential aspects of load control and safety
- Applicable to PCS across various settings, including residential homes, commercial buildings and areas adjacent to electrical panels

Energy Storage Systems (ESS)

- UL 9540, Energy Storage Systems

- Large scale fire testing
- UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
- UL 9540B, Outline of Investigation for Large-Scale Fire Test for Residential Battery Energy Storage Systems

Portable Power Packs

- UL 2743, Portable Power Packs
- New IFC 1208 (for the 2027 edition)
- aka power banks, power chargers

Batteries and Battery Powered Equipment and Devices

- New Chapter 42 (2027 IFC), proposed to 2027 IBC
- The storage of lithium-ion and lithium metal batteries at research, testing, manufacturing, recycling, and other facilities.
- The charging, use, maintenance, and repair of battery operated equipment and devices.
- The use, operation and maintenance of portable power packs with an energy capacity of 1 kWh or greater

Battery Powered Equipment and Devices

- Micromobility devices (hoverboards, e-bikes, e-scooters) - UL 2272 or UL 2849
- Automated mobile platforms (AMPs) – UL 3100
- Robotic equipment – UL 3300
- Industrial trucks – UL 583
- Equipment and appliances – UL 2595 or the applicable standard for its use

Informational Resources

Sustainable Energy Action Committee (SEAC) – www.sustainableenergyaction.org

UL Solutions – www.ul.com/codeauthorities

NEMA – www.makeitelectric.org

Questions?

If you have any questions, please contact the CALBO Office at info@calbo.org.