TRI-COUNTY
REGIONAL ENERGY NETWORK
SAN LUIS OBISPO • SANTA BARBARA • VENTURA

April 16, 2026

Energy Performance and Fire-Resistant Construction

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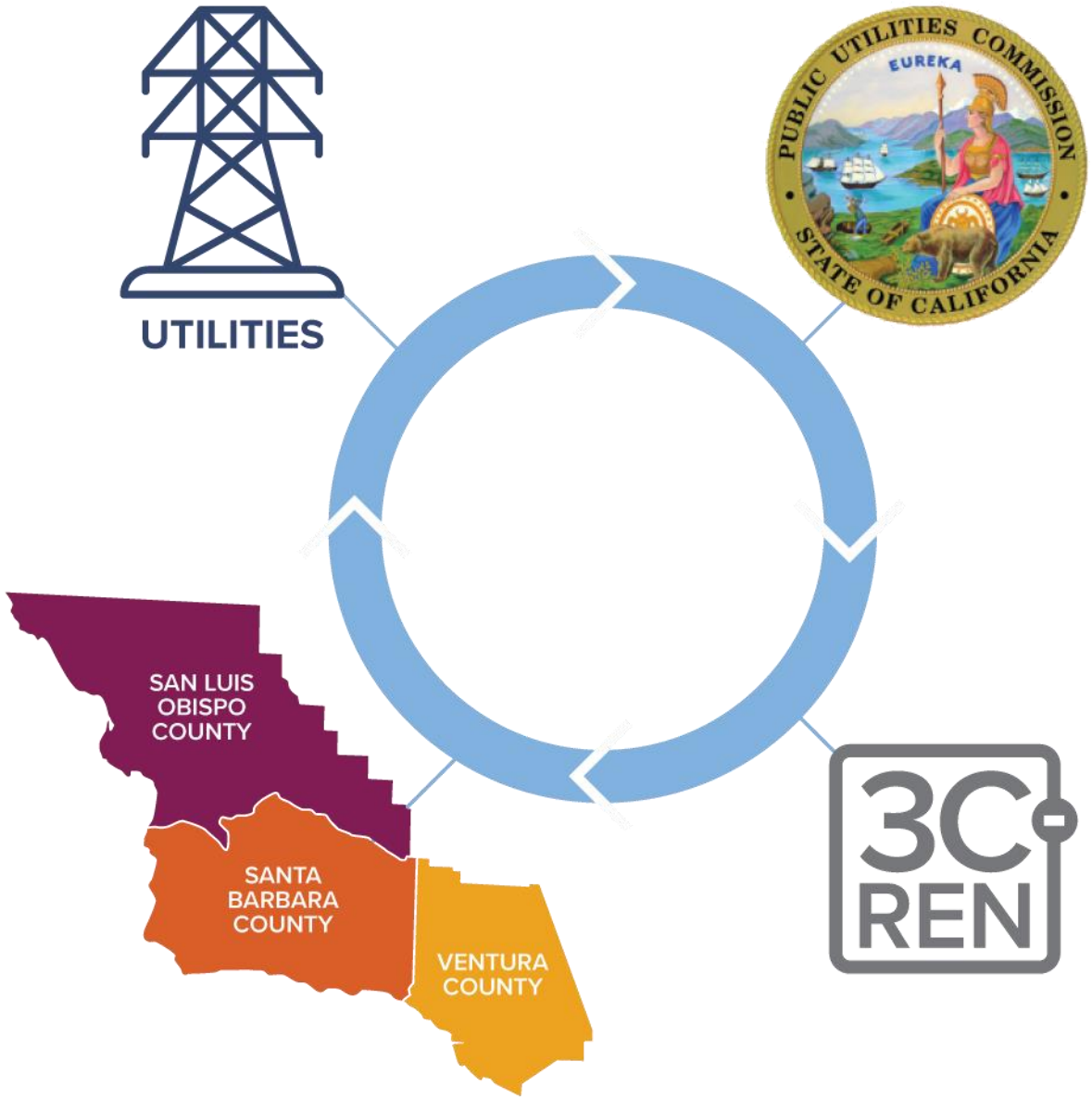
In Balance Green Consulting

Before We Begin

Here are some quick reminders:

- Did you call in? Please **share** full name to confirm attendance
- To receive LUs and CEUs, you **must attend** at least 80% of the training. Attendance will be verified
- Use the "**Chat**“ to share questions or comments
- Slides/recording are **shared** after most events and can be found on 3C-REN’s on-demand page
- 3C-REN does **not** allow **AI notetakers**, unless used to accommodate a disability.



Tri-County Regional Energy Network

3C-REN is a collaboration between the tri-counties

Our programs reduce energy use for a more sustainable, equitable and economically vibrant Central Coast

Our free services are funded via the CPUC, bringing ratepayer dollars back to the region

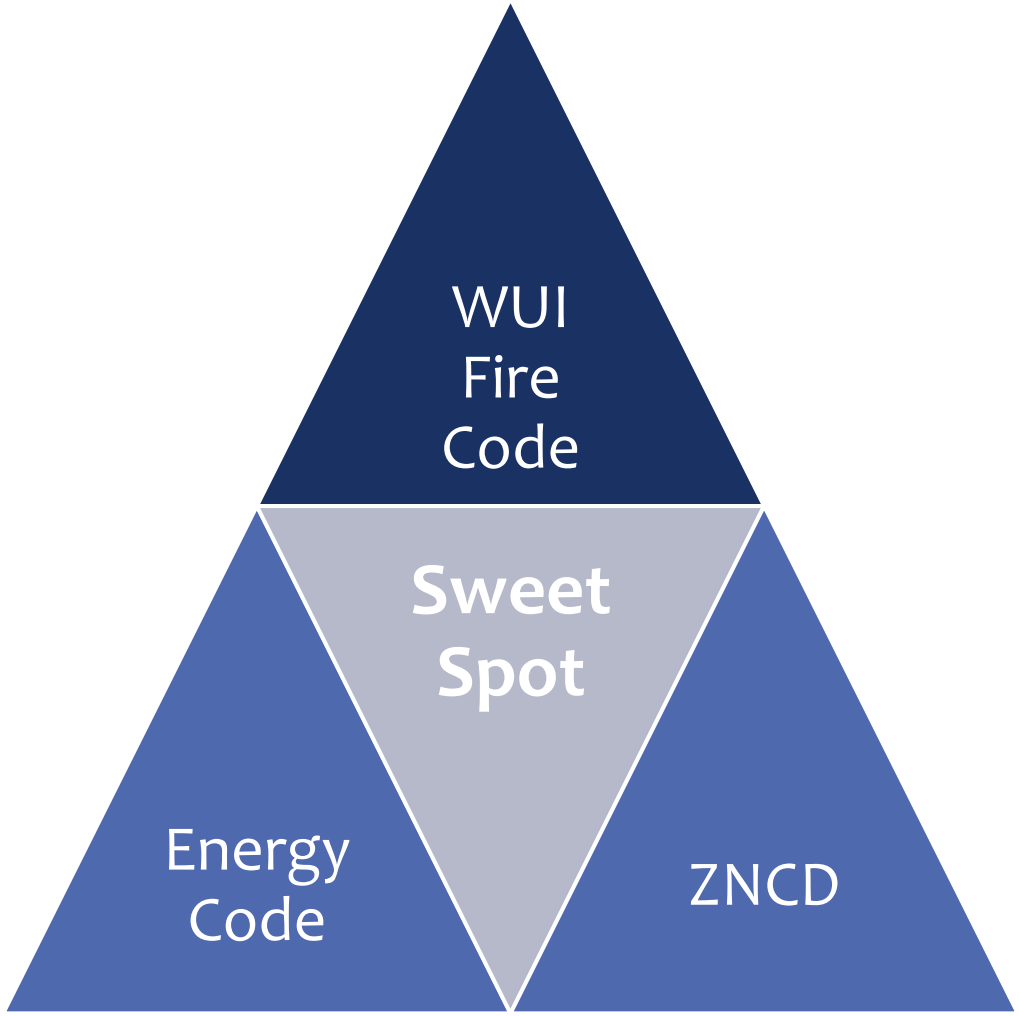
Learning Objectives

- Understand where the energy code, Wildland Urban Interface (WUI) code and Zero Net Carbon Design (ZNCD) overlap in building construction.
- Identify code requirements and key strategies for hardening the building envelope and improving energy efficiency through air sealing and strategic window choices.
- Discuss impacts and opportunities for PV panels and battery storage systems, including size, placement and chemistry.
- Evaluate options for locating electric heat pumps and heat pump water heaters to support both energy efficiency and fire resistance.

Learning Units

- 1.0 AIA HSW LUs approved for this course
- 1.0 ZNCD Continuing Education units for CAB

Premise: Coming Together of Three Efforts



Agenda

- Historical Context and Background
- Air Sealing
  - Envelope Strategies
  - Attics and Crawl Spaces
- Windows
  - Types for Home Hardening
  - Energy Code Alignment, and Exception
- Mechanical System Location
  - Outdoor Closet
  - Indoor Closet
- PV Panels and Batteries
  - Placement and Spacing for Fire Access

California Building Standards – Title 24

Part 1 - CA Administrative Code
Part 2 - CA Building Code
Part 2.5 - CA Residential Code
Part 3 - CA Electrical Code
Part 4 - CA Mechanical Code
Part 5 - CA Plumbing Code
Part 6 - CA Energy Code
Part 7 - CA Wildland-Urban Interface Code
Part 8 - CA Historical Building Code
Part 9 - CA Fire Code
Part 10 - CA Existing Building Code
Part 11 - CA Green Building Standards Code
Part 12 - CA Referenced Standards Code

Wildland Fire-Safe Construction - 2005

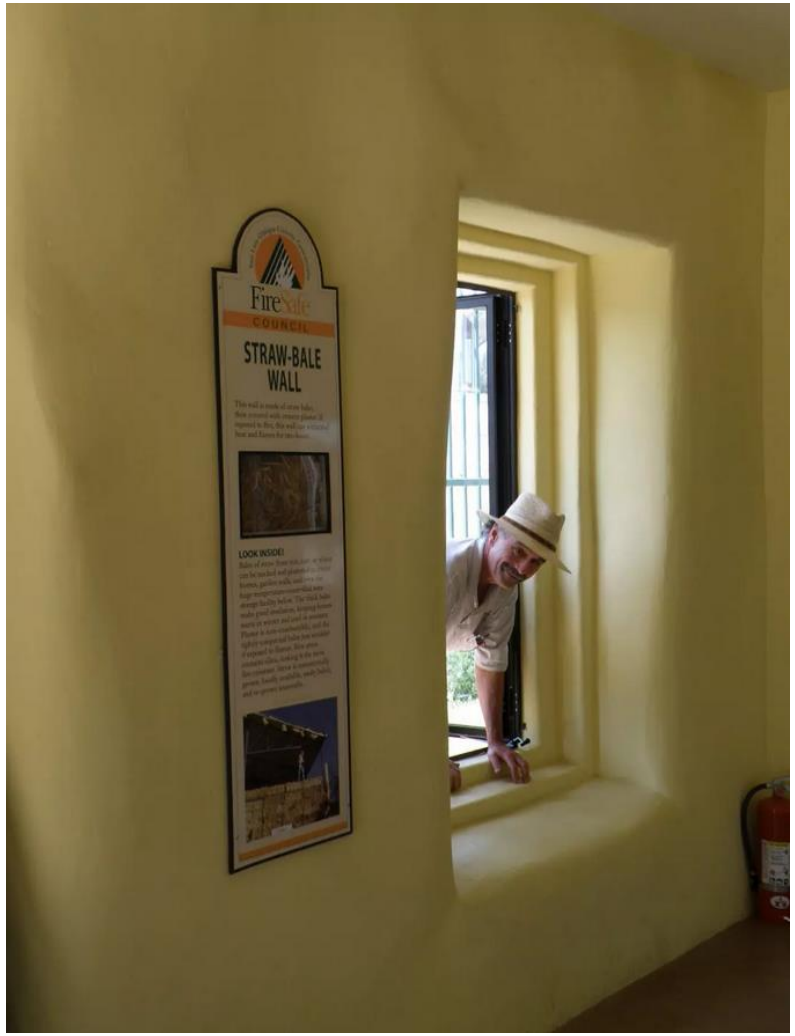
https://semmesco.com/commercial/fire-safe-demonstration-house/

Each wall and roof plane had a slightly different construction assembly to demonstrate best or better practices.

- Non-exposed roof rafters
- Non-vented attic
- Non-combustible siding and roofing assemblies
- Non-combustible insulation
- Tempered dual paned windows

CalFire Project
Demonstration Building from 2005, Paso Robles Mid-State Fair Grounds
Semmes & Co Builders
Jennifer Rennick Architect

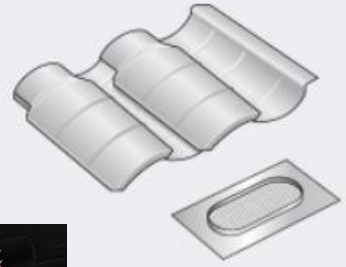
Avoid Thermal Bridging… Construct Thermal Barriers



- Avoid ‘Through-Framing’ at Decks and Balconies (Flash with Fire-Rated UL 10C Products)
- Add Fiberglass Reinforced Exterior Gypsum Underlayment at Metal Roofing
- Add Non-Combustible Exterior Continuous Gypsum Underlayment at Walls under the Siding
- Use Non-combustible Insulation Materials, such as Strawbale Walls, Cellulose and Rockwool
- Use Non-combustible Siding, such as Stucco and Cement Board
- Avoided Crawl-Spaces and Vented-Attic Construction

Better Ways to Vent Attics and Crawlspaces

Baffled and Protected Screened Openings
- Screen Openings –min 1/8” dia
- Wire Mesh –1/16” min wire thickness



O’HAGIN

FIRESTORM BUILDING PRODUCTS

When wildfires come near and reach critical temperature, the intumescent coating on the matrix structure expands, creating a "firewall."

VULCAN VENT FIRE & EMBER SAFE VENTS

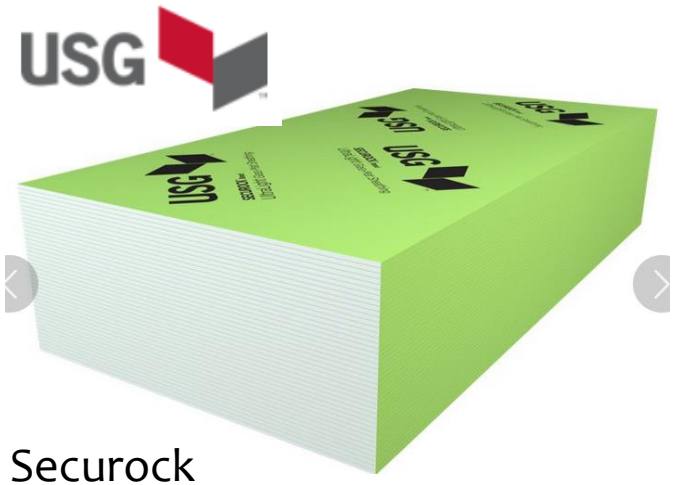
Use Fire-Rated Manufacture’s Recommended Sealant and Adhesives

3C REN

Fire-Resistant Underlayments for Metal Roofing

Class A Roofing Assemblies

- New Products on the Market
- ‘Time-Tested’ 5/8” Glass-Mat Type X Gypsum Products



Securock

DensDeck – Georga-Pacific

Sheffield Metals International
A MAZZELLA COMPANY

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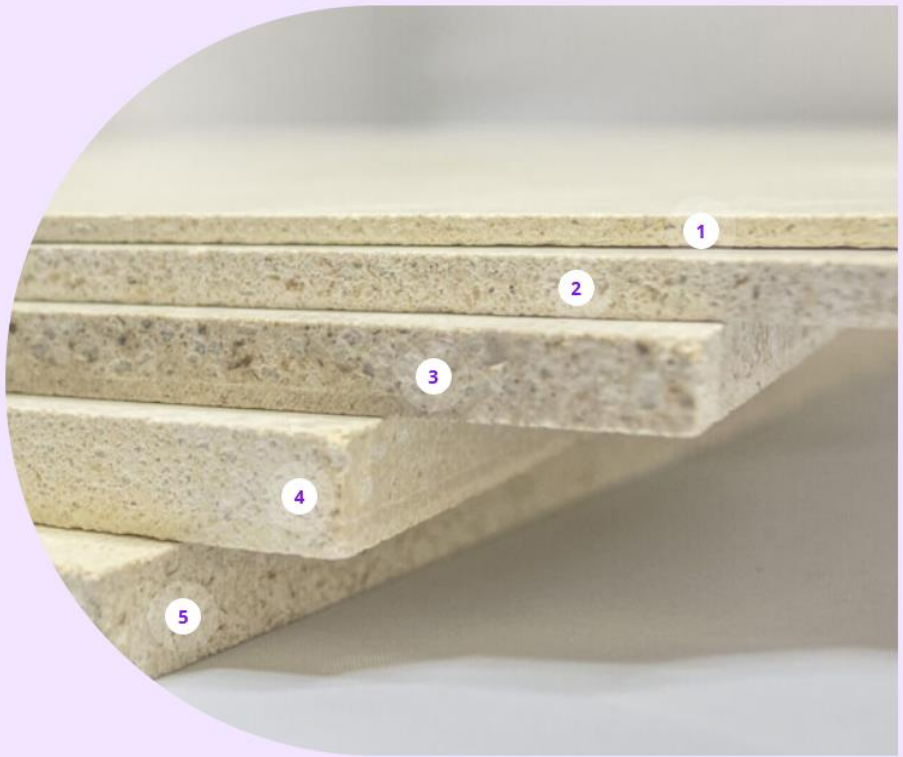
Fire-Resistant Panels and Sheathing

- Magnesium Oxide Boards/Panels



MagPanel® is ASTM-tested and A1 Fire Rated

- Intumescent Coated Structural Sheathing

- Withstands fire up to 90 minutes**
- Class A flame spread rating***
- Listed for California WUI zones****

Air Sealing

The Energy Code Meant Better Insulation and Better *Installation*

- New Insulation Materials and Standardized Testing
- Higher R-values
- QII and HERS* Introduced into the Code…

  which required the on-site verification of insulation and *air-sealing*

**Note: HERS is now called ECC for "Energy Code Compliance"*

Conversation Has Changed: Air Sealing

- Required under the Energy Code
- Continuous Air Barrier Needed
- Materials are Assessed as Individual Elements or in Assemblies
- Connections between Materials and/or Assemblies are Critical for Effective Air-Tightness and Fire-Safety
- Embers can Enter Cavities or Gaps 1/8” Wide
- Air Sealing Strategies Eliminate Gaps
- Attics and Crawls Spaces can be Mitigated for Fire Exposure

Eliminate Gaps, Voids and Concealed Cavities

- Seal Plumbing and Wiring Penetrations
  - Exterior Walls and Plates
  - Between Floors and Crawl Space
  - Ceilings and Attic Floors
- Seal Mechanical Ducts and Exhaust Fan Penetrations
- Seal Roof Rafters and Blocking at Eaves
- Don’t Create Framing ‘Cavities’

Air-tight ‘Hot Spots’ – Steps in Foundation

Situation often discovered after initial construction, during remodeling and rodent proofing efforts

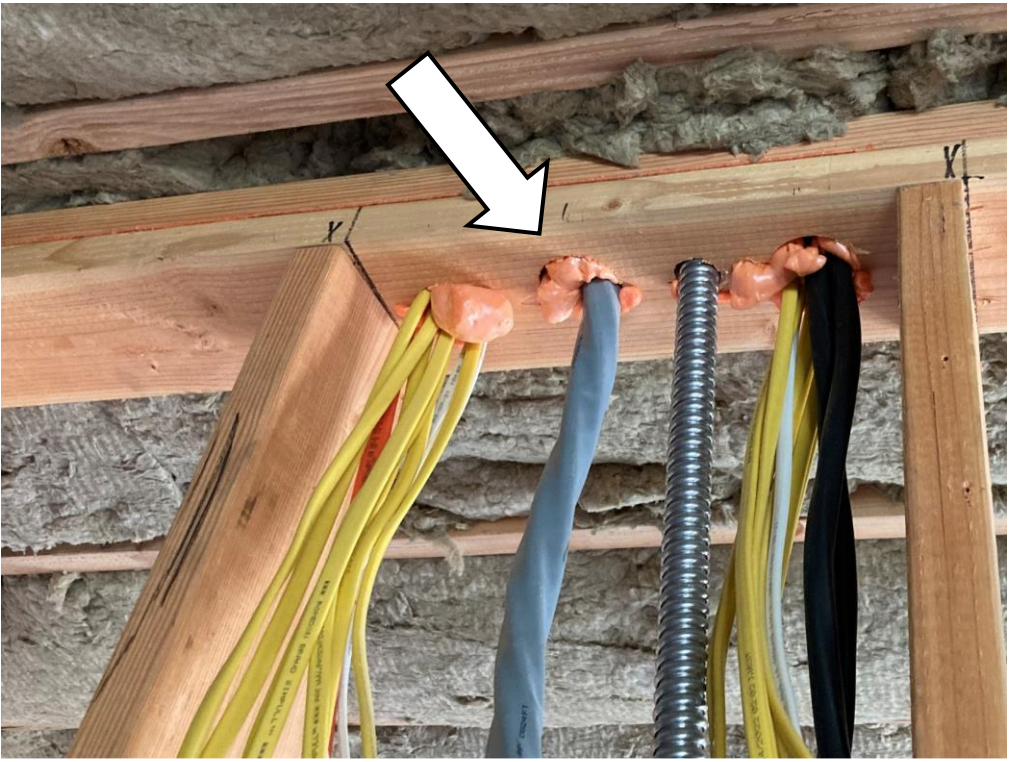
- Existing / Alterations / Remodels:
- Expose the void
- Apply liquid membrane, and tapes, etc. as needed
- Fill large voids with solid material and/or backer rod
- Fill gaps with fire-rated foam sealant

Air-tight 'Hot Spots' – Base of Wall at Foundation

Apply at base of wall – Before the rain screen and/or exterior insulation is installed

Many Options Available:

- Chemically compatible liquid membranes
- Self-adhering sheet membranes
- Tapes and sealants



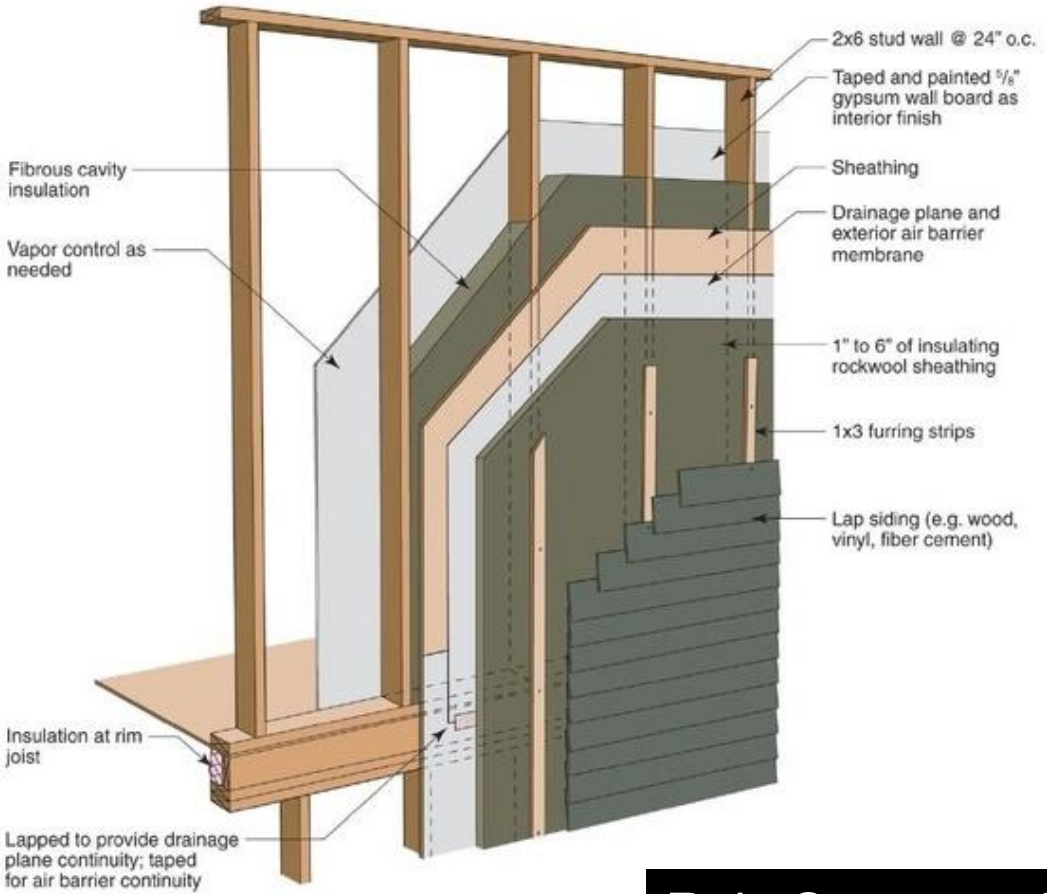
Air-tight 'Hot Spots' – Wire, Conduit, Small Piping

Many Options Available:

- Foam in a can – regular and fire-rated
- Self-adhering sheet membranes
- Tapes and sealants

Note: it's more effective to seal small individual penetrations rather than one large opening with many wires/piping running through it.

With the Improved Energy Code: Exterior Insulation and Rain Screens



Rain Screens –Create approx. 3/8" space behind siding materials

Use Non-Combustible Exterior Insulation

Consider heat-sensitive strip-vent at base of wall

VULCAN VENT
FIRE & EMBER SAFE VENTS

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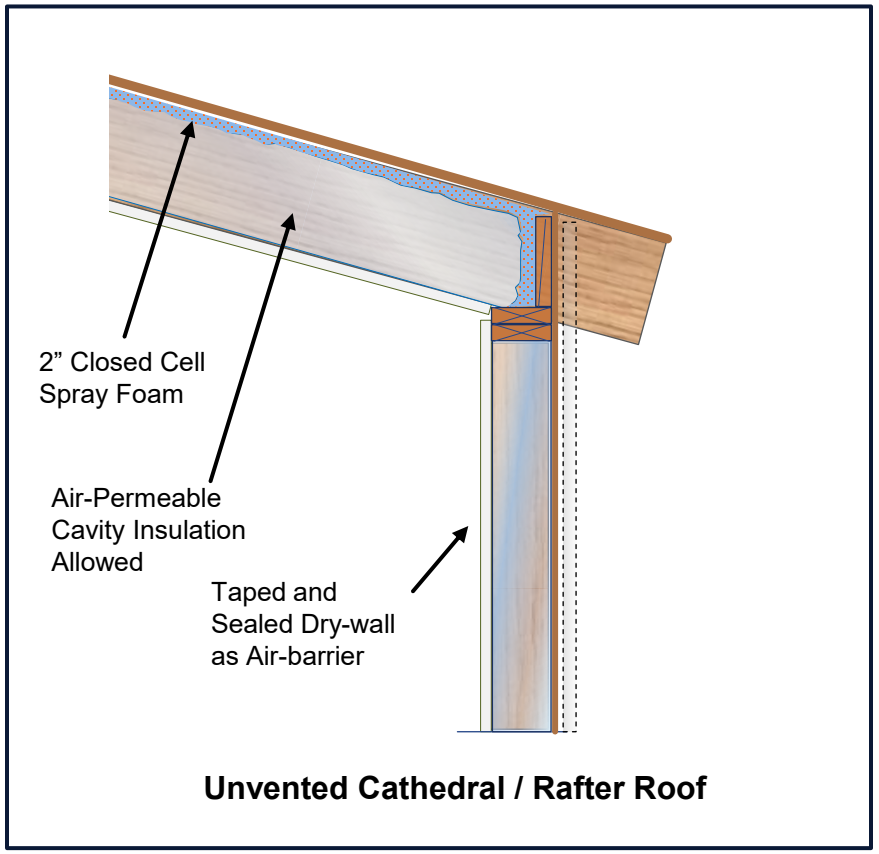
Unvented Attic Assemblies

- Energy Code (Title 24, Part 6) Dictates U-factors, i.e. Thermal Performance
- Fire Code (Title 19, Title 24 Part 2 Chapter 7A, and new for 2025 Title 24, Part 7) Addresses Fire Safety, Exterior Wild Fire Exposure, Fire-Rating and Combustibility
- Building Code (Title 24, Part 2) or Residential Building Code (Title 24, Part 2.5) Dictate Materials and Ventilation

Reminder: Seal Rafters and Blocking at Wall to Roof Connections

Unvented Cathedral / Rafter Assembly –Option 1

- Assembly with Air-Impermeable Insulation, i.e.
- Spray Foam at Underside of Roof Deck
- Class A Fire Rated Roof not shown
- Alternate Assembly: Fill entire cavity with open cell foam.

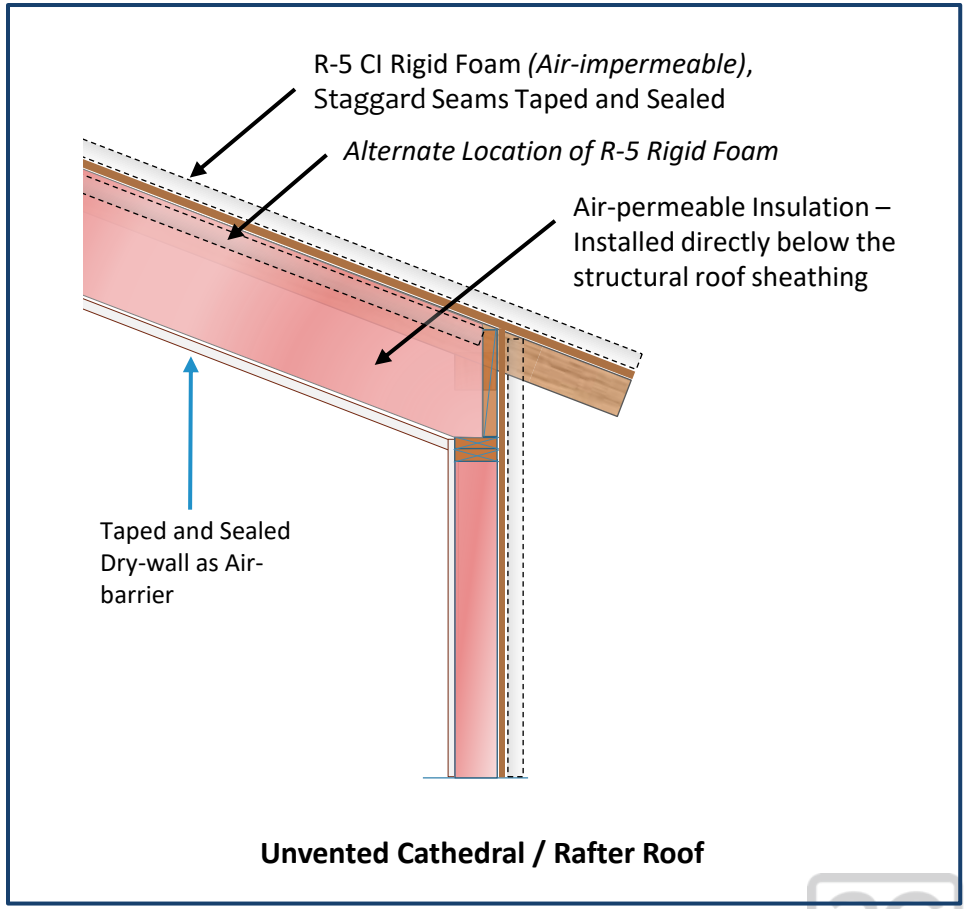


Unvented Cathedral / Rafter Roof

Unvented Cathedral / Rafter Assembly – Option 2

- Use Assembly with Air-Impermeable Insulation, i.e.
- R-5 CI Rigid Foam Taped and Sealed on Top of Roof Deck, etc.
- Class A Fire Rated Roof not shown

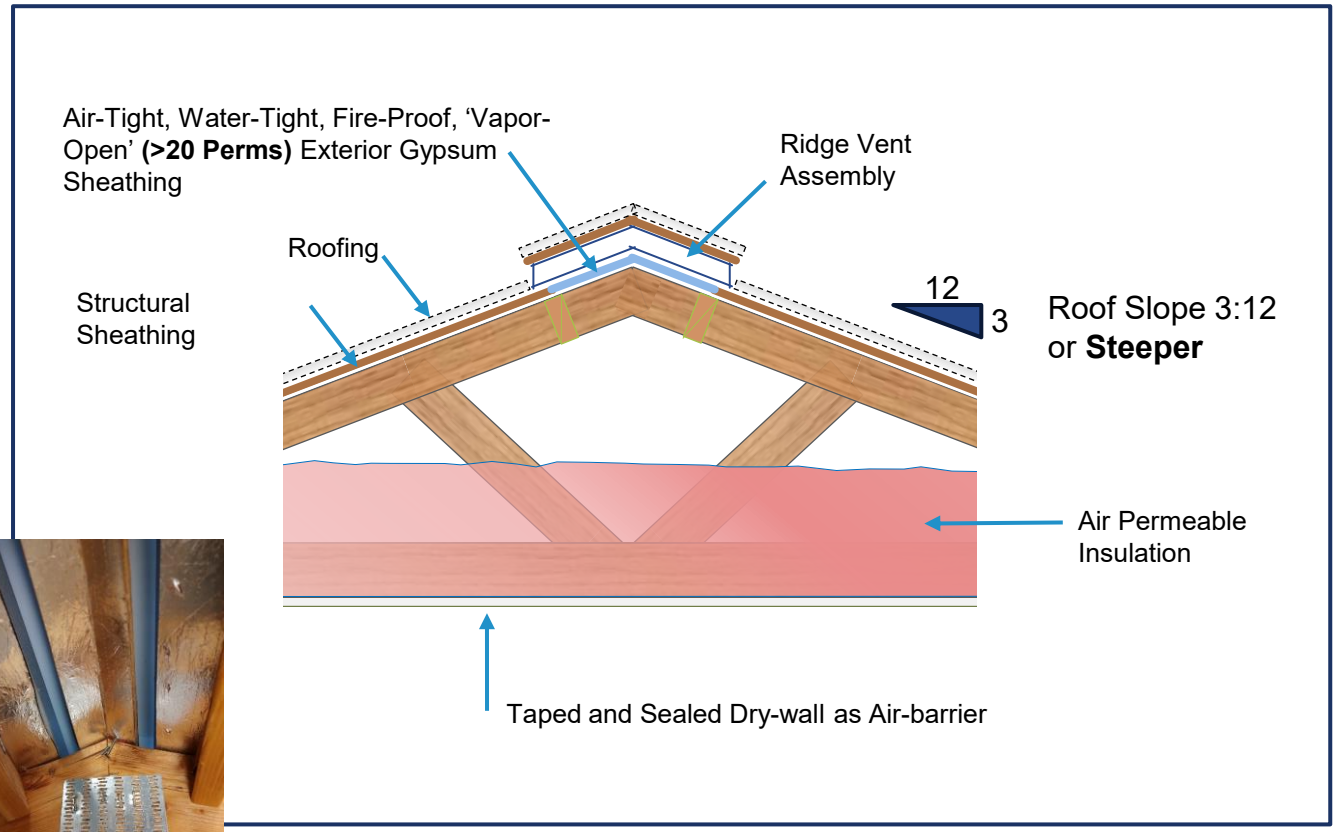
Alternate Location Note: If rigid foam is placed under the roof deck all edges must be sealed/caulked in place.

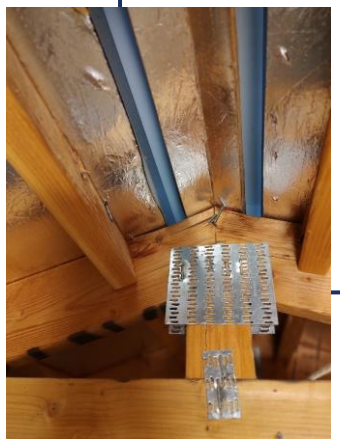


Unvented Cathedral / Rafter Roof

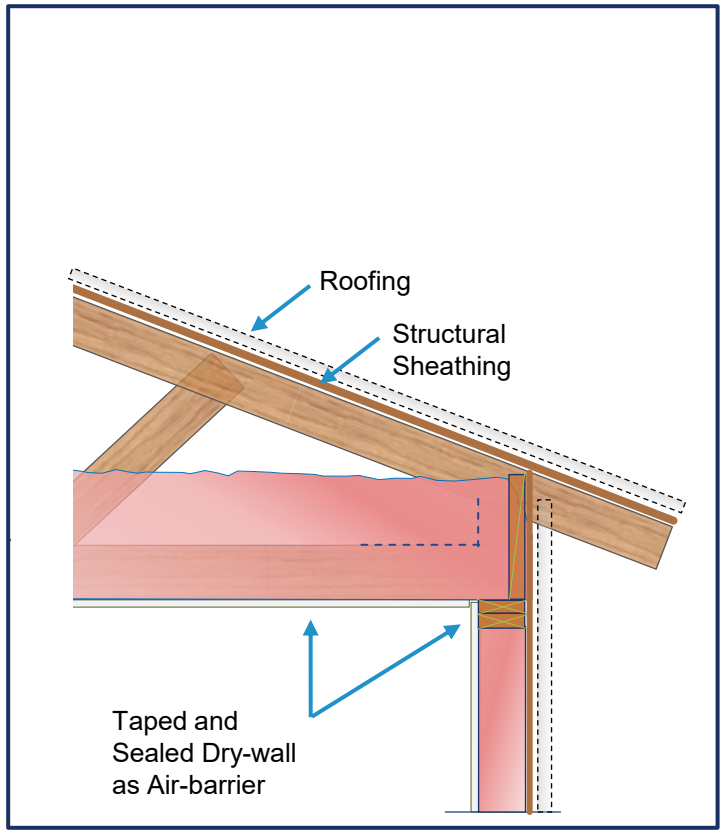
Un-vented Attic with Air-Permeable Insulation at Ceiling

Key Takeaway: Per Building Code part 2.5, this assembly requires a Vapor Diffusion Port





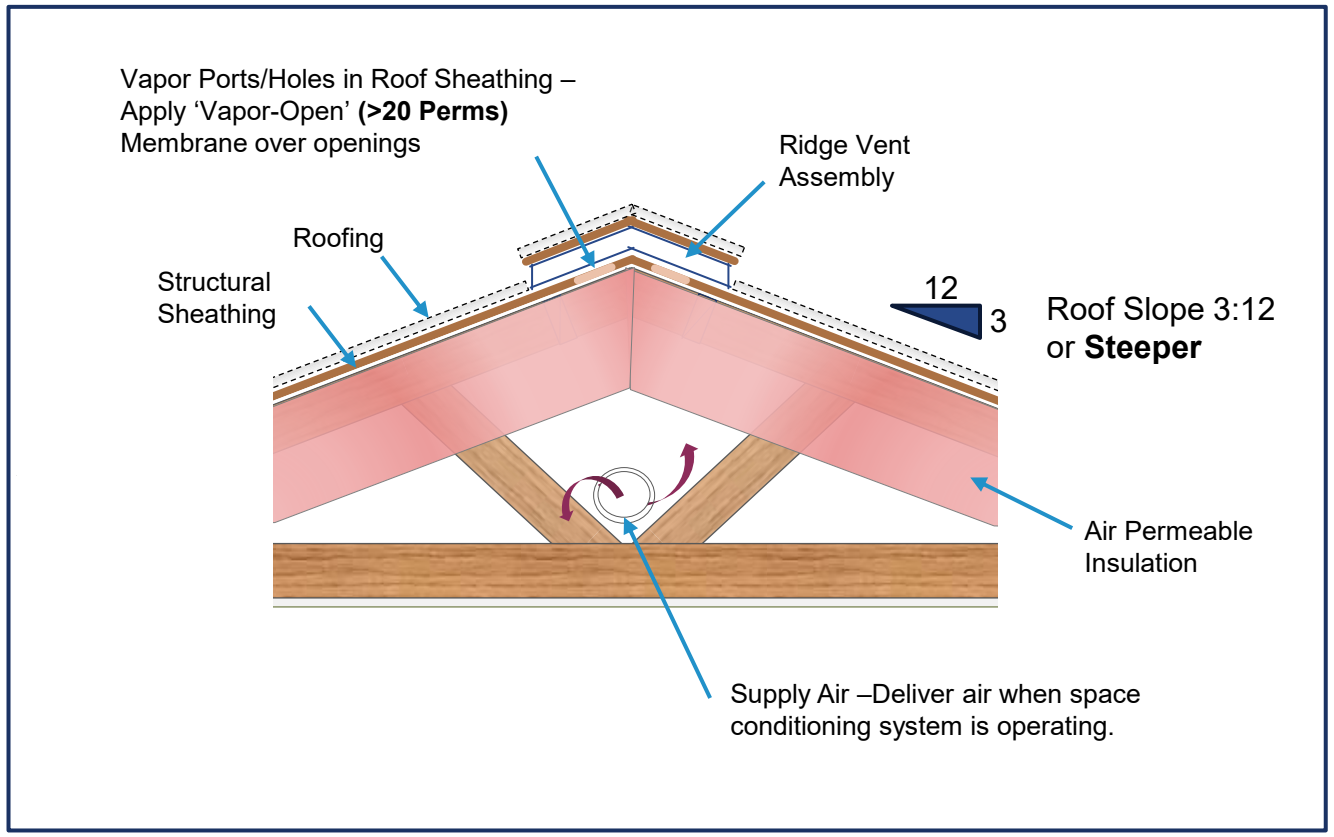
Un-Vented Attic at Roof Ridge with Vapor Diffusion Port



Un-Vented Attic at Eave

Un-vented Attic with Air-Permeable Insulation at Roof

Key Takeaway: Per Building Code part 2.5, this assembly requires a Vapor Diffusion Port and Supply Air from Space Conditioning System



Semi-Conditioned Un-Vented Attic with Vapor Diffusion Port at Roof Ridge

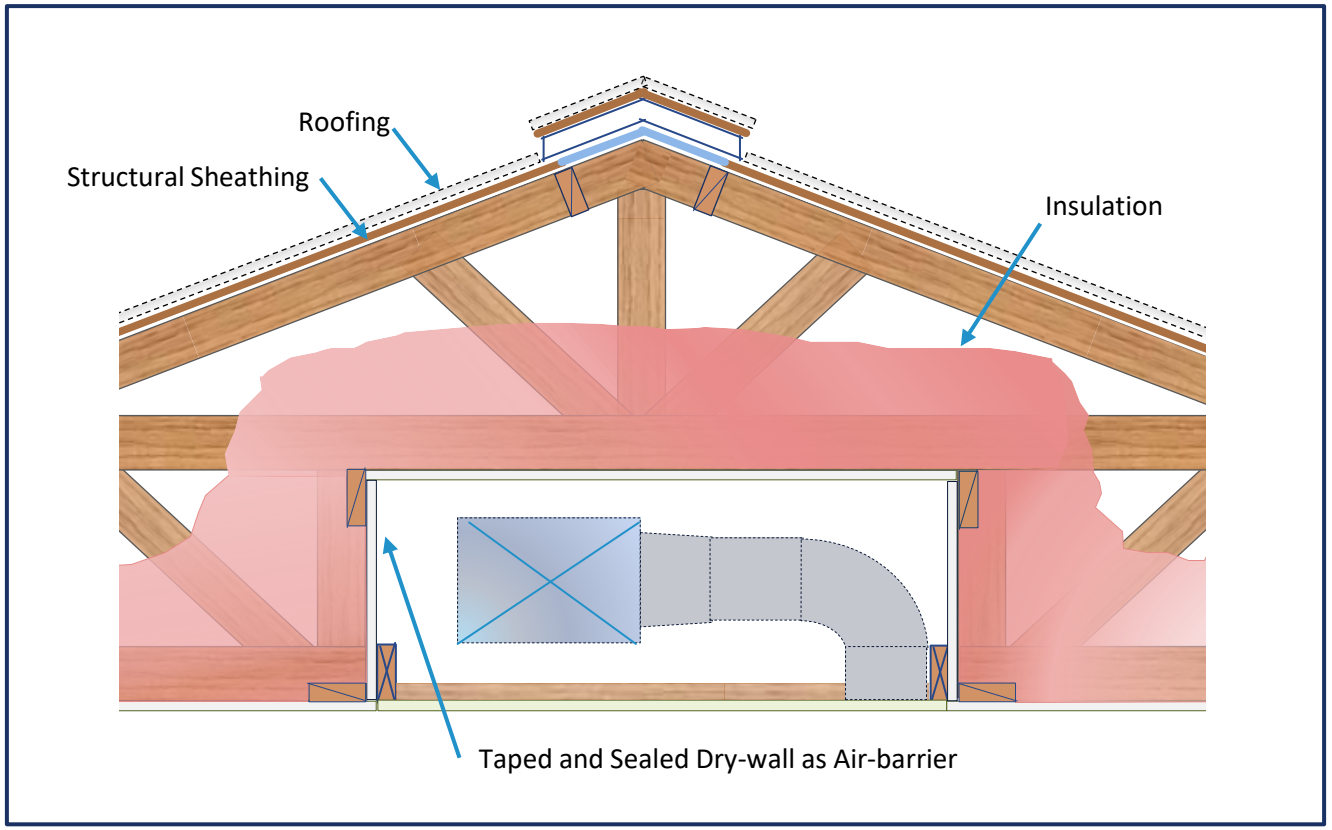
R806.5, 5.2.2. Vapor Port Area

- Net Free Area of Ridge Diffusion Ports/Holes = 1:600 of Ceiling Area
- **Example**: 1000 sq ft ceiling requires min 1.67 sf ft of opening or 240 sq inches of net free area. (50) 2.5" dia holes = 245 sq inches.

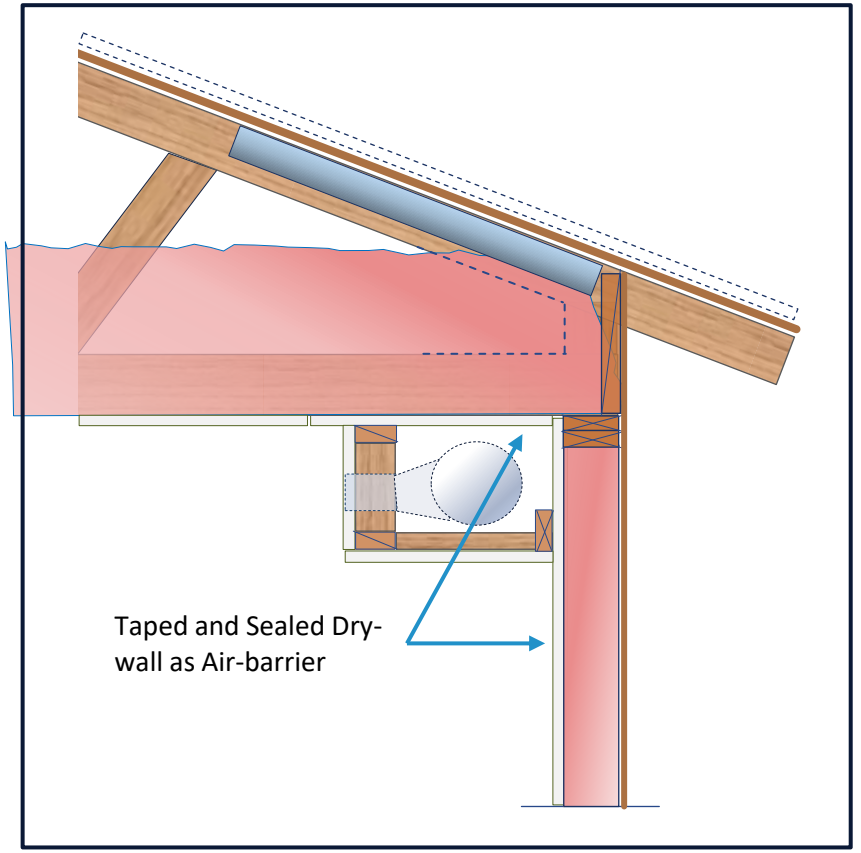
R806.5, 5.2.10. Supply Air CFM

- Supply Air = 50 cfm per 1000 sq ft of Ceiling Area
- **Rule of thumb**: 6" dia duct per each 1000 sq ft of celling area.

Sequencing is Important – Recessed Ceiling / Inverted Sofit



Modified "Attic Truss" with Continuous Air-Barrier Above Duct System



Soffit Below Continuous Air-Barrier Ceiling/Attic

Air-Barrier can be taped and sealed drywall, OSB, Plywood, etc.

Unvented Crawl Spaces *or 'Semi-Conditioned' Spaces*

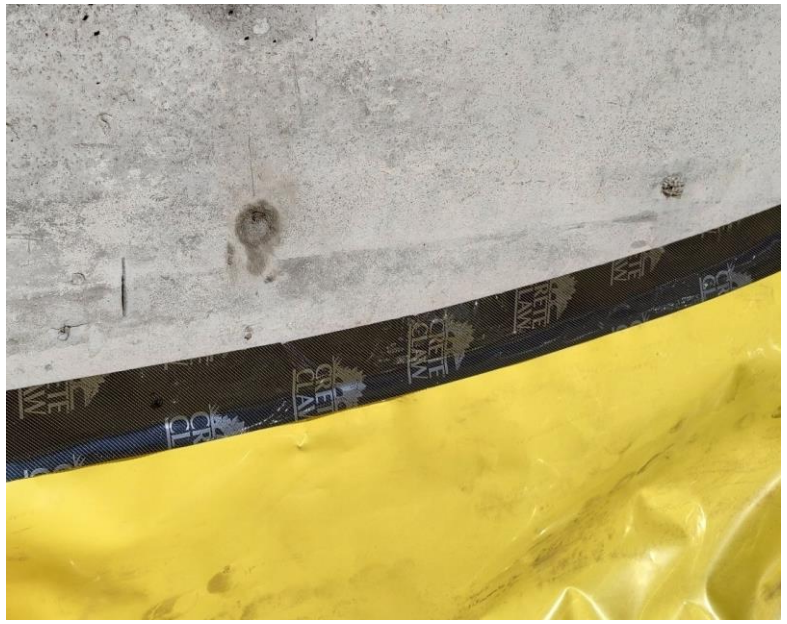
Two Items to Keep in Mind
under R408.3 (Title 24, Part 2.5)

1) Exposed earth shall be covered with a Class 1 Vapor Retarder

2) Mechanical continuous exhaust or mechanical conditioned supply and/or conditioned with dehumidification

Vapor Barrier – Required

Class I Vapor Barrier < 0.1 perms
Prevents Vapor Drive and Moisture Migration



Use specialized tape –typically sold with the vapor barrier -- securely attached to the foundation

Seams must be sealed and lapped 6" min.

Windows

Windows and Glass Doors

- Building Code (Part 2 and Part 2.5) Dictates when Tempered Glass is required, i.e. Glass in doors or windows next to doors, etc.
- Energy Code (Part 6) Dictates Thermal Performance – called U-factor

Note: The lower the U-factor the better insulating the window is against heat transfer.

2025 Energy Code Update

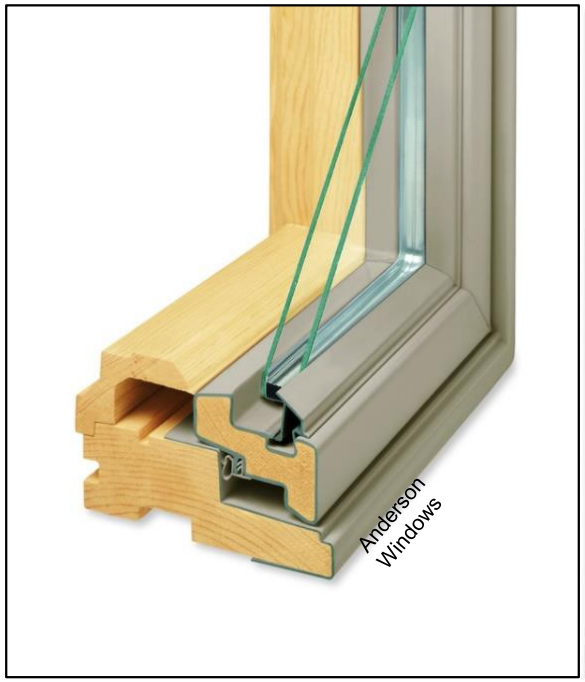
Mandatory:

- U-0.40 maximum

Prescriptive:

- U-0.27 for CZ 1-5, 11-14, 16
- U-0.30 for CZ 6-10, 15

Just about all brands of windows offer dual and triple paned options and all have tempered glass



Window Materials

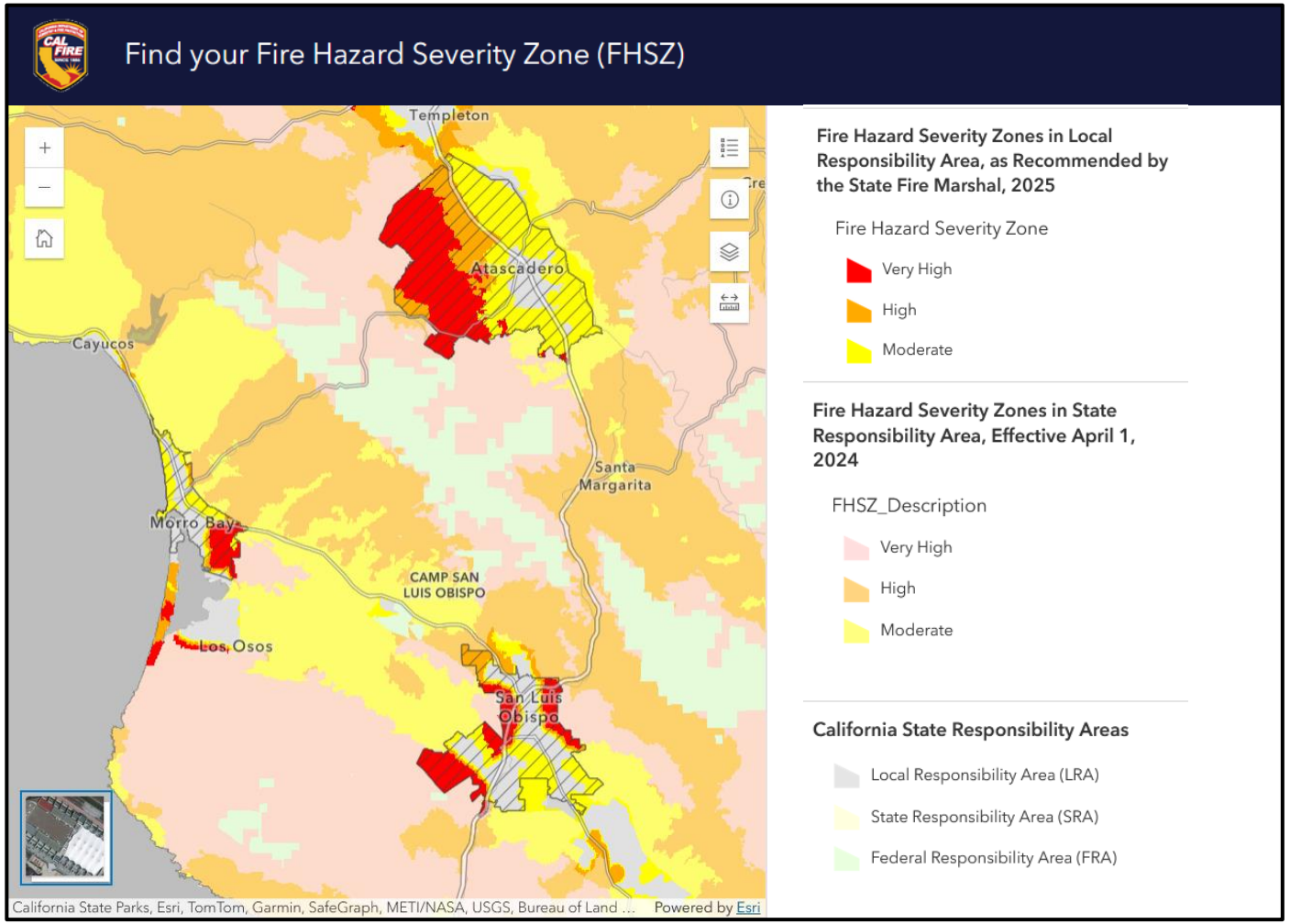
Energy Code dictates thermal/energy performance but is agnostic on many factors that impact fire safety.

From the Cal Fire website

- Combustible framing material that, when ignited, glass breaks or falls out providing a path for embers or flames to enter your home.
- Radiant heat which can cause windows to break even before fire reaches the house. Single-pane and large windows are particularly vulnerable.
- Vinyl windows that do not have an internal reinforcement bar in the horizontal or vertical separator member as they are prone to failure from radiant exposure due to deformation of the frame.

Source: https://www.fire.ca.gov/home-hardening

Windows –Minimum Performance and WUI (Sec 150.0(q))



https://osfm.fire.ca.gov/what-we-do/community-wildfire-preparedness-and-mitigation/fire-hazard-severity-zones

2025 Energy Code:
Mandatory Measure: maximum weighted average **U-factor is U-0.40**

New Energy Code Exception to Mandatory U-factor:

- Windows and Skylights installed in buildings meeting [2025 Title 24] ***Part 7 of the California Building Code, California Wildland-Urban Interface Code*** –where buildings are located in Fire Hazard Severity Zones or WUI Fire Areas as designated by the local enforcement agency.

Resource: WUI Products Handbook

CALIFORNIA DEPARTMENT of FORESTRY
and FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL

STATE FIRE MARSHAL LISTED WILDLAND-URBAN INTERFACE (WUI) PRODUCTS HANDBOOK

Published by *CAL FIRE*
FIRE ENGINEERING AND INVESTIGATIONS DIVISION
BUILDING MATERIALS LISTING PROGRAM
September 2, 2025

Thermally Broken Steel Frame for Residential Construction

RIVIERABRONZE
Distinctive Design for Luxury Living

This product line is based in Ventura and meets the Residential Prescriptive U-factor and the WUI Fire Code requirements.

https://osfm.fire.ca.gov/what-we-do/fire-engineering-and-investigations/building-materials-listing

Mechanical System Locations

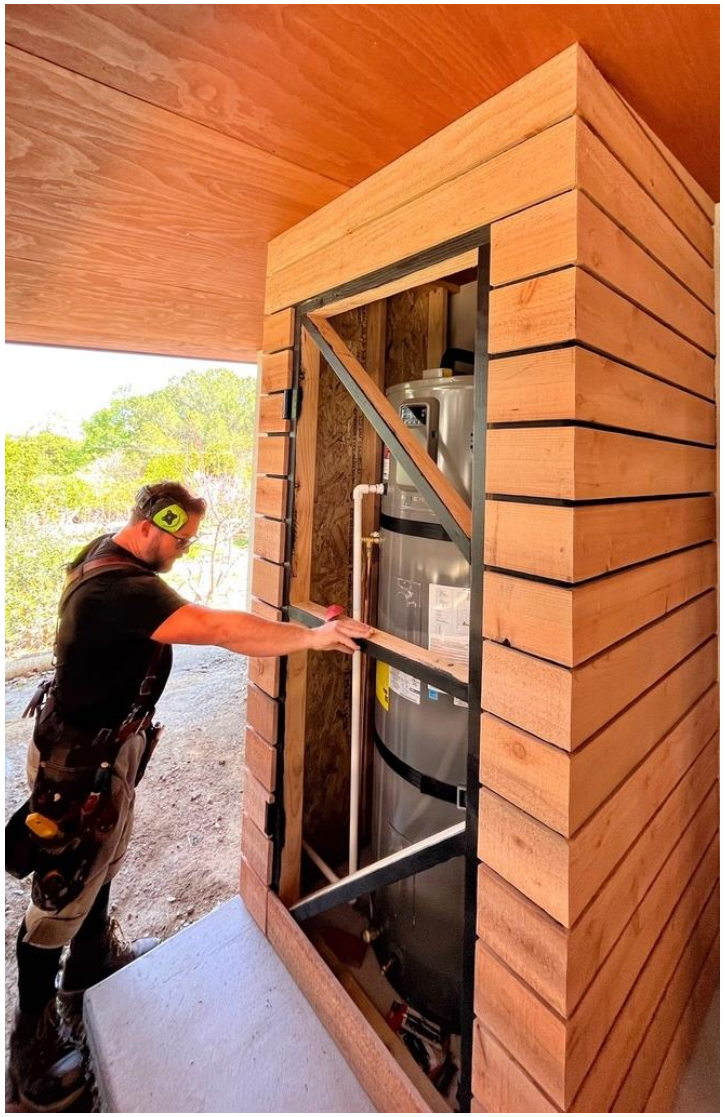
Interior Closets – Ducted and Louvered Door Options

Ducts allow the HPWH to utilize the great outdoors

In progress construction photos!

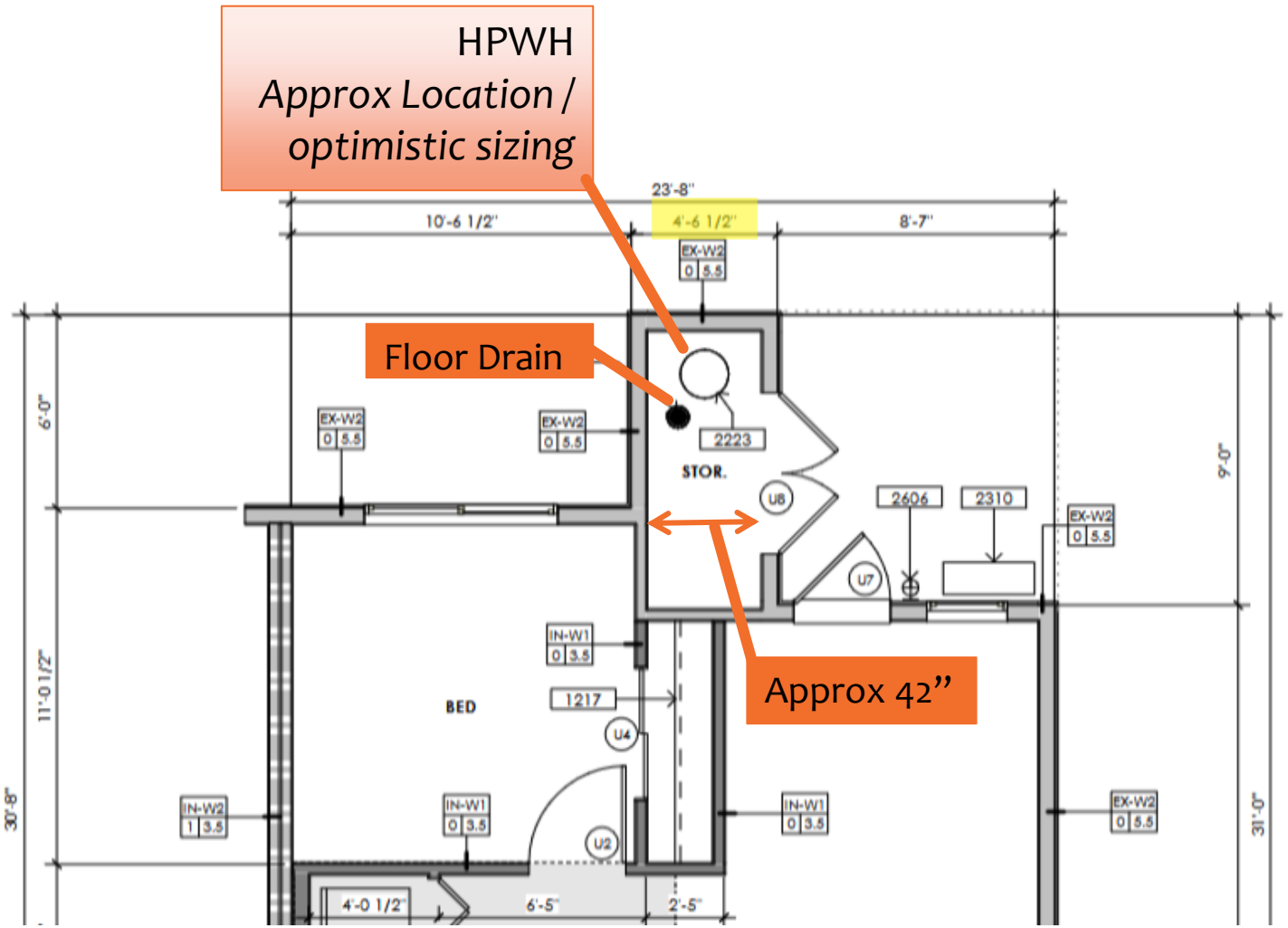
Louvered door allows the HPWH to 'communicate' to the larger spaces of the house.

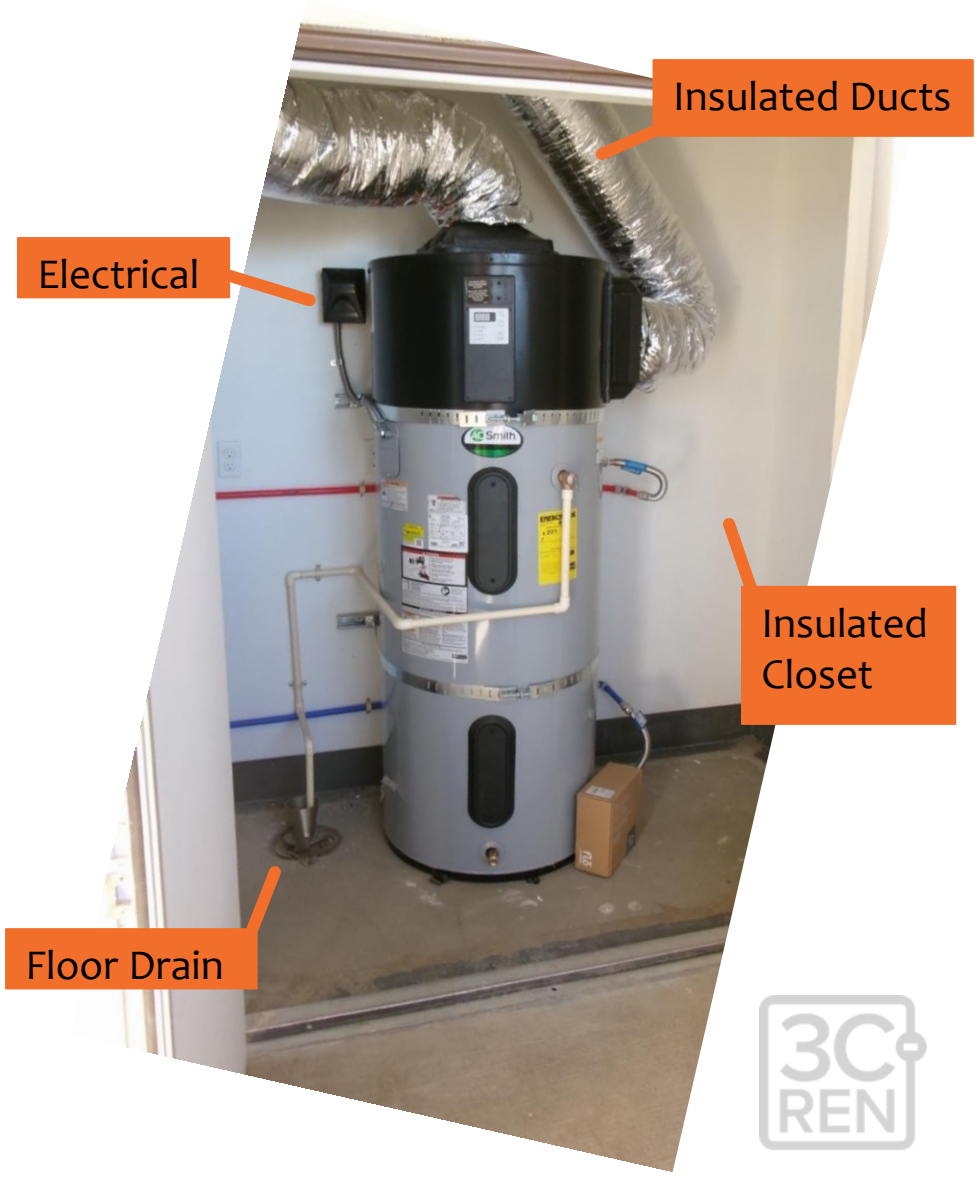
Outdoor Closet Installation… Consider Potential Exposure



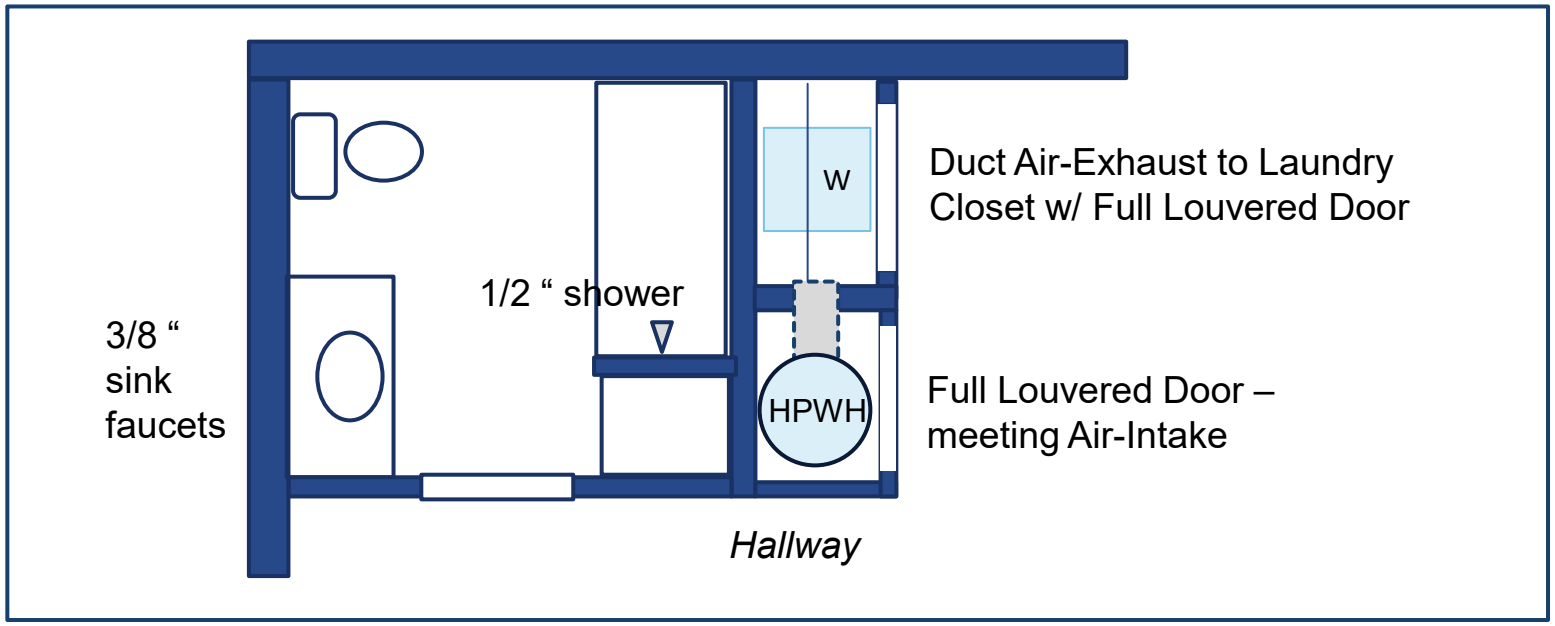
- Can work well in mild climates
- Protected from weather
- Louvered door for air volume

Insulated Outdoor Closet – Solid Doors with Ducts





Indoor Installations for Cold Climates and/or WUI



HPWH Located Indoors, and with Air-Inlet Indoors and Air-Outlet Indoors

In Wildland-Urban Interface (WUI) areas, may need to locate the HPWH within the envelope, with non-combustible siding, solid exterior doors (or indoor), fire rated windows, and screen ventilation, etc.

Roof Mounted PV Panels

Solar and Battery – Highrise and Non-Res

Applicable Occupancy Types:

- High-Rise Residential
- Grocery, Retail
- Restaurants
- School
- Library
- Warehouse
- Religious Worship
- Sports and Recreation
- Events and Exhibits
- Hotel-Motel
- Office and Financial Institution
- Unleased Tenant Space
- Medical Office Building/Clinic

Under the 2025 Code some occupancies types were added and some will have increased Solar PV and Battery requirements. Restaurants, for example, had a dramatic increase.

Solar Panels and Fire Fighter Roof Access

- Energy Code (Title 24, Part 6) Dictates when PV Systems are Required and what Size
- Fire Code (Title 24, Part 9 and/or Part 2.5) Dictates Fire Safety and Access
- Roof Access must be capable of supporting fire fighters and roof fire ventilation
- Walkways to be located with least amount of obstruction and trip hazards
- PV system conduit, wiring and raceways shall be located as close as possible to a ridge, hip, valley or outside wall

Roof Installations – Non-Res and R-3

- Title 24, Part 9 Section 1205
- Walkway widths vary by occupancy:
  - R-3 or similar: 3 ft wide walkways
  - Other Occupancies: 6 ft wide perimeter walkway and 4 ft wide interior walkways
- 4 ft clearance around smoke hatches, roof access, and skylights, etc.
- PV Panels cannot be located below an egress or in an egress pathway

Roof Installations – Residential

- Title 24, Part 2.5 Section R324
- Walkway widths:
  - 3 ft wide walkways in general
  - Ridges: with 33% PV roof coverage, 18” width on each side of ridge
  - Ridges: with greater than 33% PV roof coverage, 36” width on each side of ridge
  - For homes with qualifying fire sprinklers, PV roof coverage changes to 66%
- PV Panels cannot be located below an egress or in an egress pathway

Electrical Energy Storage (ESS) Battery Systems

Locating Batteries for Fire Safety

- Trending Towards Outdoors, but Weather Protected
  - Garages are crowded with combustibles
  - Firefighters like to have access
  - Equipment is rated for outdoor locations
- Protected from Impact
- Distance
  - From each other and from combustibles

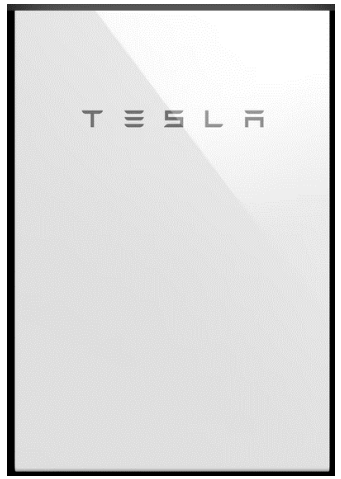
Not All Lithium (Li) Batteries are the Same:

Lithium-Ion

Typically: LNMC – Li, Ni, Mg, & Co

Thermal Runaway Possible

High-Power Density



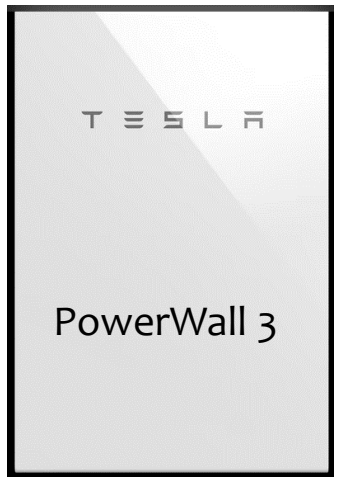
Lithium Ferro (Iron) Phosphate

LFP – Li, Fe, PO4

Non-combustible

High-Power Density

Cobalt (Co) Free



Lithium Titanate Oxide

LTO – Li & Ti

Non-combustible

Lower-Power Density

Cobalt (Co) Free

Table is Expanded with New Battery Chemistries

2025 Code update

TABLE 1207.1.3—ENERGY STORAGE SYSTEM (ESS) THRESHOLD QUANTITIES

TECHNOLOGY	ENERGY CAPACITY[a]
Capacitor ESS	3 kWh
Flow batteries[b]	20 kWh
Lead-acid batteries, all types	70 kWh[c]
Lithium-ion batteries	20 kWh
Nickel-cadmium (Ni-Cd), nickel metal hydride (Ni-MH) and nickel zinc (Ni-Zn) batteries	70 kWh
Nonelectrochemical ESS[d]	70 kWh
Other battery technologies	10 kWh
Other electrochemical ESS technologies	3 kWh
Sodium nickel chloride batteries	70 kWh
Zinc manganese dioxide batteries (Zn-MnO_2)	70 kWh

For SI: 1 kilowatt hour = 3.6 megajoules.

a. Energy capacity is the total energy capable of being stored (nameplate rating), not the usable energy rating. For units rated in amp-hours, kWh shall equal rated voltage times amp-hour rating divided by 1,000.
b. Shall include vanadium, zinc-bromine, polysulfide-bromide and other flowing electrolyte-type technologies.
c. Fifty gallons of lead-acid battery electrolyte shall be consideredequivalent to 70 kWh.
d. Covers nonelectrochemical technologies such as flywheel and thermal ESS.

https://www.poshenergy.com/articles

Large Scale Battery Energy Storage

- Hazard Mitigation Plan Required
- Large Scale Outdoor – Weather-proof Self-Contained Units with Fire Suppression
- Structural Pad and Site Drainage
- Clearances from Other Structures – Above, Back, Front, and Side to Side
- Access Doors open Front and Back
- Vehicular and other Impact Protection
- Specific Additional Requirements for Roof Top and Open Parking Garage Installations

Non-Res and R-3 Battery ESS Permitting

Code Excerpt
Title 24, Part 9 Chapter 12

1207.1.5 Construction documents.

The following information shall be provided with the permit application:

1. Location and layout diagram of the room or area in which the ESS is to be installed.
2. Details on the hourly fire-resistance ratings of assemblies enclosing the ESS.
3. The quantities and types of ESS to be installed.
4. Manufacturer's specifications, ratings and listings of each ESS.
5. Description of energy (battery) management systems and their operation.
6. Location and content of required signage.
7. Details on fire suppression, smoke or fire detection, thermal management, ventilation, exhaust and deflagration venting systems, if provided.
8. Support arrangement associated with the installation, including any required seismic restraint.
9. A commissioning plan complying with Section 1207.2.1.
10. A decommissioning plan complying with Section 1207.2.3.
11. A fire safety and evacuation plan in accordance with Section 404.

Small Scale: General Design Considerations

ESS Unit < 20 kWh

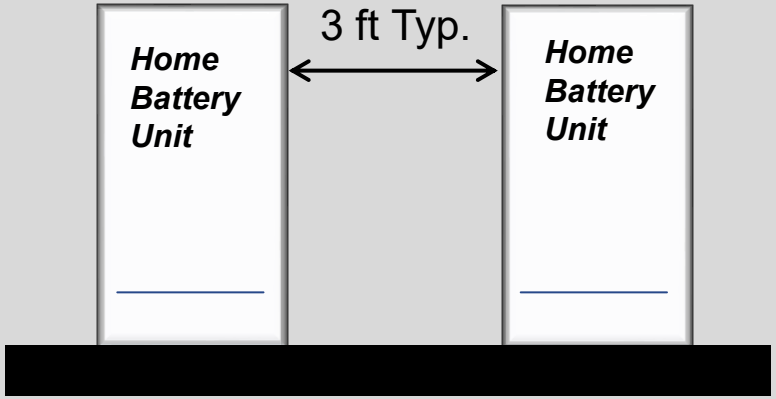
- Outdoor and Indoor
- Ground Mount or Wall Mount
- Protect from Impact Damage
- Protect from Temperature Extremes
- Protect from Adverse Weather
- Maintain 5ft (or 3 ft for Residential Code) from
  - Paths of Travel
  - Doors
  - Windows

Residential Battery Indoor Storage Location Considerations

Title 24, Part 2.5 Chapter 3 Building Planning, Section ~~R328~~ R330

- Individual ESS units max 20 kWh
- Listed and Labeled for Residential use
- Aggregate capacity shall not exceed:
  - 80 kWh on exterior walls or in outdoor installations
  - 80 kWh in garages and/or detached accessory structures
  - 40 kWh within utility closets or storage spaces
- Utility closets/spaces and/or garage shall have 5/8” Type X gypsum board ceilings and walls
- Interconnected smoke alarms shall be installed through out the dwelling and attached garage (or when appropriate an interconnected heat alarm)

Residential Batteries vary between 5 and 13.5 kWh typ.



Batteries maybe installed closer than 3 ft, if it can be shown to the AHJ that the battery manufacture has complied with proper fire testing and has specified the minimum distance.

2024 Supplemental and 2025 Code Update

Table R330.5

TABLE ~~R328.5~~
MAXIMUM AGGREGATE RATINGS OF ESS

LOCATION	MAXIMUM AGGREGATE RATINGS (kWh)	INSTALLATION REQUIREMENTS
Within utility closets, basements, and storage or utility spaces located within dwellings	*40*	
In attached garages	*80*	
On or within 3 feet of exterior walls of dwellings and attached garages	*100*	
On or within 3 feet of exterior walls of dwellings and attached garages	*200*	*Exterior walls and eaves are constructed with non-combustible surfaces[a]*
In detached garages and detached accessory structures	*200*	
In detached garages and detached accessory structures	*600*	*Detached garage or detached accessory structure is a minimum 10 feet away from property lines and dwellings*
Outdoors on the ground	*200*	*ESS is a minimum 3 feet away from property lines and dwellings*
Outdoors on the ground	*600*	*ESS is a minimum 10 feet away from property lines and dwellings*

For SI: 1 foot = 304.8 mm.

a. *Noncombustible wall surface shall extend in accordance with all the following:*

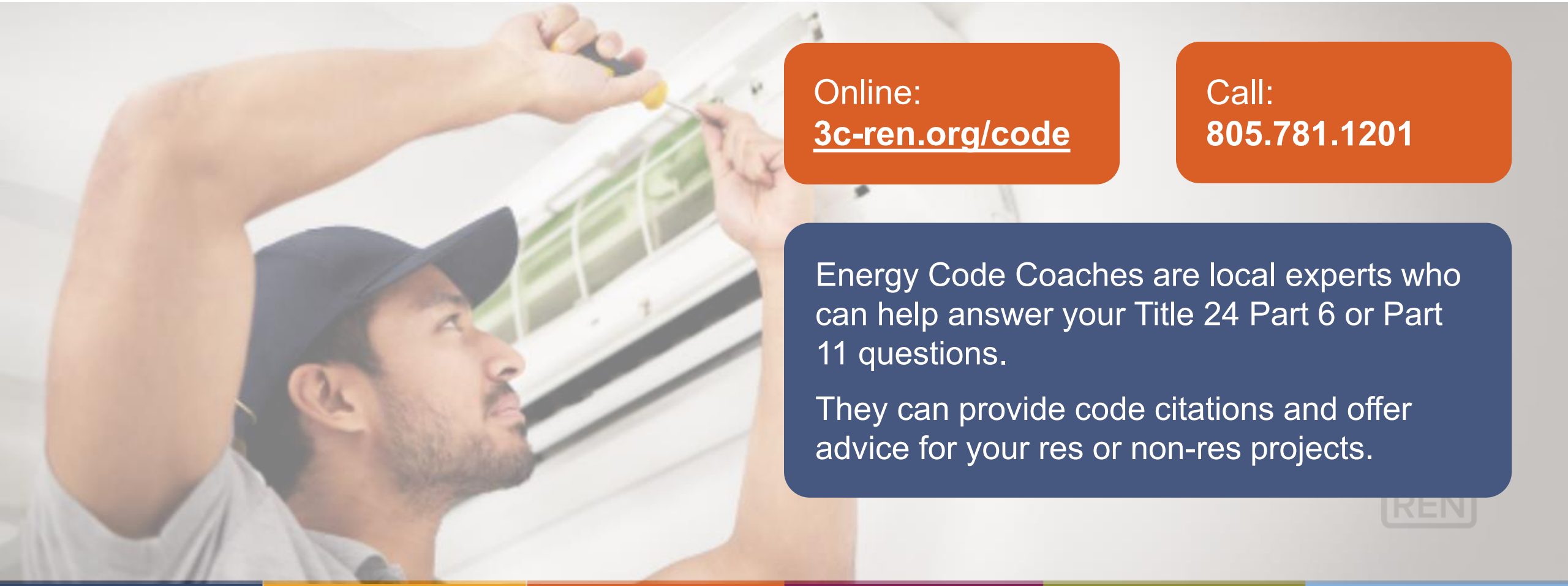
1. A minimum of 5 feet horizontally from the edge of the ESS.
2. A minimum of 1 foot vertically below the bottom edge of the ESS.
3. A minimum of 8 feet vertically above the ESS, or to a non-combustible eave, whichever is less.

The code official is authorized to approve reductions of installation requirements based on large-scale fire testing complying with Section 1207.1.5 of the California Fire Code.

Closing

Questions about Title 24?

3C-REN offers a *free* Code Coach Service



Online:
3c-ren.org/code

Call:
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Energy Code Coaches are local experts who can help answer your Title 24 Part 6 or Part 11 questions.

They can provide code citations and offer advice for your res or non-res projects.

Thanks for coming!

Continuing Education Units Available

- Contact chloe.swick@venturacounty.gov with any questions

Today's Slides and Recording are Coming to Your Inbox Soon!

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- 2025 Energy Code in Practice: Multifamily Residential (5/13)
- Builder's Perspective: Insulation and Air Sealing (**Rescheduled!** 5/26)