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

2025 California Energy Code & Passive House

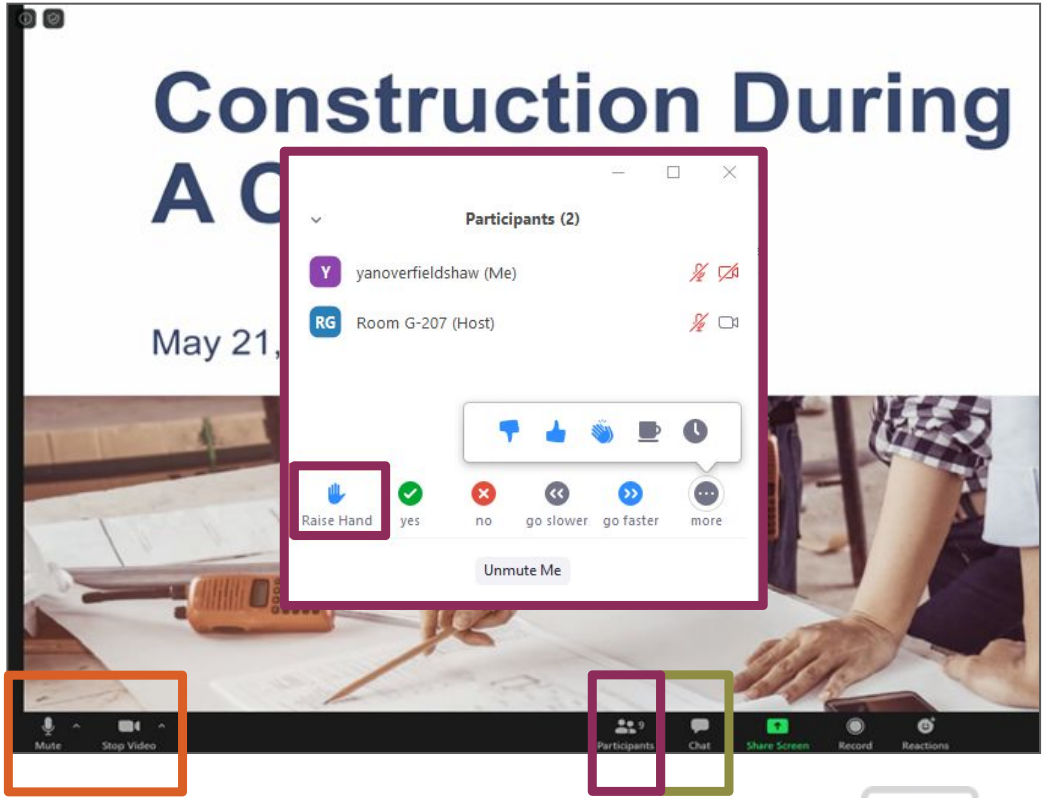
Ken Levenson – Passive House Network

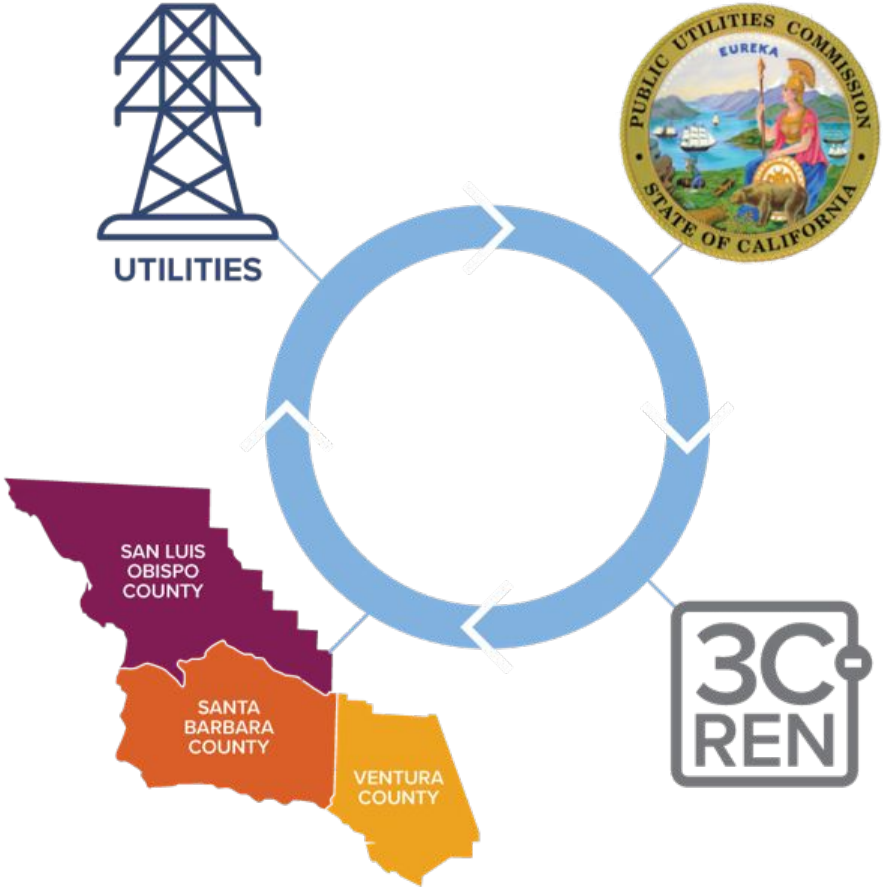
February 10, 2026

Before We Begin

Here are some quick reminders:

- Call in? Please **share** full name to confirm attendance
- To receive AIA LUs, 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

Our Services

Incentives

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3c-ren.org/for-residents
3c-ren.org/multifamily

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View past trainings at
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AGRICULTURE ENERGY SOLUTIONS

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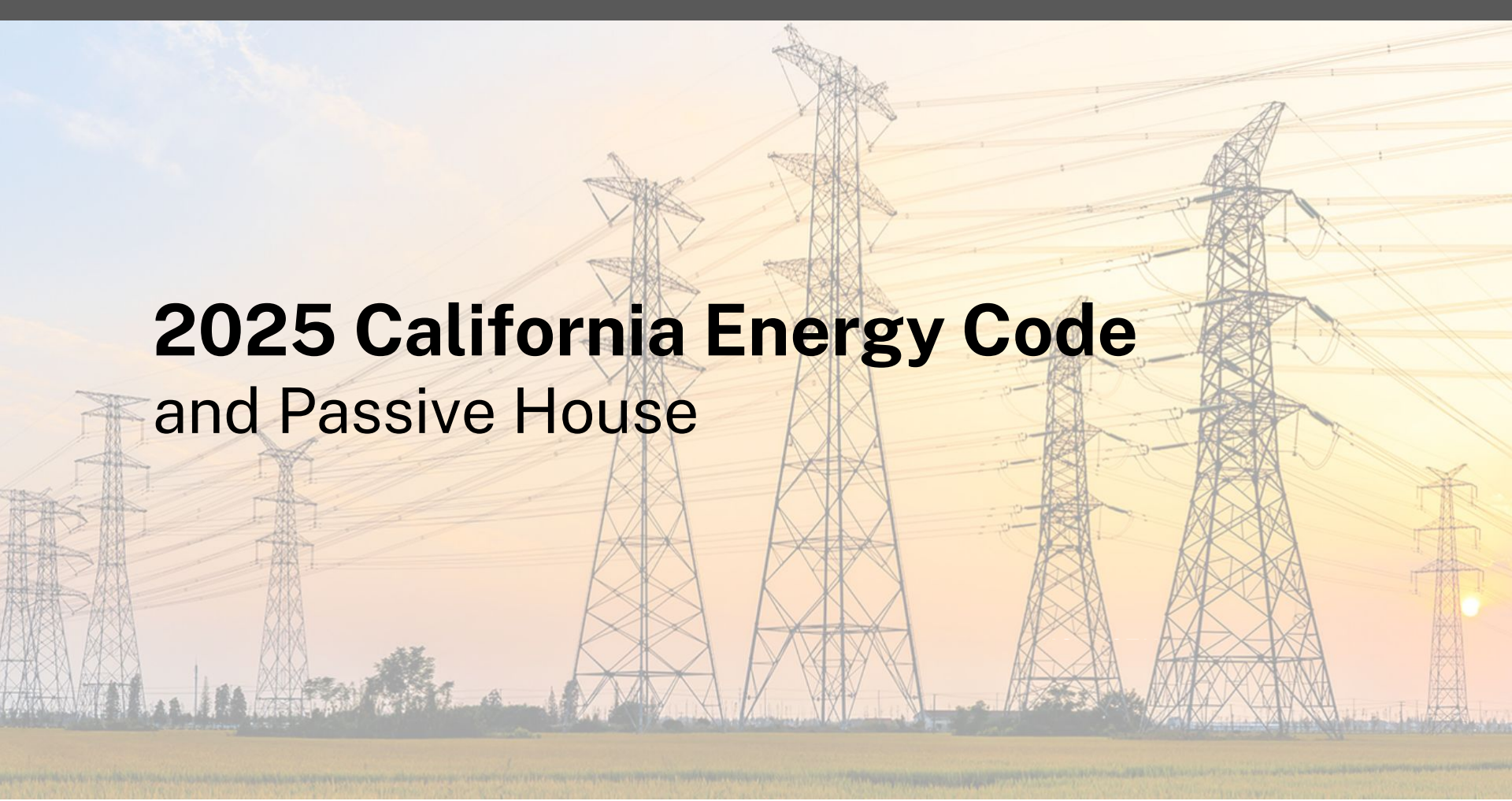


2025 California Energy Code
and Passive House

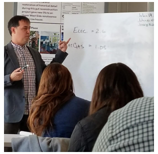
The Network

Global Knowledge. Regional Context. Local Applications



















Passive House Seattle
The Passive House Network

Passive House Rocky Mountains
The Passive House Network

Passive House Minnesota
The Passive House Network

Passive House Pennsylvania
The Passive House Network

Passive House Washington DC
The Passive House Network

New Jersey Passive House
The Passive House Network

Passive House Empire State
The Passive House Network

Passive House Northeast
The Passive House Network

PHCA Passive House California

North American Certifiers Circle — Passive House Certifier, Passive House Institute accredited

International Passive House Association iPHA

Passive House Institute

Designer — Certified Passive House Designer

Certified Passive House Tradesperson — Tradesperson

Certified Passive House — Passive House Institute

2025 California Building Energy Code & Passive House

Description:
This course will provide an overview of how the 2025 California Title 24, Part 6 code addresses Passive House concepts. We will look at basic Passive House principles, methodology, and performance targets, focusing on electrification goals and how they relate to the updated California codes. The class will illustrate the goals, strategies, and results with regional case studies.

Learning Objectives:

1. Explain Passive House principles and benefits.
2. Describe relevant California Code updates.
3. Outline strategies for building design and construction to meet Passive House and new code requirements.
4. Describe case studies of homes that achieve all-electric code-compliant Passive House outcomes and the strategies and outcomes.

Instructor:
Ken Levenson, Executive Director, The Passive House Network.
Ken was a practicing architect for over three decades, completing early Passive House projects in New York City. Committed to accelerating Passive House growth and knowledge sharing, he co-founded 475 High Performance Building Supply, was a founding member of the Phius Passive House Alliance, a co-founder of New York Passive House and of NAPHN, which would become The Passive House Network (PHN). Today, as Executive Director of PHN, Ken continues to focus on driving building industry culture change with Passive House education.

Personal Start: A Townhouse Retrofit

Brooklyn, NY

Agenda

- Goals of Title 24 & Passive House
- Title 24, Part 6, Code Updates
- Passive House Introduction
- Passive House & Title 24
- Case Study
- Resources

Goals of Title 24 & Passive House

Different Character of Goals

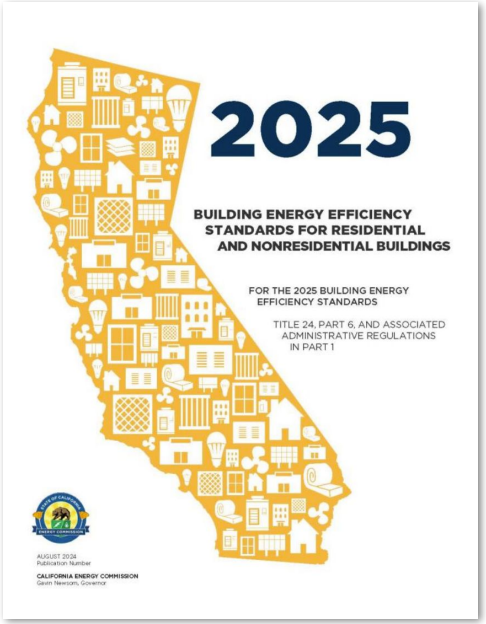
Energy Code	**Passive House**
Relative Targets	*Fixed Scientific* Targets
Thermal Comfort *not addressed*	Thermal Comfort
Improved Indoor Air Quality	Healthy Indoor Air Quality
More Energy Efficient	Energy Efficient
More Durable	Durable
Affordability	Affordability
Integration leveraged more	Integration leveraged
Flexibility through tech	Flexibility through passive buffers
Unoptimized All-Electric Future	Optimized All-Electric Future

2025 Title 24 Updates

2025 Energy Code Goals

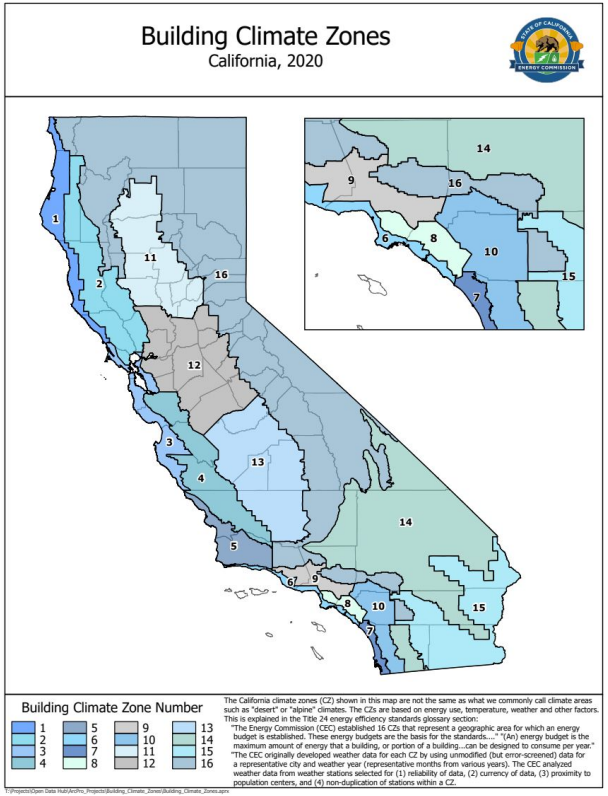
Effective January 1, 2026

- Comprehensive update to the statewide minimums, generally more stringent than previous cycles.
- Greater uniformity across state.
- Expansion of Prescriptive requirements.
- Establishes an energy budget, rather than a “rating” metric.
- Increase building energy efficiency cost-effectively
- Increase heat pump usage
- Promote demand flexibility, solar PV, and battery energy storage systems
- Improved ventilation systems and IAQ.



Why Did the Energy Code Change?

- To reduce greenhouse gas (GHG) emissions by four million metric tons and fight climate change.
- Save $4.8 billion in energy costs
- Drive 500,000 heat pump installations in the first three years
- Save water - enough to fill 100 Olympic-sized swimming pools annually.



Focus CZs 4,5,6,9 & 16

Key

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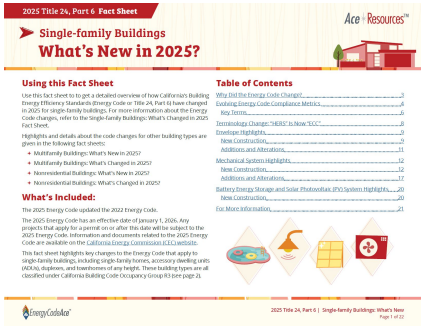
~~2022 Code Provisions Eliminated~~

New/replacement 2025 Code Provisions Added

2022 Provision Remaining (not exhaustive)

Existing modified in 2025


2025 Title 24, Part 6 Fact Sheet

Single-family Buildings

What's New in 2025?

Ace Resources

Using this Fact Sheet

Use this fact sheet to to get a detailed overview of how California's Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) have changed in 2025 for single-family buildings. For more information about the Energy Code changes, refer to the Single-family Buildings: What's Changed in 2025 Fact Sheet.

Highlights and details about the code changes for other building types are given in the following fact sheets:

- Multifamily Buildings: What's New in 2025?
- Multifamily Buildings: What's Changed in 2025?
- Nonresidential Buildings: What's New in 2025?
- Nonresidential Buildings: What's Changed in 2025?

What's Included:

The 2025 Energy Code updated the 2022 Energy Code.

The 2025 Energy Code has an effective date of January 1, 2026. Any projects that apply for a permit on or after this date will be subject to the 2025 Energy Code. Information and documents related to the 2025 Energy Code are available on the California Energy Commission (CEC) website.

This fact sheet highlights key changes to the Energy Code that apply to single-family buildings, including single-family homes, accessory dwelling units (ADUs), duplexes, and townhomes of any height. These building types are all classified under California Building Code Occupancy Group R3 (see page 2).

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2025 Title 24, Part 6 | Single-family Buildings: What's New

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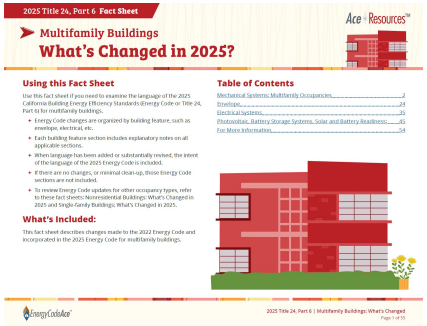
2025 Title 24, Part 6 Fact Sheet

Multifamily Buildings

What's Changed in 2025?

Ace Resources

Using this Fact Sheet

Use this fact sheet if you need to examine the language of the 2025 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) for multifamily buildings.

- Energy Code changes are organized by building feature, such as envelope, electrical, etc.
- Each building feature section includes explanatory notes on all applicable sections.
- When language has been added or substantially revised, the intent of the language of the 2025 Energy Code is included.
- If there are no changes, or minimal clean-up, those Energy Code sections are not included.
- To review Energy Code updates for other occupancy types, refer to these fact sheets: Nonresidential Buildings: What's Changed in 2025 and Single-family Buildings: What's Changed in 2025.

What's Included:

This fact sheet describes changes made to the 2022 Energy Code and incorporated in the 2025 Energy Code for multifamily buildings.

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2025 Title 24, Part 6 | Multifamily Buildings: What's Changed

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https://passivehousenetwork.org/wp-content/uploads/2025/06/ECAMFWhatsChangedFactSheetWEB_1925.pdf

Changing Metrics & Terms

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- ~~Energy Design Rating (EDR)~~
- ~~Time Dependent Value (TDV)~~
- **Long-term System Cost (LSC)** - present value energy system (30 year life) $/ft2
  Based on hour of year, climate zone, energy type, building type.
  - **LSCe - Efficiency** - for the building itself and core systems costs
  - **LSCt - Total** - adds inclusion of on-site renewable and batteries costs
- ~~Source EDR~~
- **Source** - marginal fossil fuel use at building or time dependent system loads, value lifetime average. kBtu/ft2yr
- ~~HERS Rater~~
- **ECC Rater (Energy Code Compliance Rater)** - moved to Title 24 (from 20)
  - Field verification and diagnostic testing.

- **Peak Cooling** - Cooling demand between 4pm & 9pm. kWh (single-family)
- ~~Energy Storage System (ESS)~~
- **Battery** (Ready) **Energy Storage System** (BESS)

Performance Path vs Prescriptive Path vs Mandatory

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Performance

- Energy Model Calculations
  - Long-term System cost (LSC)
  - Source
  - Peak Cooling (single-family)
- Greater flexibility
- **Allows fossil fuels** for space or water heating
- Optimization
  - Credit for variable capacity heat pumps
  - Credit for heat recovery ventilation
  - Credit for confirmed greater airtightness, down to 2 ACH50, insulation etc…

Prescriptive

- No energy modeling (a recipe)
  - Tighter window requirements (U-value/SHGC)
  - Balanced ventilation requirements.
- Less flexible but simpler
- **No fossil fuels** for space or water heating = **only heat pumps**
  - Verify HP refrigerant charge.
- Expanded roof insulation requirements
- No optimization incentive

Mandatory requirements backstop **Performance** and Prescriptive paths.

2025 Mandatory Requirements: Enclosure

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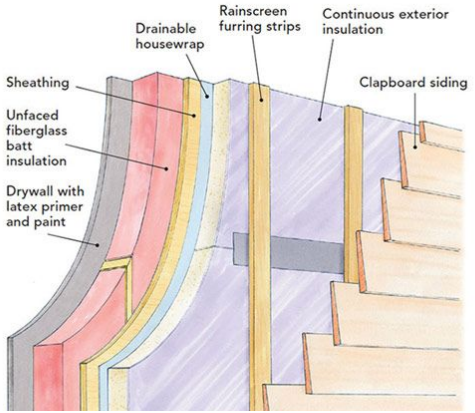
- Max Wall U-factors:
  - Wood Framed
    - 0.095 from 0.102 (2x4) = R-15 from R-13 with 16” O.C. framing
    - 0.069 from 0.071 (2x6) = R-21 from R-20 with 16” O.C. framing
  - Metal Framed
    - 0.151 from 0.217 (2x4) with layer of continuous insulation.

Credit: Fine Homebuilding



2025 Mandatory Requirements: Enclosure

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- Max Window (& Skylight) U-factors
  - tightened to 0.40 from 0.45
  - For windows installed to meet fire resistance requirements in Wildland-Urban Interface (WUI) per Building Code part 7, **it's not required.**
- Airtightness: 5 ACH50 **assumed**
  - **Air sealing is required and 3 ACH50 is a target, but actual airtightness is not required.**

2025 Mandatory Requirements: Enclosure

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- **Multifamily**
  - metal frame walls must have more continuous insulation depending on climate zone.
  - unit airtightness
  - entry vestibules (many exceptions)

2025 Mandatory Requirements: Ventilation

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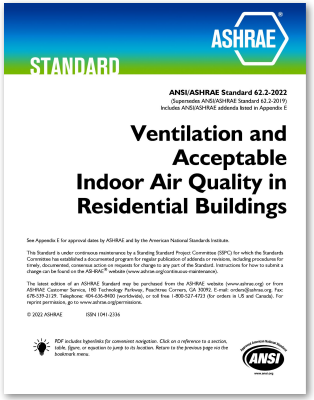
- Ventilation
  - ASHRAE 62.2
  - HRV/ERV: balanced ventilation with heat recovery systems not mandatory, but if used, the below is now mandatory.
    - filters/cores must be accessible.
    - Intake/exhaust design requirements
    - Fault Indicator Display Devices (FIDs)
    - Get an energy credit in Performance method



Multifamily -

- ~~Exhaust only ventilation~~
- only supply or balance ventilation allowed.
- Balanced ventilation required for 1-3 stories in climate zones 1-15.

2025 Mandatory Requirements: Heating & Cooling

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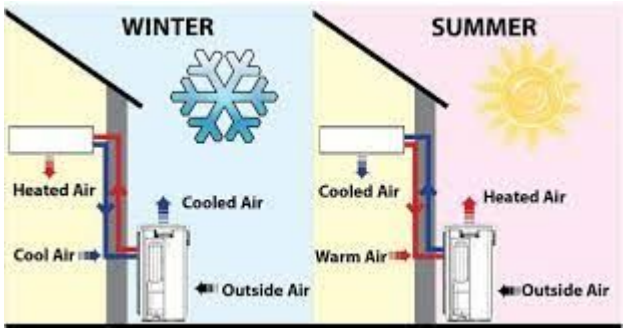
- Heating sizing per Air Conditioning Contractors of America (ACCA) Manual S-2023
- With no limit on cooling capacity

If heat pumps used for space heating
(mandatory for prescriptive)

- Verification of refrigerant charge by ECC rater.
- Enhanced controls - display outdoor air temp +

If gas space heating installed (Performance)

- HP ready - space and circuits



2025 Mandatory Requirements: Hot Water

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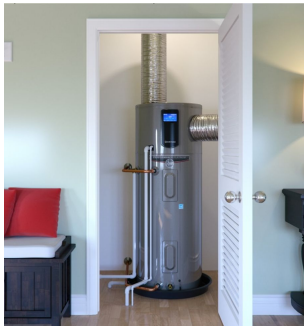
- Heat Pump Water Heaters (HPWH)
  - **mandatory in Prescriptive**
  - Extensive definitions
    - Integrated vs split-refrigerant vs split hydronic
  - Installation requirements
    - Ducted (R-6 insulation)
    - Non-ducted unit space volume
    - Filter access
    - Backup heat source (integrated elec element)
  - Gas instantaneous no longer allowed
  - For <500SF elec point of use (instantaneous or tank) allowable.
  - Controls

- If gas hot water heater installed (Performance)
  - HPWH ready - space and circuits



Integrated and Ducted

Integrated/Not Ducted

Split Hydronic

2025 Mandatory Requirements: Electrical

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- Electric Ready
  - Circuits at panels & Physical space
    - Hot water (30 amp)
    - Space heating (30 amp)
    - Cooking (50 amp)
    - Clothes dryer (30 amp)
- Battery Energy Storage System (BESS) **ready**
  - Exceptions if the dwelling service is 125 amps or less and if the home has a system already installed. (mandatory for 225 amps and above.)
- Solar
  - Solar Access Roof Area (SARA) calculation modified
  - added to more occupancy types
- Commercial kitchens to be electric ready.

Prescriptive: Assembly

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BUILDING COMPONENT ROOFS AND CEILINGS	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Above Grade Framed Walls[3]	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.065	U-0.065	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048

Walls

- Min R-15 cavity insulation plus continuous as req'd

=R-21

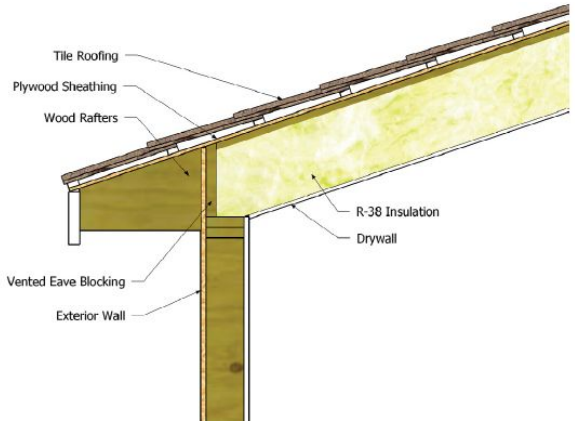
Ceiling below Ventilated Attic

Option C[14] Ceiling Insulation for Vented Attics	R-38	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38

Unvented Cathedral Roofs, Climate Zones 1-16

- Now allowed in Prescriptive
  - Continuous rigid/air impermeable insulation directly above or below the roof sheathing.
  - Vapor permeable/vapor ports or vented cold roof can also be possible.

Option C Roof Deck Insulation for Cathedral Ceilings[1,4]	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38



Multifamily

- New slab edge insulation requirements

Prescriptive: Windows

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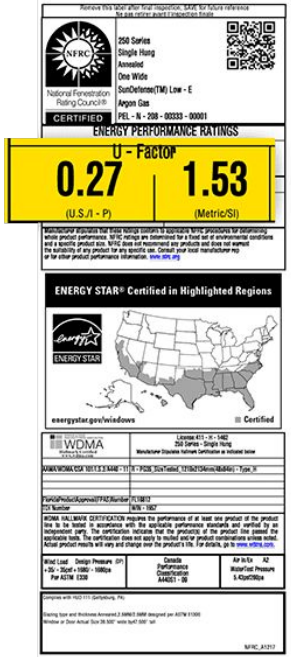
Windows have stricter U-values, plus SHGC value limits.

BUILDING COMPONENT ROOFS AND CEILINGS	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Fenestration - Maximum *U*-factor[12]	0.27	0.27	0.27	0.27	0.27	0.30	0.30	0.30	0.30	0.30	0.27	0.27	0.27	0.27	0.30	0.27
Fenestration - Maximum SHGC	NR	0.23	NR	0.23	NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.203	NR



Multifamily

- max U-value 0.28 CZ 1, 3-5, 11 and 13-16
- No change in u-values in other climate zones
- WUI compliance exceptions

Prescriptive: Ventilation

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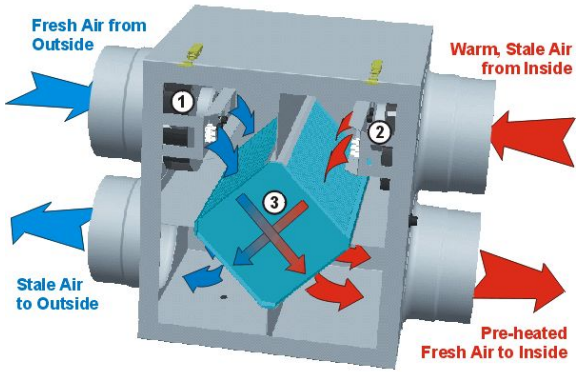
If Balanced continuous ventilation installed

- Min heat recovery of 67%
- Fan efficiency of 0.6 w/cfm
- Unit accessibility requirements
  - Change filters & maintain equipment
  - No higher than 10’ above walking surface or have a Fault Indicator Display (FID)
- Outdoor intake:
  - accessible & weather protected.



Heat Recovery Ventilation Unit

Performance: Peak Cooling Load

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CZs 4, 8-15

- Peak Cooling Load cannot exceed 120% of prescriptive model building. (Between 4pm & 9pm)

Capping use at stress point.

Performance: BESS Self-Utilization Credit

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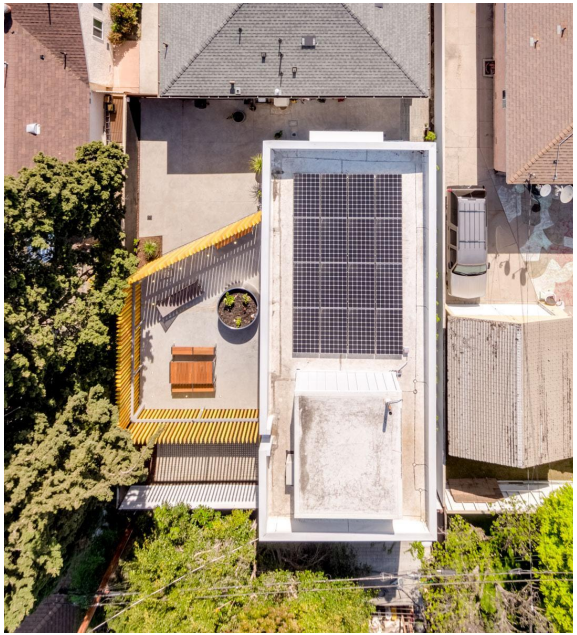
In context of Long-term System Cost and peak Cooling Energy limits it encourages more direct integration and can allow a smaller solar panel installation to meet requirements while increasing resiliency.



Performance: Airtightness

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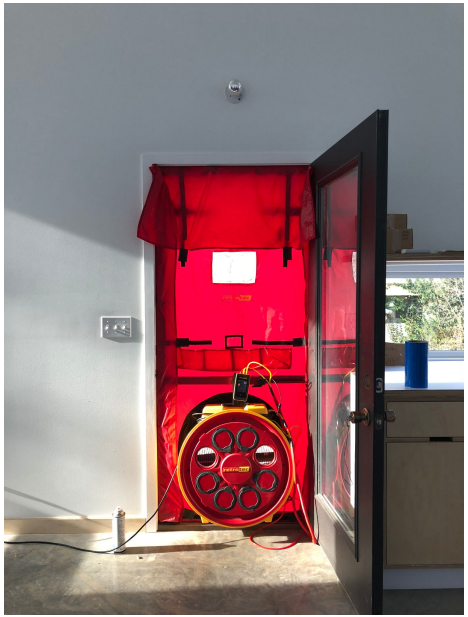
ECC-Verified Reduced Building Air Leakage: An energy credit is allowed for single-family buildings through the performance approach when the rate of envelope air leakage of the building is less than the air leakage rate assumed for the standard design building of 5 ACH50.

Note for ECC-Raters: A third-party ECC-Rater shall verify the air leakage rate shown on compliance documentation through diagnostic testing of the air leakage of the building.

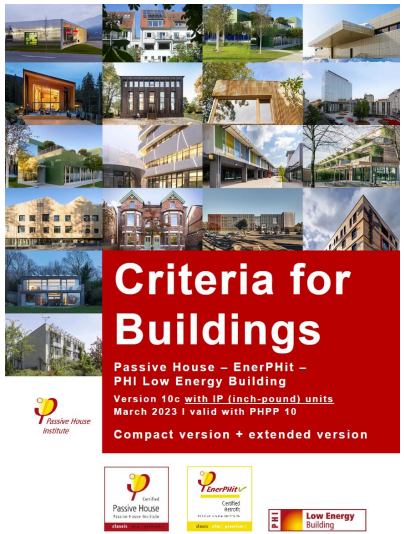


Code Update Summary

- Establishes an **energy budget** ($ & KW/FT2), rather than a “rating” metric.
- Comprehensive update to statewide minimums - generally more stringent.
- Greater uniformity across state.
- Expansion of Prescriptive requirements.
- Increase heat pump usage.
- Promote **demand flexibility**, solar PV, and battery energy storage systems.
- **Improved ventilation systems and IAQ**.
- Went into effect **January 1, 2026**.

Passive House Introduction

What is Passive House?

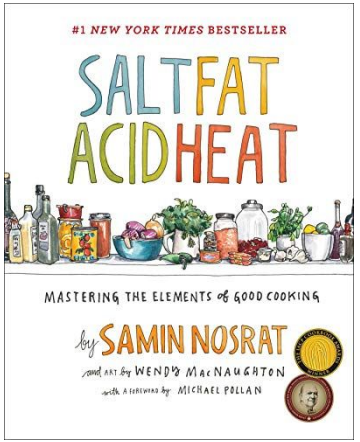


- Passive House is a building standard
- The most rigorous energy efficiency certification available
- Applies to new & existing buildings
- Performance-based approach
- Focuses on mastering the drivers of building performance.

How we use fundamental elements matters

“I was working as a physicist. I read that the construction industry had experimented with adding insulation to new buildings and that energy consumption had failed to reduce. This offended me – it was counter to the basic laws of physics. I knew that they must be doing something wrong. So I made it my mission to find out what, and to establish what was needed to do it right.”

- Wolfgang Feist



Passive House masters the elements of high-performance building.

First Passive House, Completed in 1991

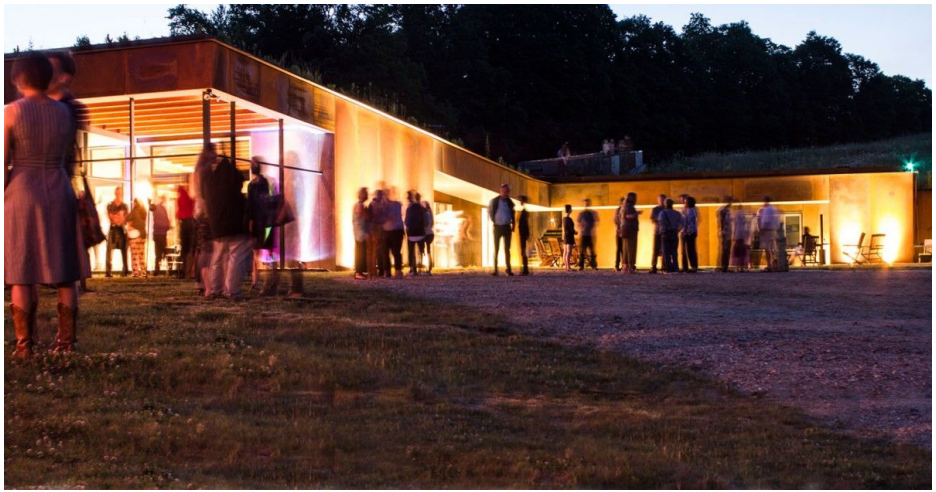
Realization: Passive House efficiency underlies what we value most.

Occupants (home, school, work)

- Comfortable
- Healthy indoor air quality
- Fewer allergies
- More alert
- Quiet
- Resilient & Safe
- Affordable operation & maintenance
- High levels of satisfaction

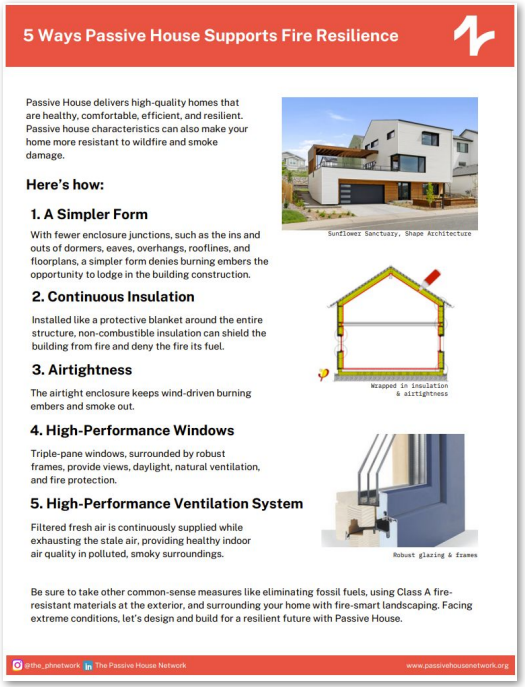
Owners

- Affordable upfront cost
- Fewer callbacks
- Reduced maintenance
- Perpetual energy savings
- Happy occupants and lower vacancy
- Higher sale price
- Durable high quality asset
- Lower risk investment



Ryall Sheridan Architects, VT

Wildfire Resilience



5 Ways Passive House Supports Fire Resilience

Passive House delivers high-quality homes that are healthy, comfortable, efficient, and resilient. Passive house characteristics can also make your home more resistant to wildfire and smoke damage.

Here's how:

1. A Simpler Form

With fewer enclosure junctions, such as the ins and outs of dormers, eaves, overhangs, rooflines, and floorplans, a simpler form denies burning embers the opportunity to lodge in the building construction.

Sunflower Sanctuary, Shape Architecture

2. Continuous Insulation

Installed like a protective blanket around the entire structure, non-combustible insulation can shield the building from fire and deny the fire its fuel.

Wrapped in insulation & airtightness

3. Airtightness

The airtight enclosure keeps wind-driven burning embers and smoke out.

4. High-Performance Windows

Triple-pane windows, surrounded by robust frames, provide views, daylight, natural ventilation, and fire protection.

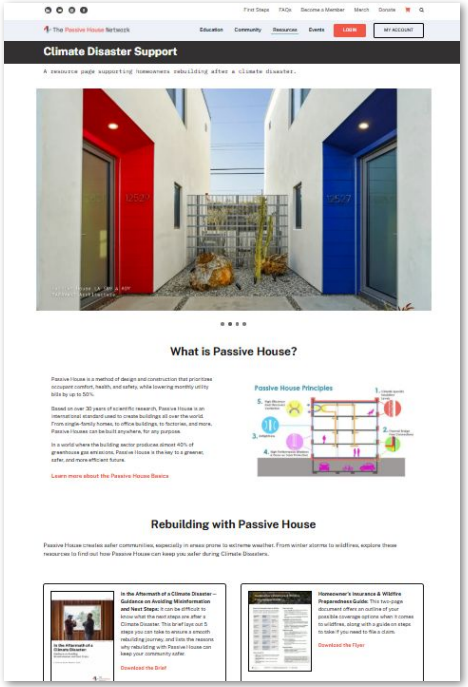
Robust glazing & frames

5. High-Performance Ventilation System

Filtered fresh air is continuously supplied while exhausting the stale air, providing healthy indoor air quality in polluted, smoky surroundings.

Be sure to take other common-sense measures like eliminating fossil fuels, using Class A fire-resistant materials at the exterior, and surrounding your home with fire-smart landscaping. Facing extreme conditions, let's design and build for a resilient future with Passive House.

@the_phnetwork The Passive House Network www.passivehousenetwork.org



Climate Disaster Support

A resource page supporting homeowners rebuilding after a climate disaster.

What is Passive House?

Passive House Principles

Rebuilding with Passive House

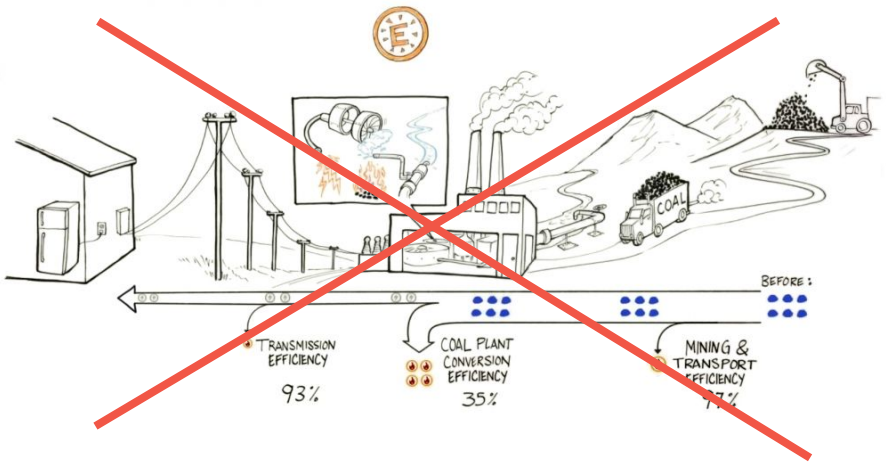
California Rebuilds

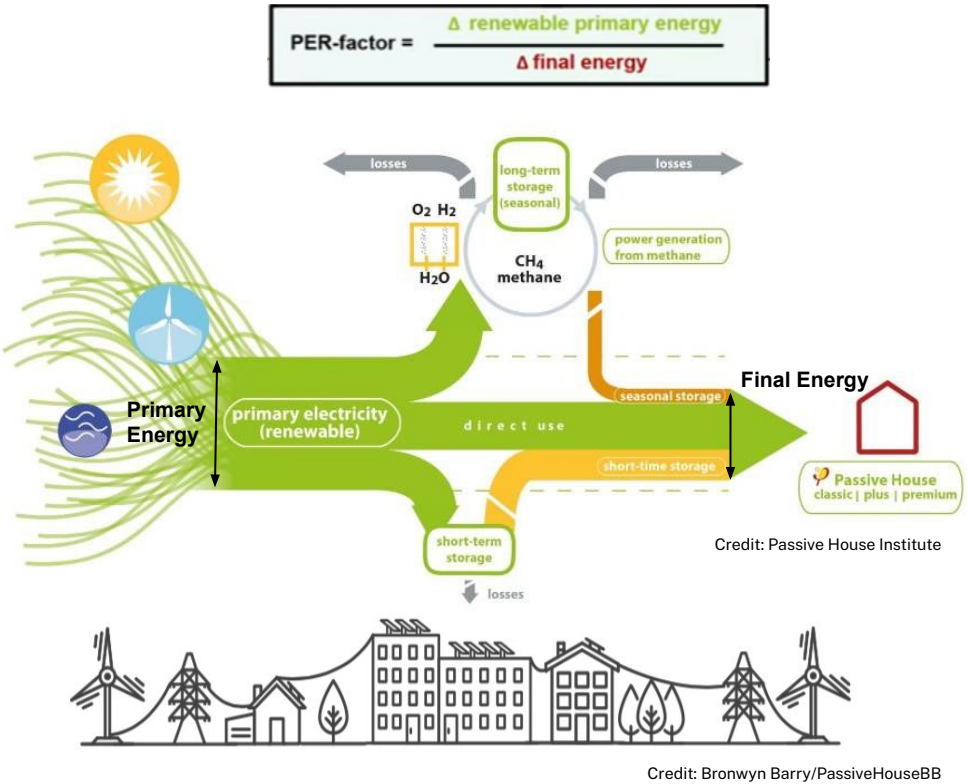
A Passive House Design Competition

Submission Deadline: Sept 30, 2025

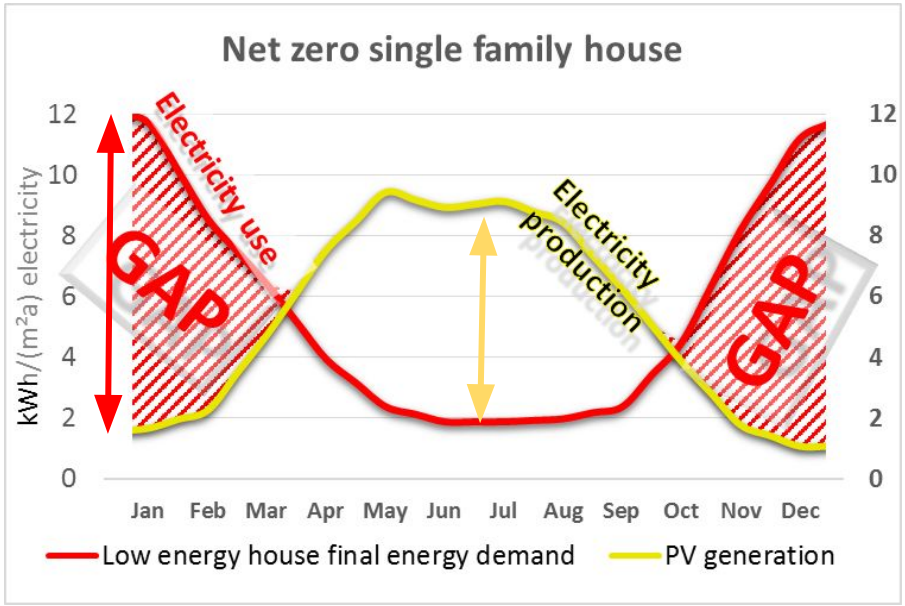
Shift Focus: Analysis to fit our all renewable future

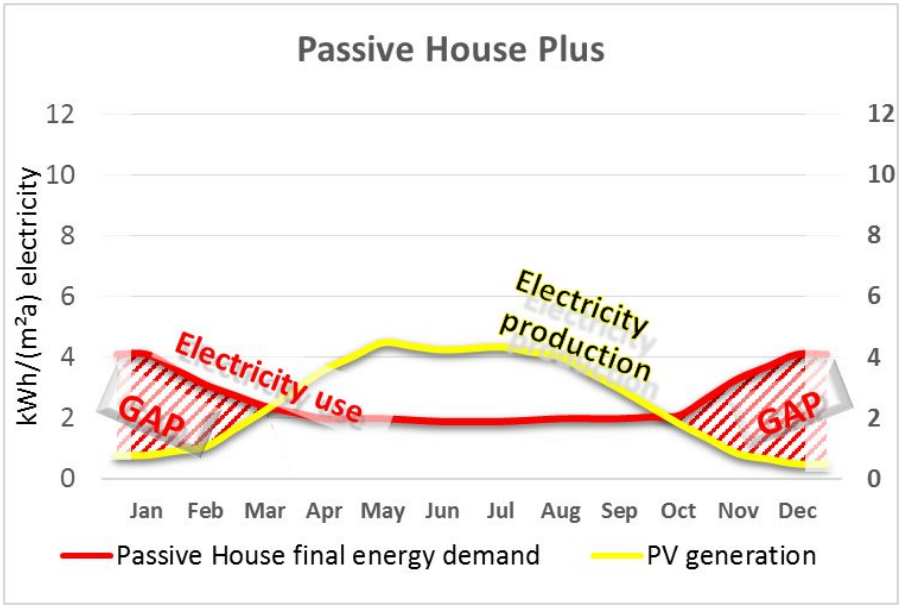
Passive House looks beyond the emissions analysis and to renewable production & utilization.





Empower electrification: “crush the heating demand”





Homes...

Affordable Housing


Brownsville, Brooklyn


Sendero Verde, East Harlem

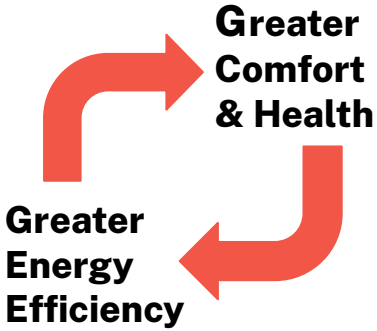
Schools

Opal Architecture, Bar Harbor, Maine

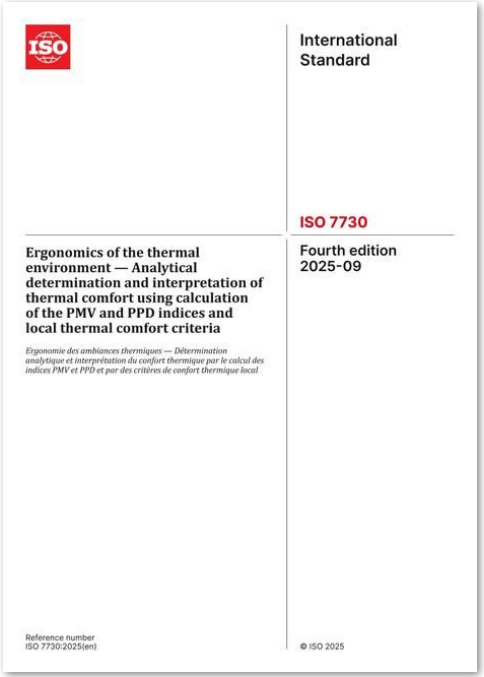
Architecture Research Office, Brooklyn NY

Goals of Passive House

- Thermal Comfort
- Hygienic conditions
  - No mold
  - Healthy indoor air quality
- Energy Efficiency
- Durability
- Affordability



International Standard of Thermal Comfort



International Standard

ISO 7730

Fourth edition
2025-09

Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria

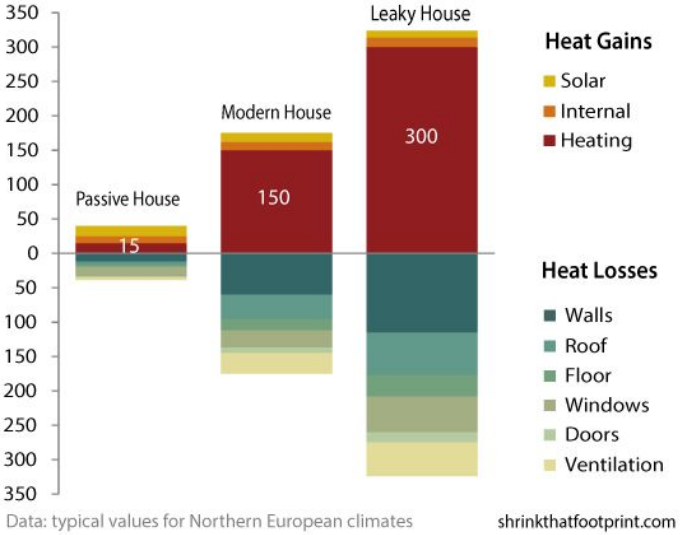
Ergonomie des ambiances thermiques — Détermination analytique et interprétation du confort thermique par le calcul des indices PMV et PPD et par des critères de confort thermique local

Reference number
ISO 7730:2025(en)

© ISO 2025

Decouple power & performance with fixed target

Energy Balance



Certified Passive House
Passive House Institute

Not relative improvement to a baseline.

Criteria: Energy Metrics & Targets = Energy Budget

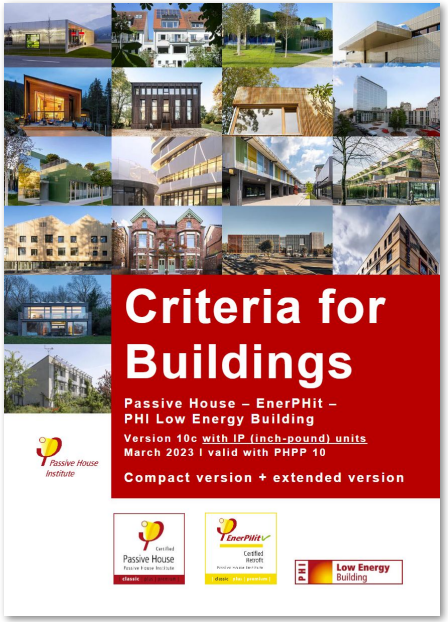
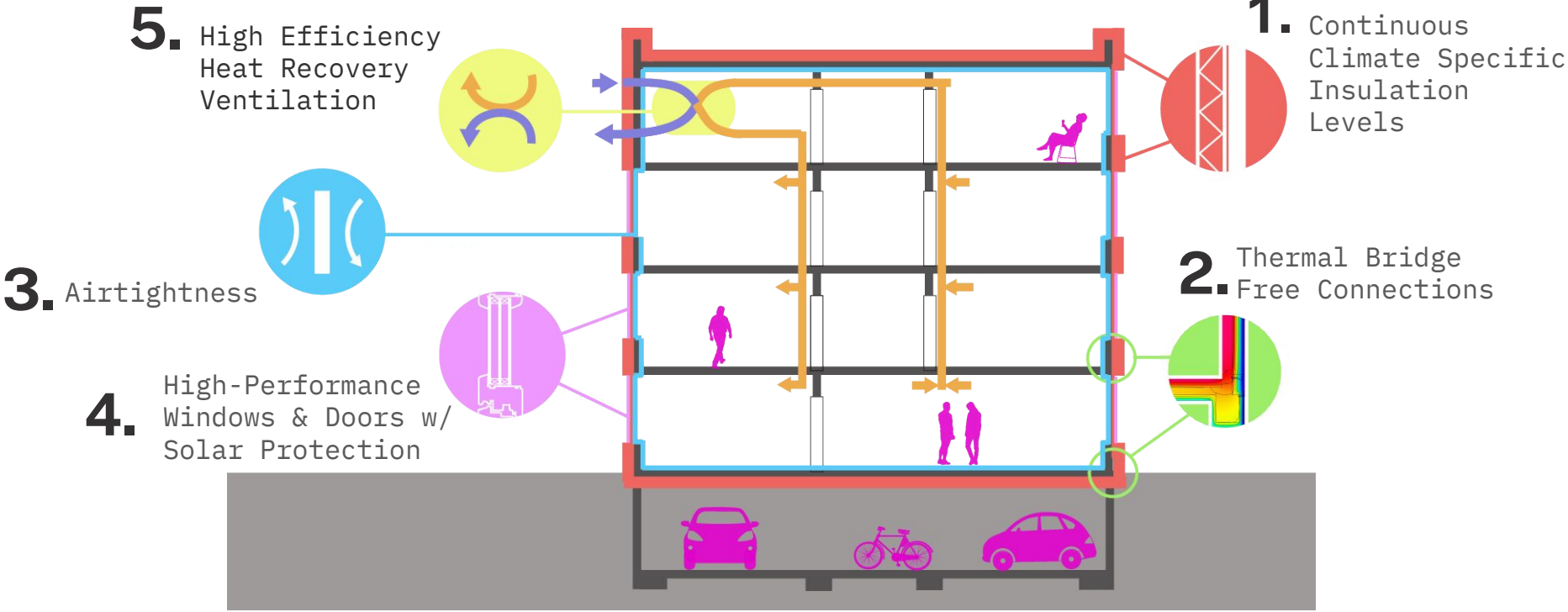


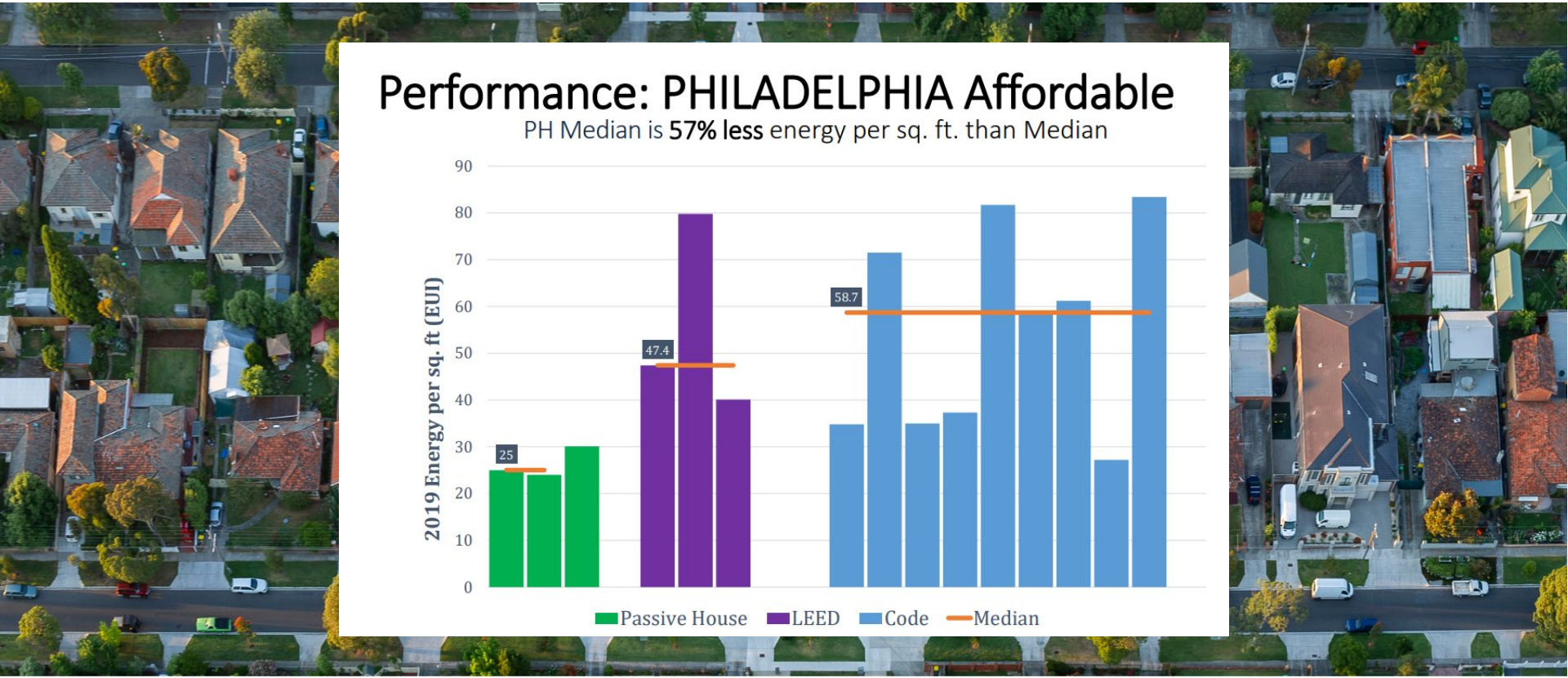
Table 1 Passive House criteria

			Criteria[1]			Alternative Criteria[2]
Heating						
Heating demand	[kBTU/(ft²yr)]	≤	4.75			-
Heating load[3]	[BTU/(hr.ft²)]	≤	-			3.17
Cooling						
Cooling + dehumidification demand	[kBTU/(ft²yr)]	≤	4.75 + variable allowance[4]			
Airtightness						
Pressurization test result n_{50}	[1/hr]	≤	0.6			
Renewable Primary Energy (PER)[5]			Classic	Plus	Premium	
PER demand[6]	[kBTU/(ft²yr)]	≤	19.02	14.26	9.51	±4.75 kBTU/(ft²yr) deviation from criteria...
Renewable energy generation[7] (with reference to projected building footprint)	[kBTU/(ft²yr)]	≥	-	19.02	38.04	...with compensation of the above deviation by different amount of generation[8]

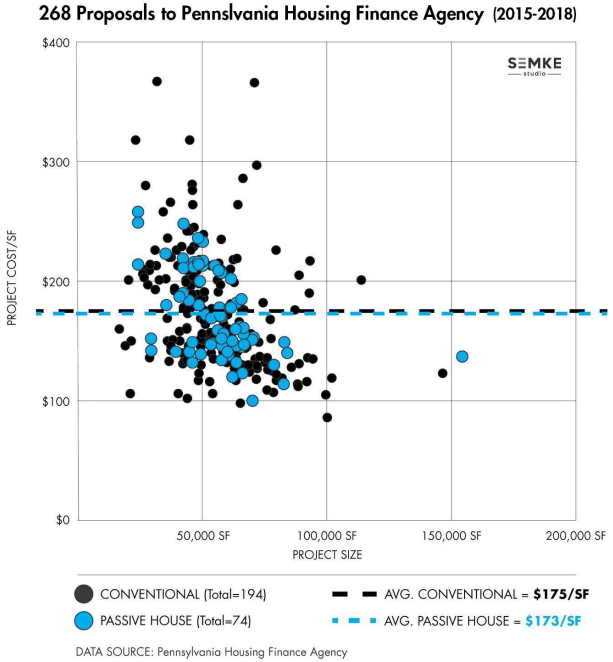
5 Principles of Construction (the drivers)

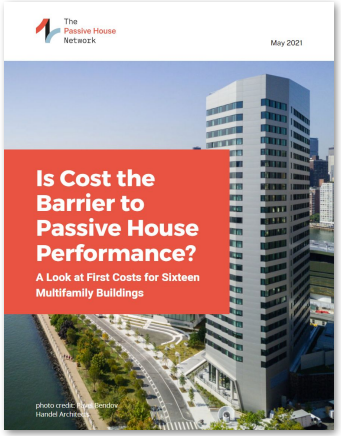


Predictable Performance is THE thing.

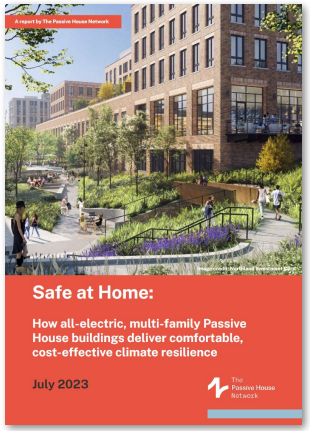


Budgets: Pushing Toward Parity





https://passivehousenetwork.org/wp-content/uploads/2022/10/Is-Cost-the-Barrier-to-Passive-House-Performance-May-2021-PHN.pdf



https://passivehousenetwork.org/safe-at-home/

https://passivehousenetwork.org/wp-content/uploads/2024/10/CONSTRUCTION-COST-ANALYSIS-OF-HIGH-PERFORMANCE-MULTI-UNIT-RESIDENTIAL-BUILDINGS-IN-BRITISH-COLUMBIA-V3.1.pdf

Stay in budget & on target:

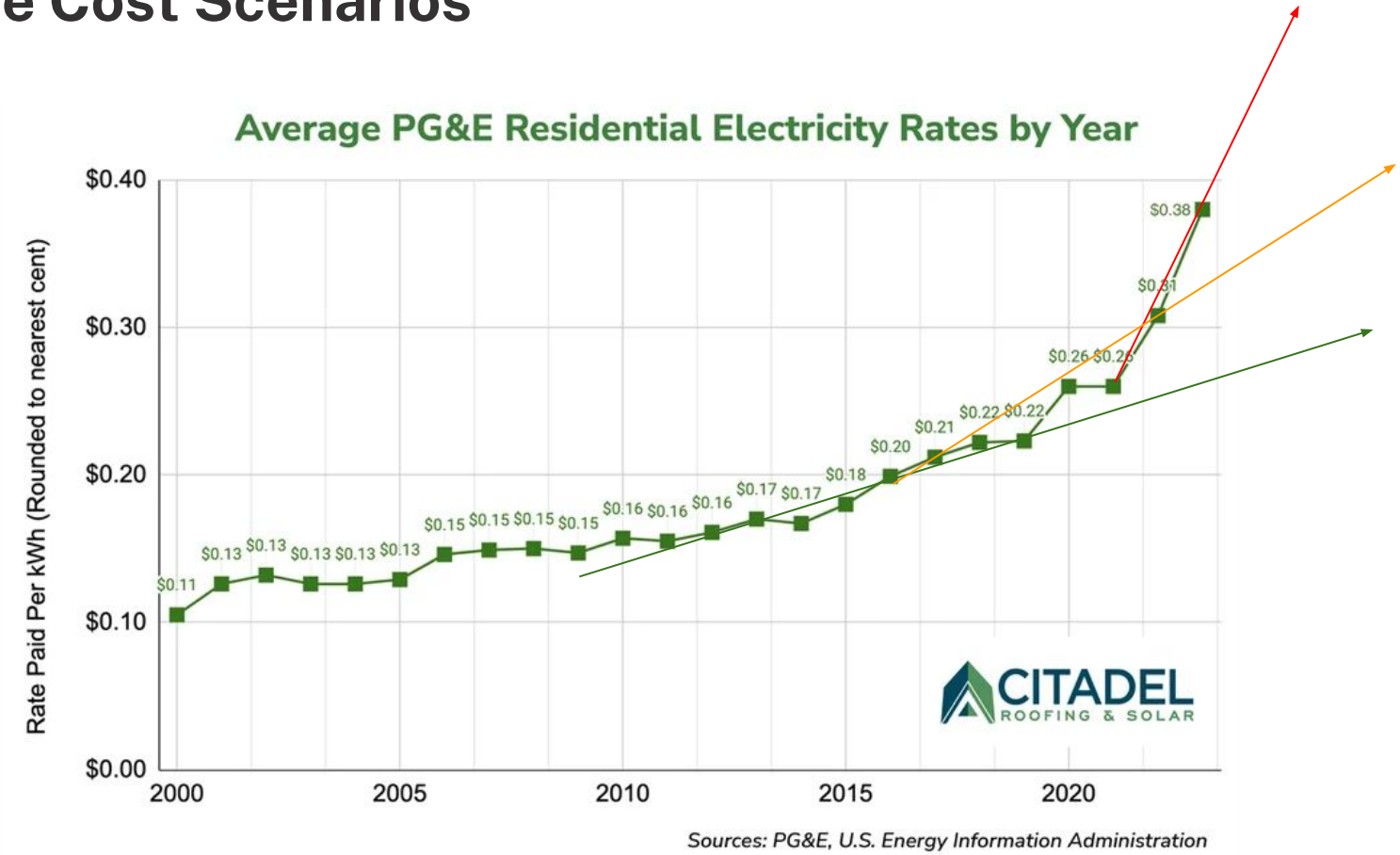
- Passive House from day one
- Work with a Certifier from day one
- Require team to have proper training
- Optimize from start & stick to certification and targets.

Passive House & Title 24

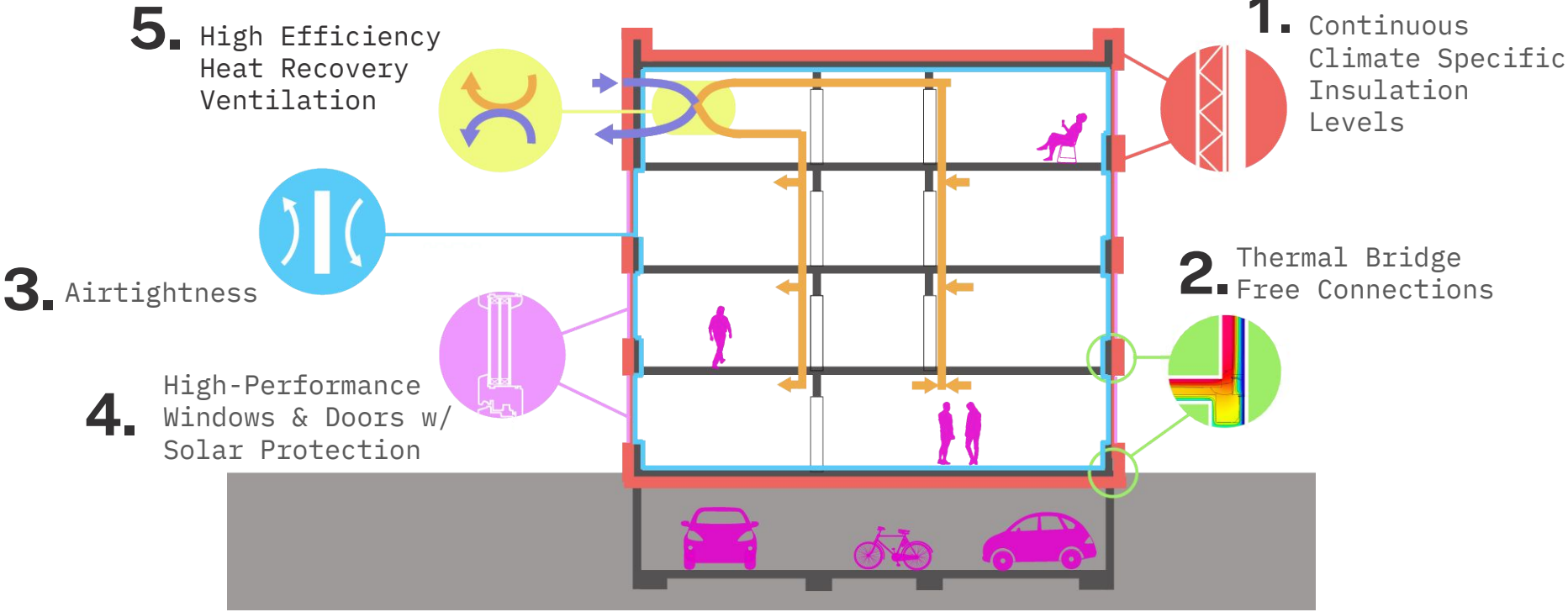
Different Character of Goals

Energy Code	**Passive House**
Relative Targets	*Fixed Scientific* Targets
Thermal Comfort?	Thermal Comfort
Improved Indoor Air Quality	Healthy Indoor Air Quality
More Energy Efficient	Energy Efficient
More Durable	Durable
Affordability	Affordable
Integration leveraged more	Integration leveraged
Flexibility through tech	Flexibility through buffers
Unoptimized All-Electric Future	Optimized All-Electric Future

Future Cost Scenarios



5 Principles of Construction (the drivers)



Health & Resilience Benefits

“We haven’t had to take our child to the emergency room with an asthma attack once since moving in.”
- Passive House occupant & mother


Sendero Verde, East Harlem

Thermal Comfort & Resilience

“The house maintains a steady temperature so well that it wasn’t until many weeks into winter that we realized the heat was not even on.”
- Passive House Resident

Element #1: Climate Specific Insulation

like a climate rated sleeping bag.

Minimize Thermal Bridging vs. ?

Vs.

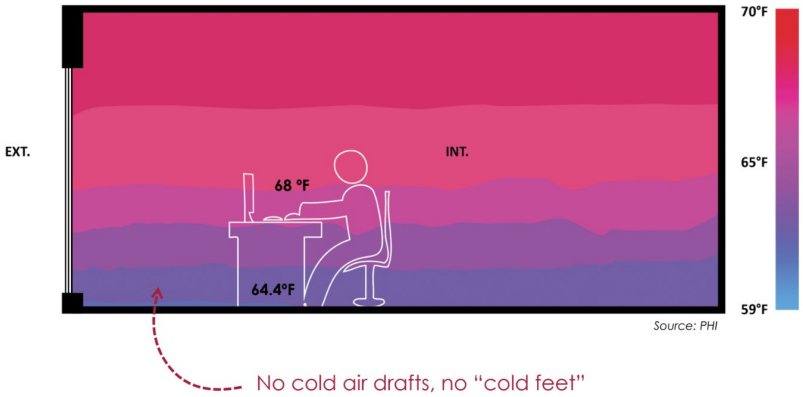
Criteria: Enclosure Quality Drives Thermal Comfort

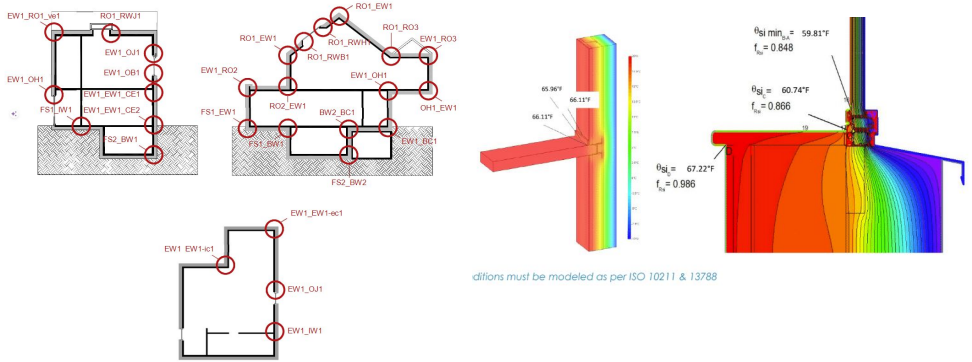
Thermal Protection (COMFORT)

- Interior Surface Temperatures: not more than 7.6 F below the operative indoor temperature.
- Floors: not below 66.2 F, Checked against 71.6 F in PHPP

Moisture Protection (HYGIENE/HEALTH)

fRsi defines the coldest point which can occur on the interior surface of a construction system. For example, if the temperature factor is 0.7, then 70% of the temperature difference between the inside and outside air is still present at the interior surface. If the temperature factor is achieved, then mould and condensation formation can be safely prevented at normal outdoor temperatures, indoor temperatures and indoor air humidity levels.

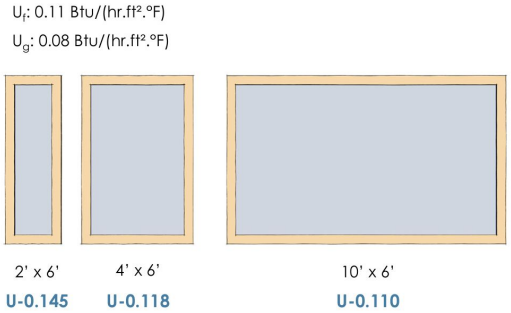




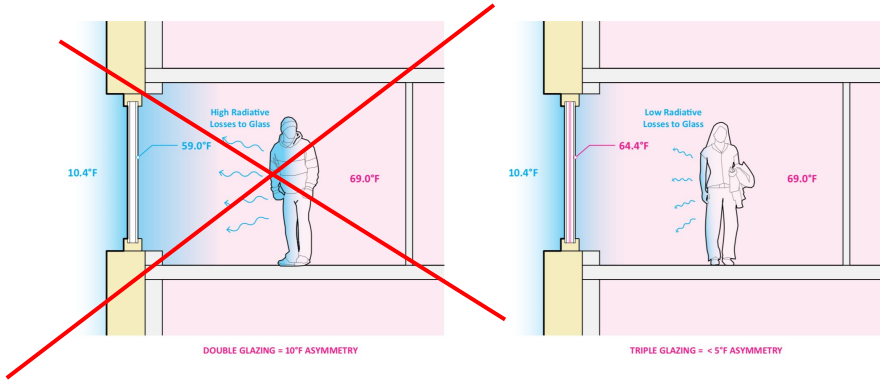
Even internal surface temperatures - Details matter a lot!

Criteria: High-Performance Windows & Doors

- Airtight
- Excellent thermal performance
- Interior Surface Temperatures: not more than 7.6 F below the operative indoor temperature.



Less Frame = Better Performance



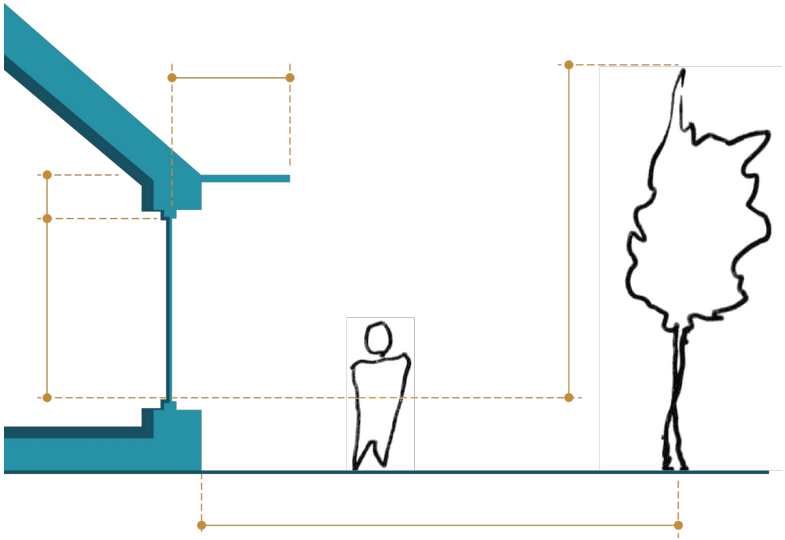
Cooling Demand Reduction

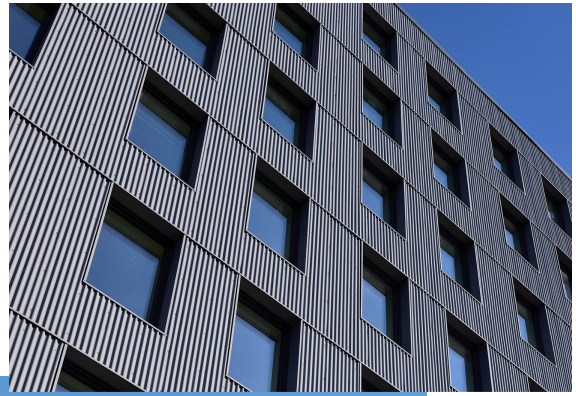
“Our house can hold the temperature in the summer too - utilize natural ventilation when cool at night, and benefit from shading strategies.”

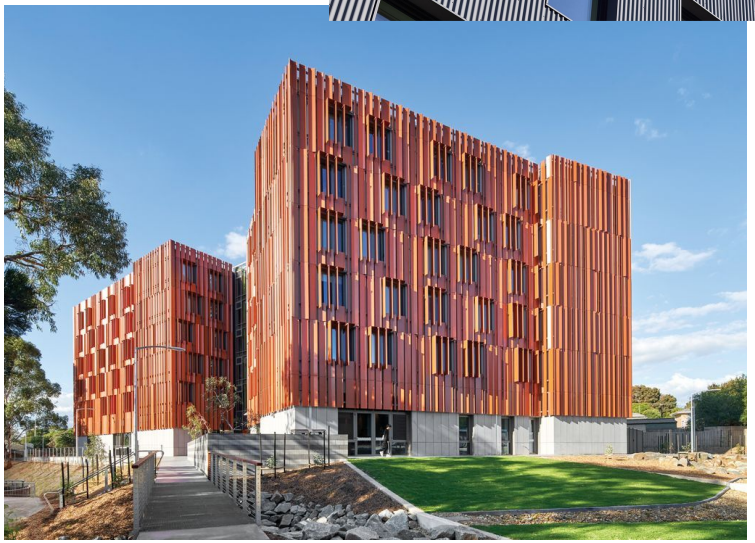
- Passive House Resident in Hot Summer Climate

SHGC only approach vs. Shading as Design Element

Exterior Shading vs. SHGC only approach

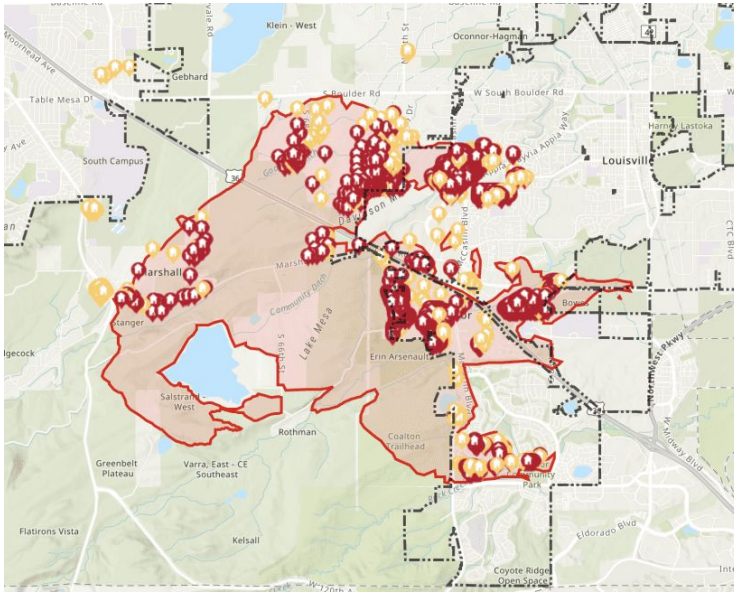




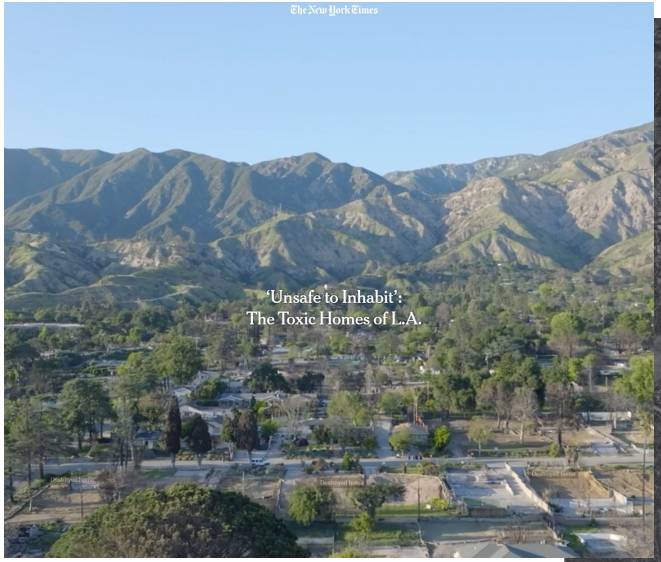


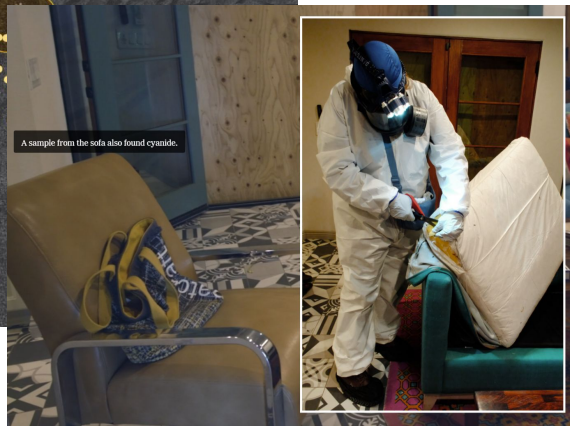
Airtightness & Resilience

“Smoke infiltration from the Marshall fire destroyed my neighbors homes, but our Passive House kept the smoke out and our house undamaged.”
- Louisville Colorado Resident



Urban Conflagration is More Toxic the Forest Fires



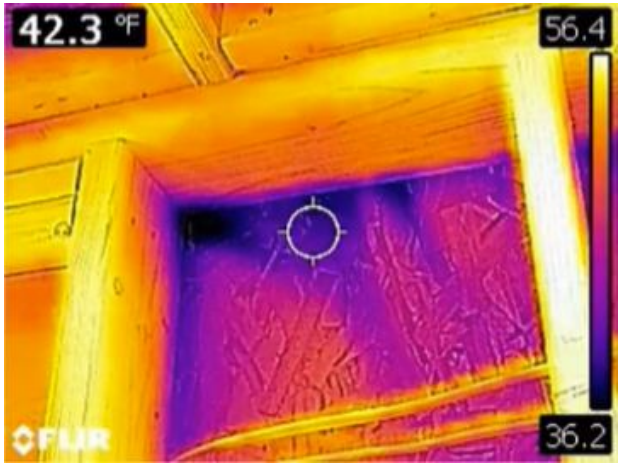


Cyanide, Carcinogens, Lead…

Tested 0.6 ACH50 vs Untested (verified 3 to 5 ACH50 in performance path)

Airtightness (Health, Comfort & Durability)

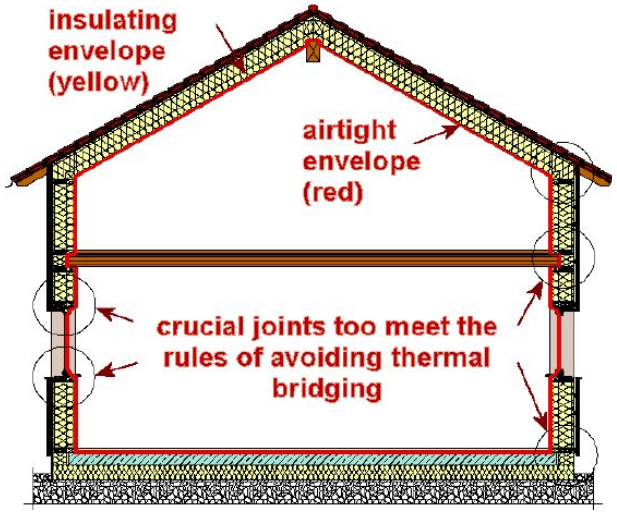
- Whole building test result of equal or less than **0.60 ACH50**.
- Average of depressurization & pressurization.



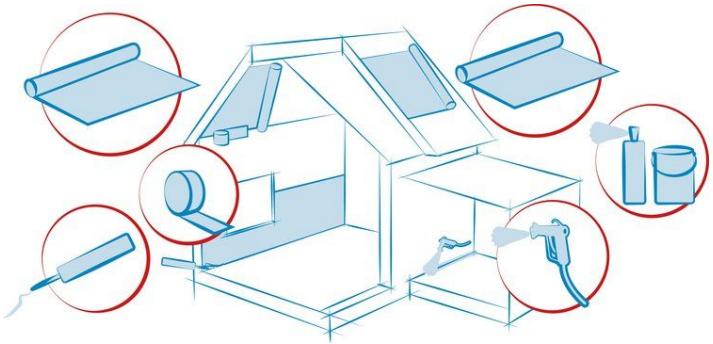
SECTION 110.7 – MANDATORY REQUIREMENTS TO LIMIT AIR LEAKAGE

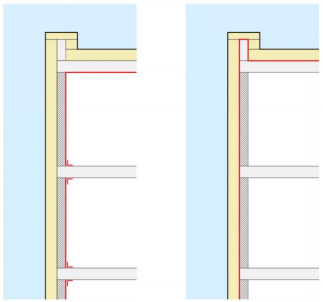
All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit infiltration and exfiltration.

Airtightness is a system. How robust?



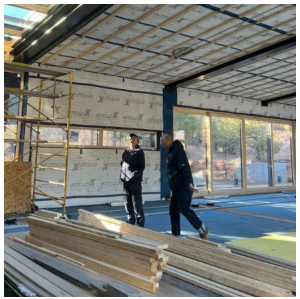
Ref http://passipedia.passiv.de/passipedia_en/





Air Barriers








Air Barriers?

Service Cavities!

Passive House Final Test – as “in use”

ISO 9972 Method 1

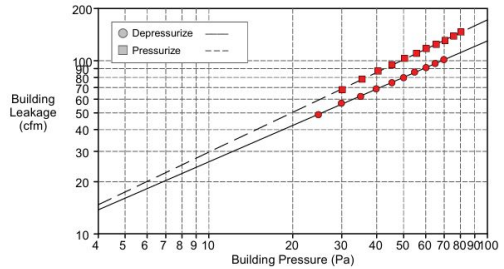
1. Fill plumbing drain p-traps with water or seal opening if no p-trap is present
2. Turn off all supply and/or exhaust fans.
3. Close and latch all access doors.
4. Close and latch all exterior doors and windows.
5. Seal ventilation system intake and exhaust.
6. All interior doors to be open.

Date of Test: 1/11/2013 Test File: 15 Park Place Test
Technician: Nicholas Abreu Signature:
Project Number: 15 Park Place

Customer: Placetailor
67 Dudley Street
Roxbury, MA 02119
Phone: 617-639-0633
Fax:

Building Address: 15 Park Place
Somerville, MA 02144

	Depressurization	Pressurization	Average
Test Results at 50 Pascals:			
cfm (Airflow)	80 (+/- 0.6 %)	101 (+/- 0.5 %)	91 (+/- 0.4 %)
ACH50	0.38	0.48	0.43
cfm/ft² (Floor Area)	0.0609	0.0770	0.0689
cfm/ft² (Surface Area)	0.0154	0.0194	0.0174
Leakage Areas:			
Canadian EqLA @ 10 Pa (in²)	7.7 (+/- 2.5 %)	8.7 (+/- 2.6 %)	8.2 (+/- 1.8 %)
in²/ft² Surface Area	0.0015	0.0017	0.0016
LBL ELA @ 4 Pa (in²)	3.9 (+/- 4.0 %)	4.2 (+/- 4.0 %)	4.0 (+/- 2.8 %)
in²/ft² Surface Area	0.0008	0.0008	0.0008
Building Leakage Curve:			
Flow Coefficient (C)	5.2 (+/- 6.2 %)	5.1 (+/- 6.1 %)	5.2 (+/- 4.3 %)
Exponent (n)	0.698 (+/- 0.016)	0.763 (+/- 0.015)	0.730 (+/- 0.011)
Correlation Coefficient	0.99959	0.99965	
Test Standard:	E779-10		
Test Mode:	Depressurization and Pressurization		



Indoor Air Quality

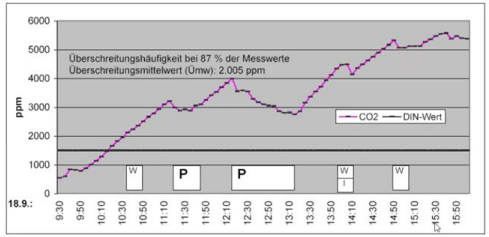
“While the outdoor air quality can vary significantly, indoors the quality remains very good.”

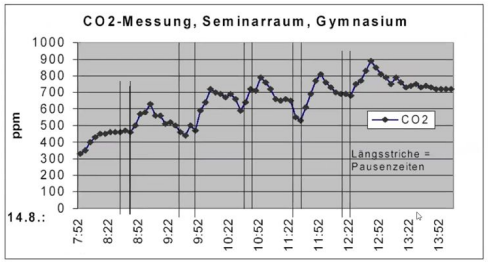
- Passive House Resident

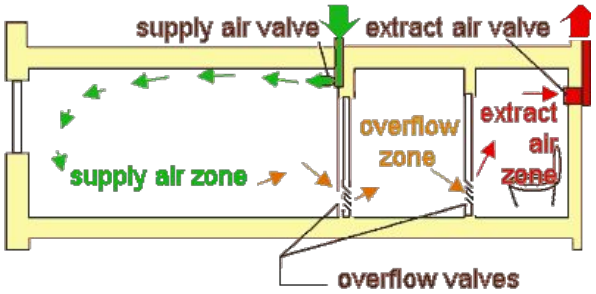
Needbased, Sante Fe, NM

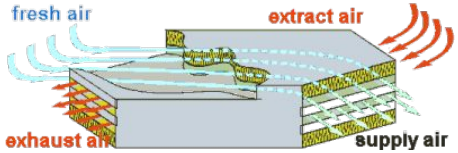
Criteria: Ventilation

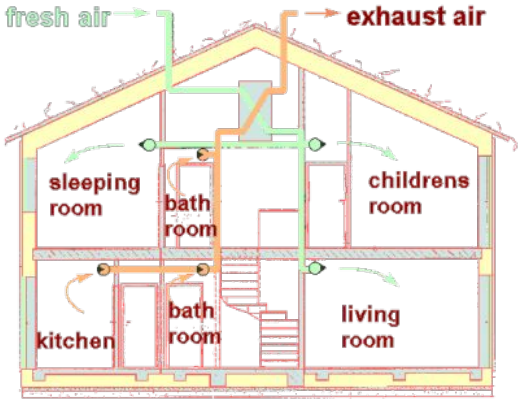
1. Sufficient filtered fresh air to all occupied spaces
2. User control and boost
3. 75% min system heat recovery efficiency
4. Fan power efficiency <0.765 W/CFM
5. Balanced Flow: <10% disbalance between fresh air supply and exhaust air.



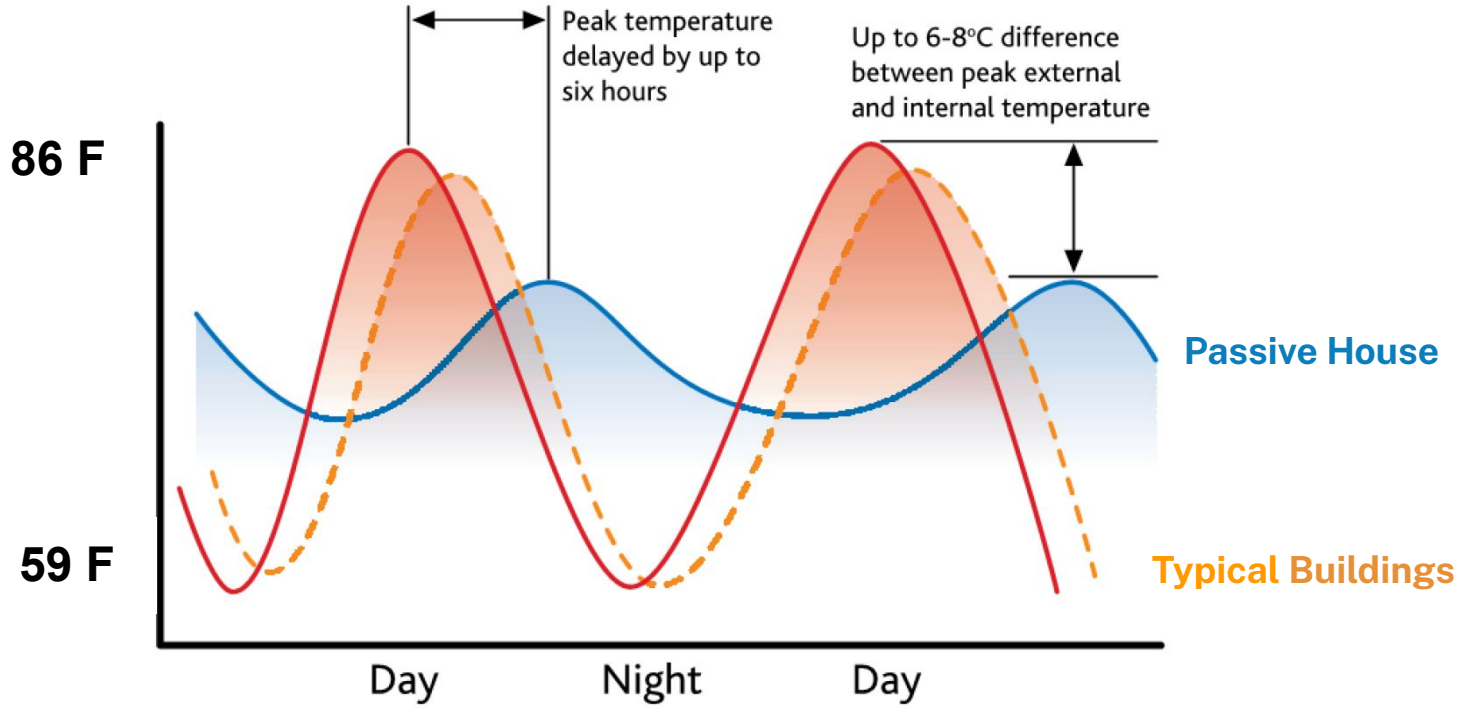






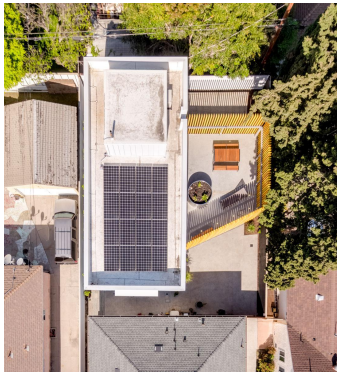


Source Energy: incremental marginal peak usage



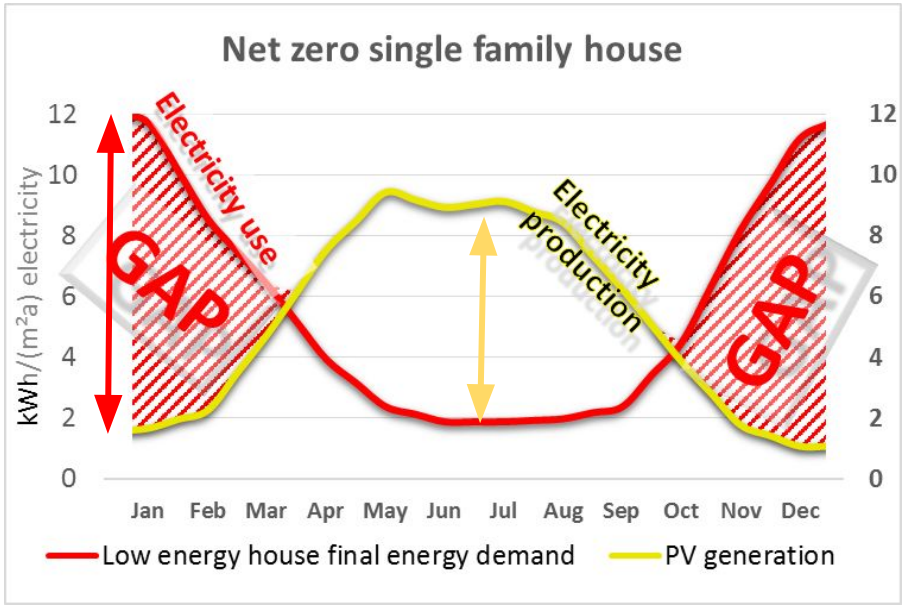
Net Zero vs. Simultaneity

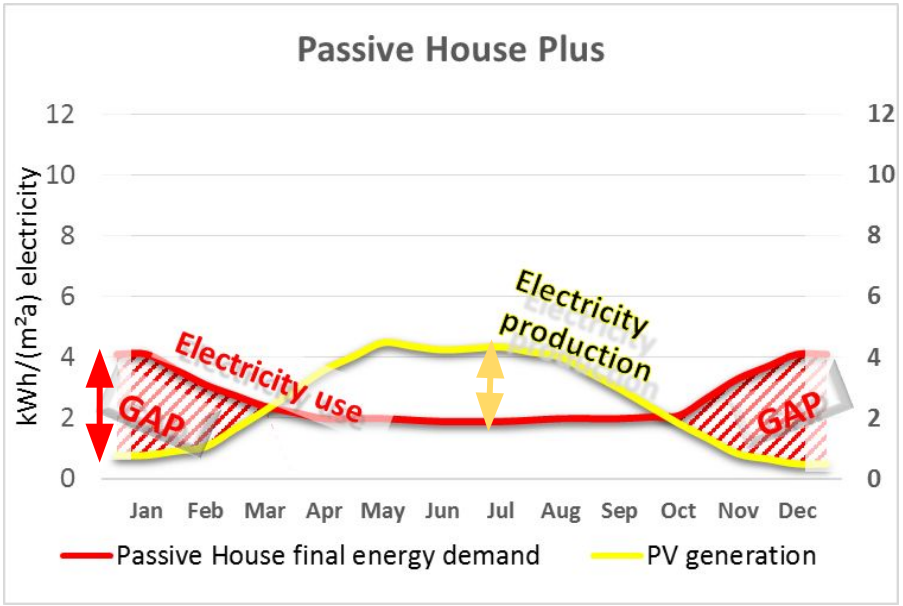
“Our solar array is modest in size and charges our car too.”
- Passive House Resident



Credit: Paravant Architects

Empower electrification: “crush the heating demand”





Sunnyvale CA Retrofit

- 1500 SF
- Heating load – 4795 BTU/1405 watts
- Cooling load – 2650 BTU/775 watts
- Net zero – 9 kW solar PV system

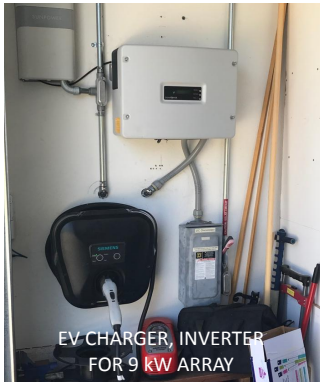
Credit: Bronwyn Barry/PassiveHouseBB

Equipment


INDUCTION COOKTOP WITH DIRECT VENT TO EXTERIOR


80 GA SE ACCELERA 300 HEAT PUMP WATER HEATER


1-TON DUCTED MINI-SPLIT HEAT PUMP (ECM MOTOR)

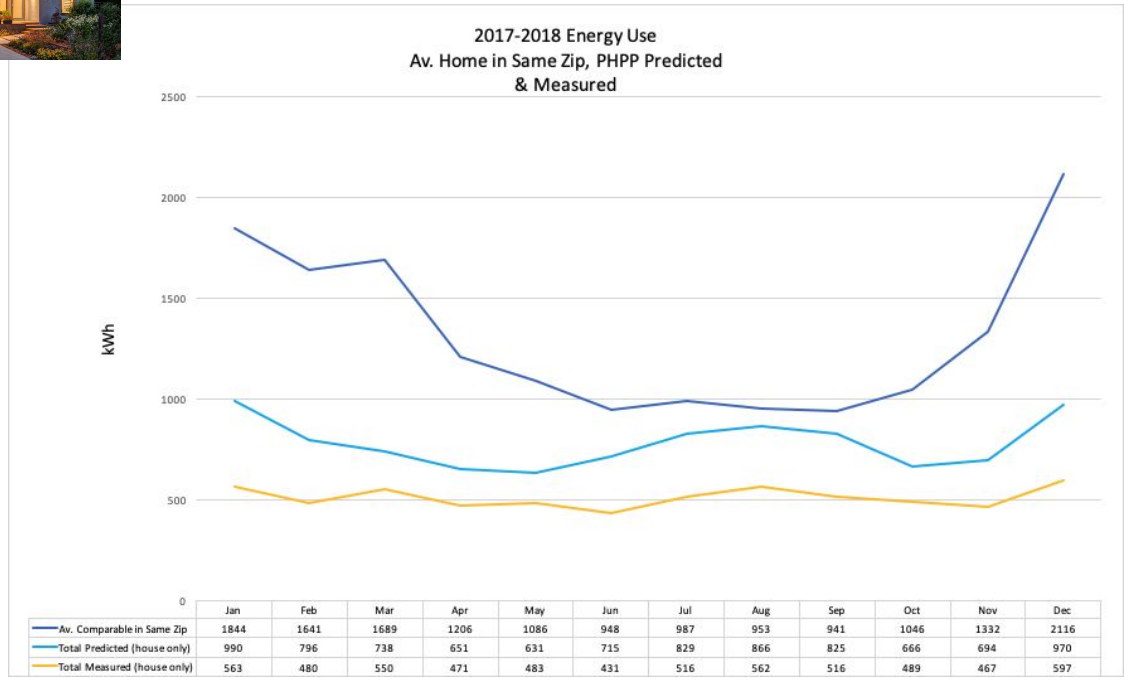

EV CHARGER, INVERTER FOR 9 kW ARRAY


ZEHNDER COMFOAIR 350 HEAT RECOVERY VENTILATOR


FUJITSU COMPRESSOR (VERY LOW DB RATING)

Credit: Bronwyn Barry/PassiveHouseBB

Crushing Heat Demand (& Total Energy)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Av. Comparable in Same Zip	1844	1641	1689	1206	1086	948	987	953	941	1046	1332	2116
Total Predicted (house only)	990	796	738	651	631	715	829	866	825	666	694	970
Total Measured (house only)	563	480	550	471	483	431	516	562	516	489	467	597

TOTALS:
Av. Home in Same Zip:
15,788 kWh

Passive House:
6,125 kWh

= 38% of typical

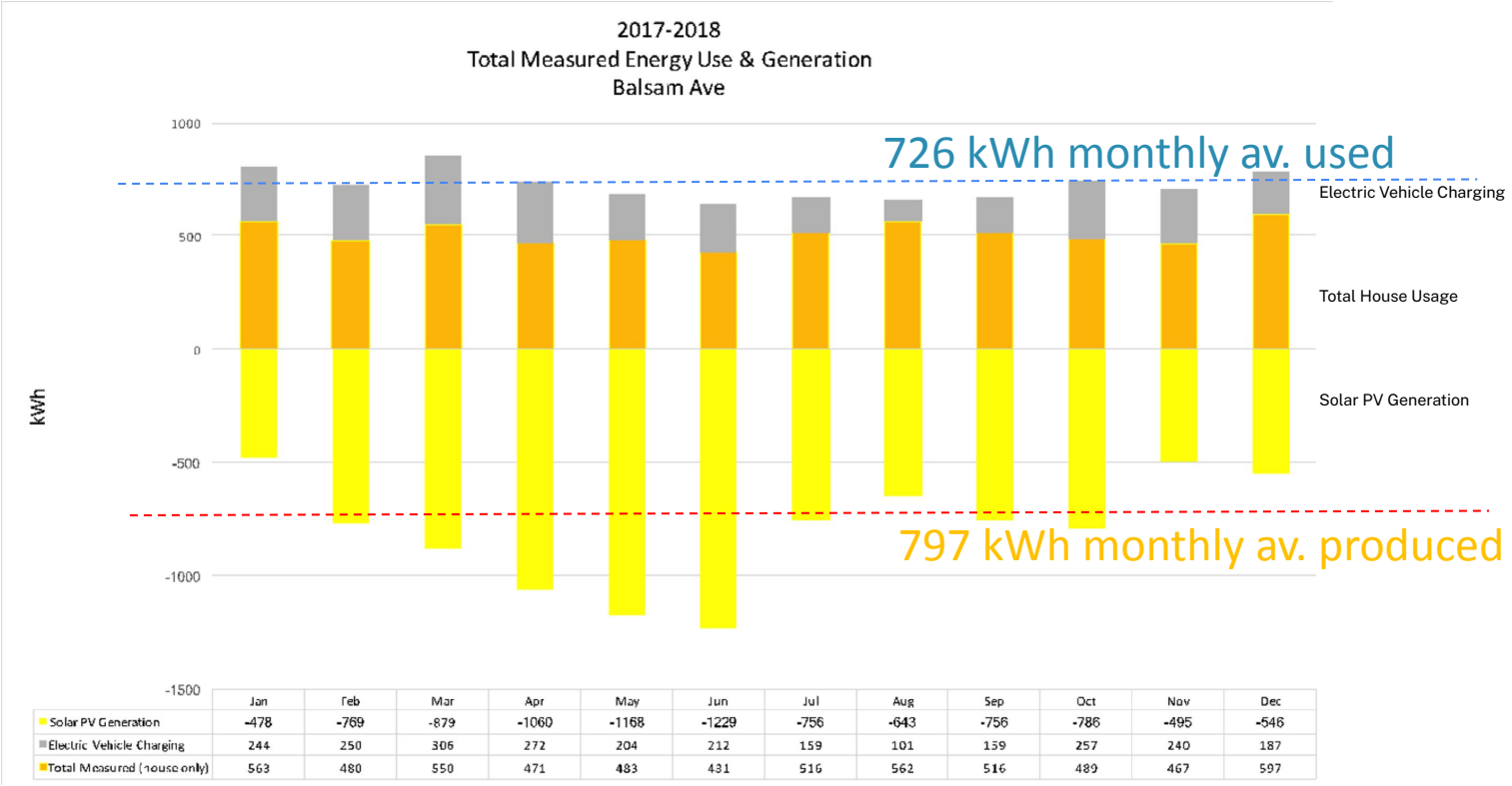
DIFFERENTIAL AT WINTER PEAK:
Av. Home in Same Zip:
2,516 kWh

Passive House:
597 kWh

= 23% of typical

Credit: Bronwyn Barry/PassiveHouseBB

Tuned Performance for “True Net Zero” w/ car



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar PV Generation	-478	-769	-879	-1060	-1168	-1229	-756	-643	-756	-786	-495	-546
Electric Vehicle Charging	244	250	306	272	204	212	159	101	159	257	240	187
Total Measured (house only)	563	480	550	471	483	431	516	562	516	489	467	597

Credit: Bronwyn Barry/PassiveHouseBB

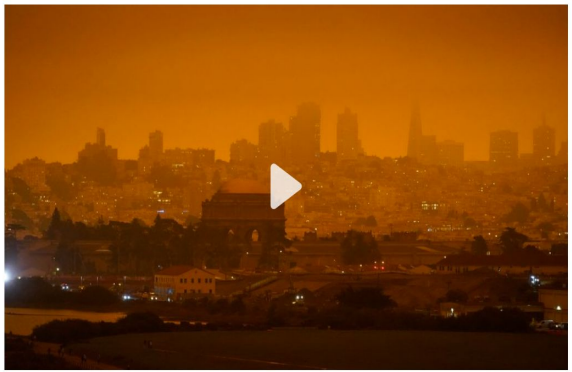
Resilience vs. ?

“We the power went out, we could safely shelter in place until the utility got it running again.”
- Passive House Resident

We have two kinds of buildings:
Those that are prepared for climate change, and those that are not.

The Western US has the worst air quality in the world, group says

By Paul P. Murphy, CNN
2 minute read · Updated 4:11 PM EDT, Mon September 14, 2020



Video Ad Feedback

'It looks like the apocalypse.' See wildfire smoke turn San Francisco's sky orange

WINTER STORM 2021

Texas puts final estimate of winter storm death toll at 246

Officials added 36 to the estimate of lives lost in the disaster, which knocked out power in much of the state. Some experts place the toll even higher.

BY PATRICK SVITEK JAN. 2, 2022 UPDATED: JAN. 3, 2022 SHARE REPUBLISH

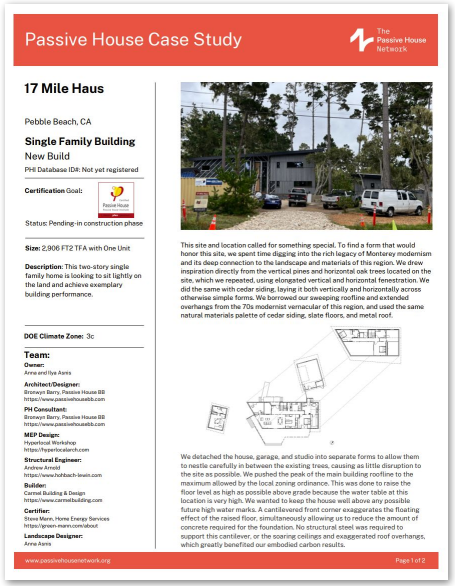
Ice and snow covered an alley in South Austin after a storm rolled through the area last February. Miguel Gutierrez Jr./The Texas Tribune

Extreme heat has killed 147 people in 5 counties, coroners report. The real number is likely much higher

By Rachel Ramirez, CNN
4 minute read · Updated 2:26 PM EDT, Mon August 7, 2023

Case Study

Pebble Beach Case Study



Passive House Case Study

The Passive House Network

17 Mila Haus

Pebble Beach, CA

Single Family Building

New Build

PHI Database ID#: Not yet registered

Certification Goal:

Status: Pending-in construction phase

Size: 2,906 FT2 TFA with One Unit

Description: This two-story single family home is looking to sit lightly on the land and achieve exemplary building performance.

DOE Climate Zone: 3c

Team:

Owner:
Anne and Ilya Axels

Architect/Designer:
Bronwyn Barry, Passive House BB
https://www.passivehousebb.com

PH Consultant:
Bronwyn Barry, Passive House BB
https://www.passivehousebb.com

MEP Design:
Hyperlocal Workshop
https://hyperlocalarch.com

Structural Engineer:
Andrew Arnold
https://www.hohbach-lewin.com

Builder:
Carmel Building & Design
https://www.carmelbuilding.com

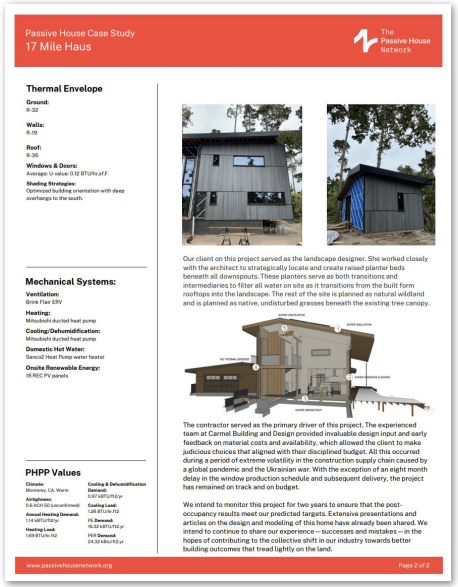
Certifier:
Steve Mann, Home Energy Services
https://green-mann.com/about

Landscape Designer:
Anne Axels

This site and location called for something special. To find a form that would honor this site, we spent time digging into the rich legacy of Monterey modernism and its deep connection to the landscape and materials of this region. We drew inspiration directly from the vertical pines and horizontal oak trees located on the site, which we repeated, using elongated vertical and horizontal fenestration. We did the same with cedar siding, laying it both vertically and horizontally across otherwise simple forms. We borrowed our sweeping roofline and extended overhangs from the 70s modernist vernacular of this region, and used the same natural materials palette of cedar siding, slate floors, and metal roof.

We detached the house, garage, and studio into separate forms to allow them to nestle carefully in between the existing trees, causing as little disruption to the site as possible. We pushed the peak of the main building roofline to the maximum allowed by the local zoning ordinance. This was done to raise the floor level as high as possible above grade because the water table at this location is very high. We wanted to keep the house wall above any possible future high water marks. A cantilevered front corner exaggerates the floating effect of the raised floor, simultaneously allowing us to reduce the amount of concrete required for the foundation. No structural steel was required to support this cantilever, or the soaring ceilings and exaggerated roof overhangs, which greatly benefited our embodied carbon results.

www.passivehousenetwork.org Page 1 of 2



Passive House Case Study
17 Mila Haus

The Passive House Network

Thermal Envelope

Ground:
R-32

Walls:
R-19

Roof:
R-36

Windows & Doors:
Average: U-value: 0.12 BTU/hr.sf.F

Shading Strotegies:
Optimized building orientation with deep overhangs to the south.

Mechanical Systems:

Ventilation:
Brink Flair ERV

Heating:
Mitsubishi ducted heat pump

Cooling/Dehumidification:
Mitsubishi ducted heat pump

Domestic Hot Water:
Sanco2 Heat Pump water heater

Onsite Renewable Energy:
18 REC PV panels

PHPP Values

Climate:
Monterey, CA. Warm

Airtightness:
0.6 ACH 50 (uncorrected)

Annual Heating Demand:
1.14 kBTU/ft2/yr

Heating Load:
1.69 BTU/hr.ft2

Cooling & Dehumidification Demand:
0.67 kBTU/ft2/yr

Cooling Load:
1.26 BTU/hr.ft2

PE Demand:
16.33 kBTU/ft2.yr

PER Demand:
24.32 kBtu/ft2.yr

Our client on this project served as the landscape designer. She worked closely with the architect to strategically locate and create raised planter beds beneath all downspouts. These planters serve as both transitions and intermediaries to filter all water on site as it transitions from the built form rooftops into the landscape. The rest of the site is planned as natural wildland and is planned as native, undisturbed grasses beneath the existing tree canopy.

The contractor served as the primary driver of this project. The experienced team at Carmel Building and Design provided invaluable design input and early feedback on material costs and availability, which allowed the client to make judicious choices that aligned with their disciplined budget. All this occurred during a period of extreme volatility in the construction supply chain caused by a global pandemic and the Ukrainian war. With the exception of an eight month delay in the window production schedule and subsequent delivery, the project has remained on track and on budget.

We intend to monitor this project for two years to ensure that the post-occupancy results meet our predicted targets. Extensive presentations and articles on the design and modeling of this home have already been shared. We intend to continue to share our experience—successes and mistakes—in the hopes of contributing to the collective shift in our industry towards better building outcomes that tread lightly on the land.

www.passivehousenetwork.org Page 2 of 2

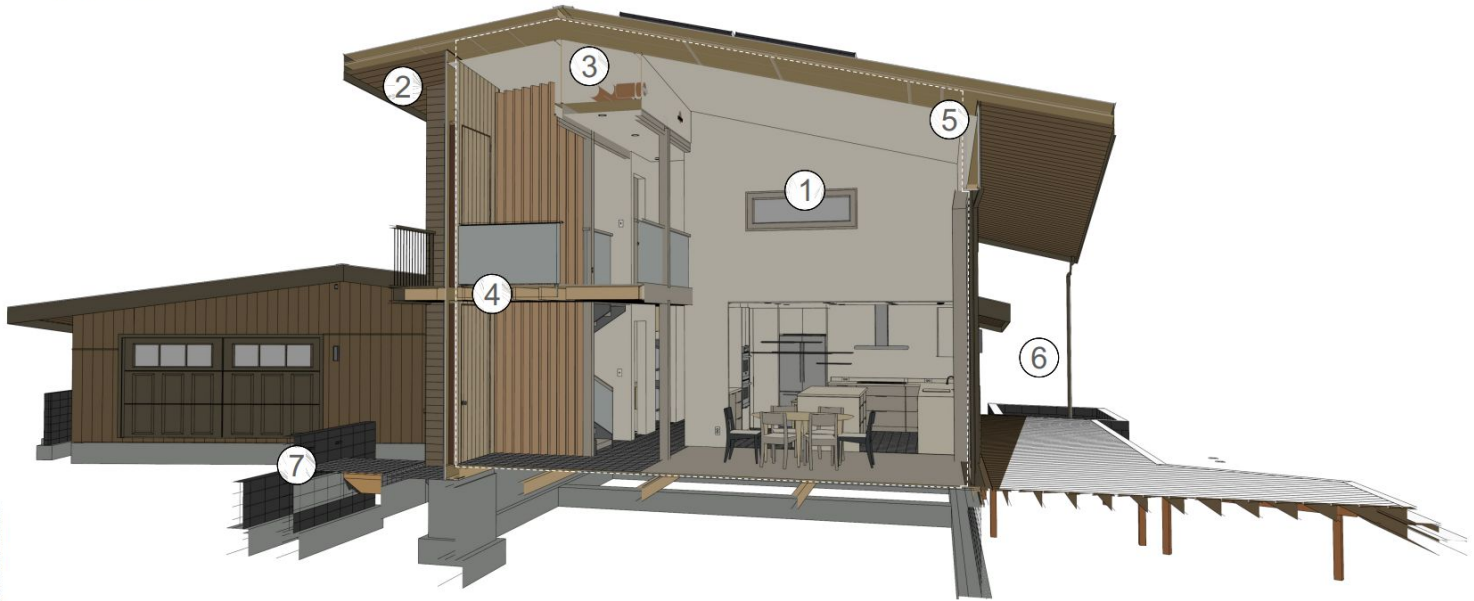
https://passivehousenetwork.org/wp-content/uploads/2023/11/17-Mile-Haus-Passive-House-Case-Study-Final-Version.pdf

Credit: Bronwyn Barry/PassiveHouseBB

R-36 Roof
R-19 Walls
R-32 Floor

Legend

1. Super-Windows & Doors
2. Fire Resilient
3. Heat Recovery Ventilation
4. No Thermal Bridges
5. Smoke-Tight
6. Well Shaded
7. Embodied Carbon Calcs
8. Passivhaus Certification

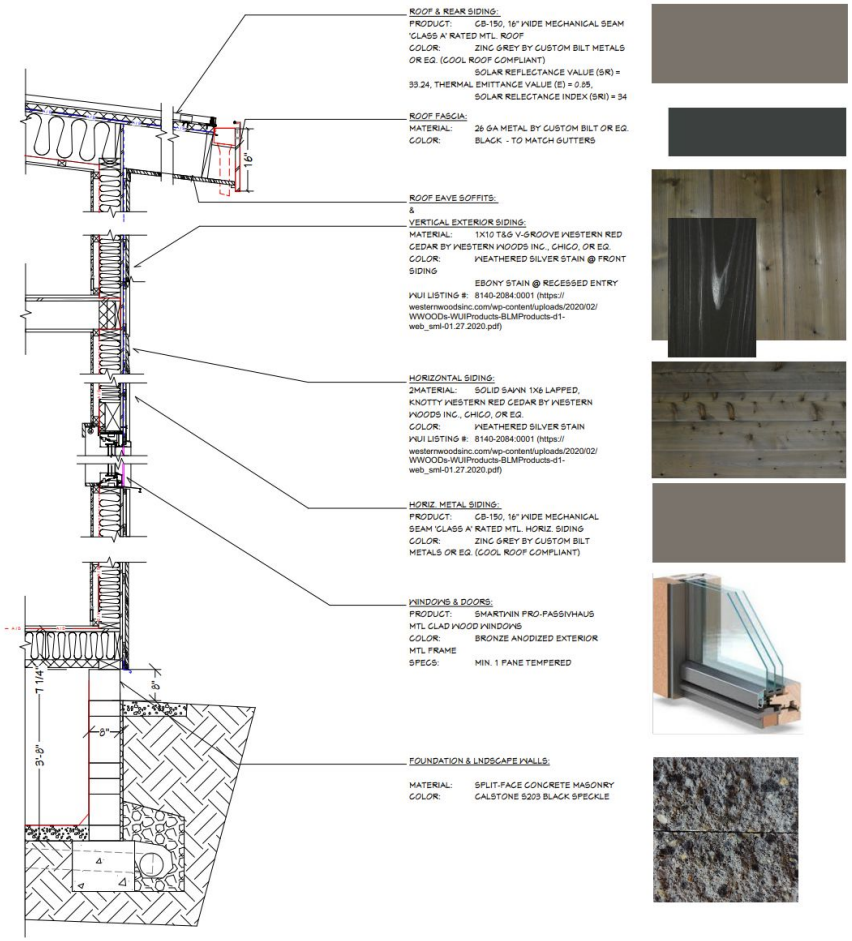


passivehouseBB.com

Credit: Bronwyn Barry/PassiveHouseBB

Assembly

R-36 Roof
R-19 Walls
R-32 Floor

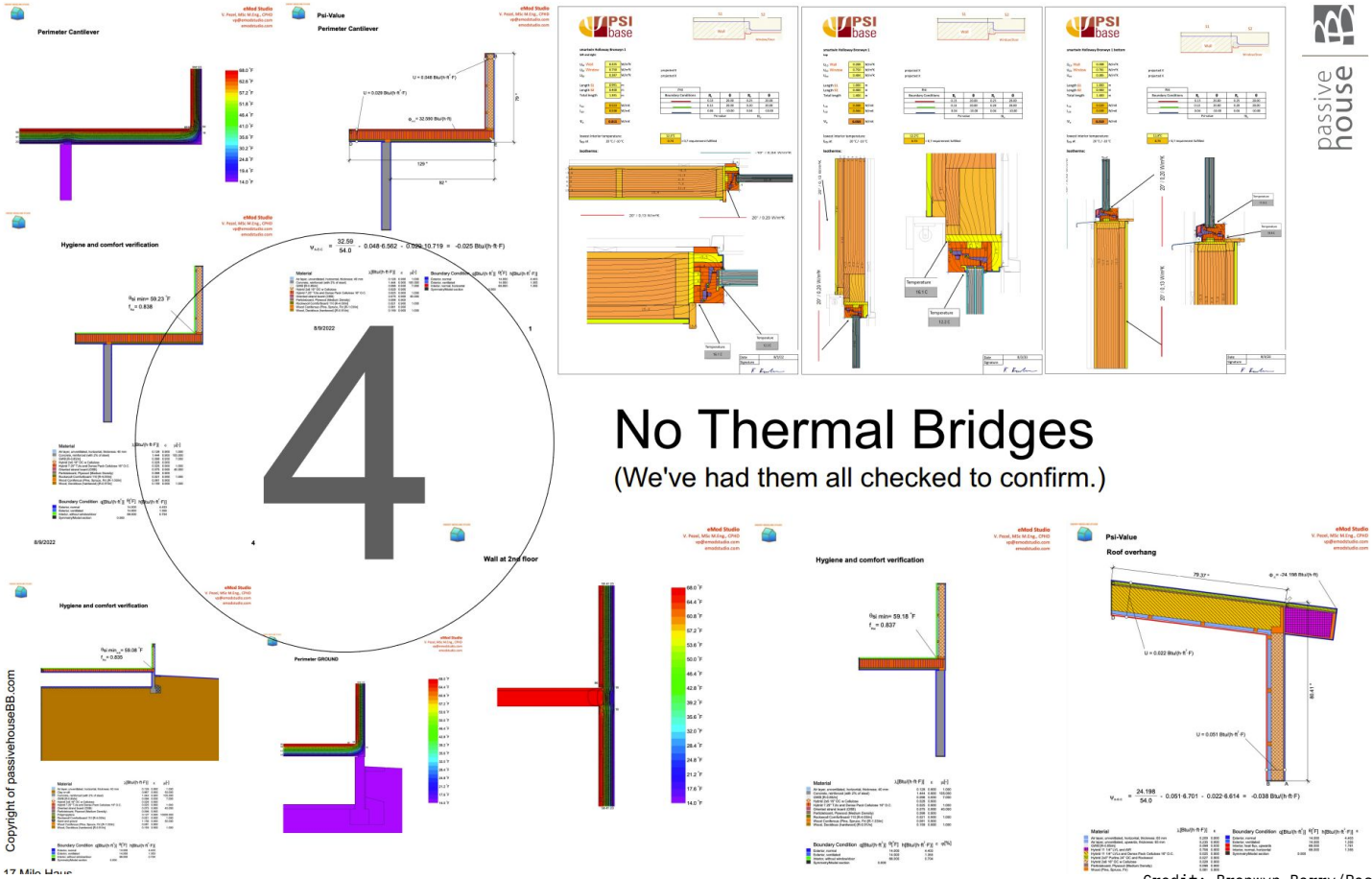


2. TYP. SECTION & ASSEMBLIES

Scale: 1" = 1'-0"

1. EXTERIOR MATERIALS PALETTE & SPECS

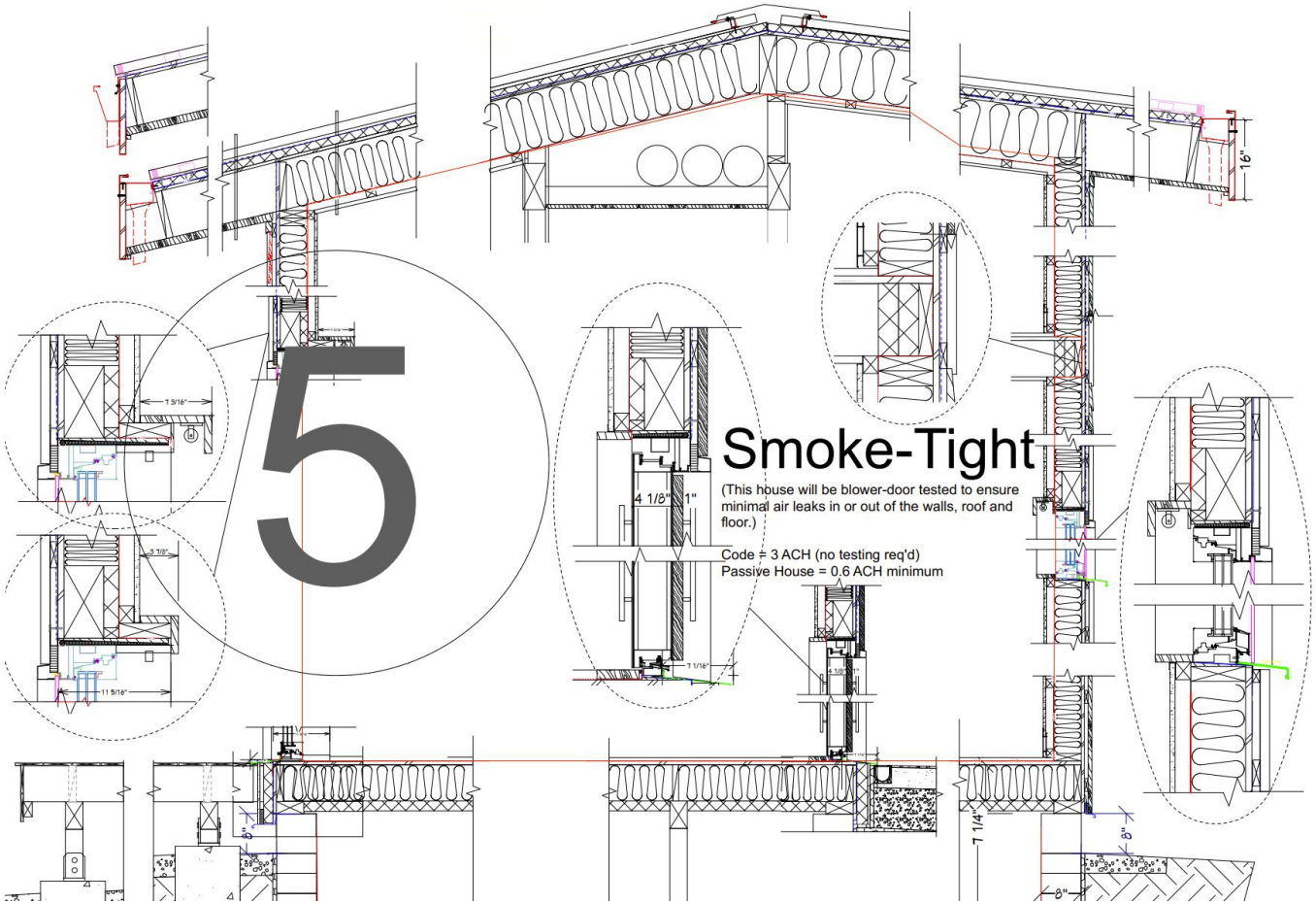
Credit: Bronwyn Barry/PassiveHouseBB



No Thermal Bridges

(We've had them all checked to confirm.)

Credit: Bronwyn Barry/PassiveHouseBB



Credit: Bronwyn Barry/PassiveHouseBB

Energy Model Verification Page

Passive House Verification

Building:	Asnis Residence		
Street:	2821 Seventeen Mile Drive		
Postcode/City:	CA		
Province/Country:	California	US-United States of America	
Building type:	Single Family Dwelling Unit		
Climate data set:	ud---01-Monterey, CA		
Climate zone:	5: Warm	Altitude of location:	20 ft
Home owner / Client:	Asnis		
Street:			
Postcode/City:			
Province/Country:			
Architecture:	Passive House BB		
Street:			
Postcode/City:	CA 94110	San Francisco	
Province/Country:	California		
Energy consultancy:	Hyperlocal Workshop		
Street:	PO Box 241		
Postcode/City:	80541	Masonville	
Province/Country:	Colorado	US-United States of America	
Mechanical engineer:			
Street:			
Postcode/City:			
Province/Country:			
Certification:	Steve Mann		
Street:			
Postcode/City:			
Province/Country:			

Year of construction:	2021	Interior temperature winter [°F]:	68.0	Interior temp. summer [°F]:	77.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [BTU/(hr.ft²)]:	0.74	IHG cooling case [BTU/(hr.ft²)]:	0.74
No. of occupants:	2.0	Specific capacity [BTU/F per ft² TFA]:	10.6	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area	ft²	2196				
Space heating	Heating demand	kBTU/(ft²yr)	1.12	≤	4.75	-	yes
	Heating load	BTU/(hr.ft²)	1.89	≤	-	3.17	
Space cooling	Cooling & dehum. demand	kBTU/(ft²yr)	2.39	≤	4.75	4.75	yes
	Cooling load	BTU/(hr.ft²)	1.97	≤	-	3.25	
	Frequency of overheating (> 77 °F)	%	-	≤	-		-
	Frequency of excessively high humidity (> 0.012 lb/lb)	%	0.0	≤	3.17		yes
Airtightness	Pressurization test result n_{50}	1/hr	0.6	≤	0.19		yes
Non-renewable Primary Energy (PE)	PE demand	kBTU/(ft²yr)	23.23	≤	-		-
Primary Energy Renewable (PER)	PER demand	kBTU/(ft²yr)	10.45	≤	19	19	yes
	Generation of renewable energy (in relation to pro-jected building footprint area)	kBTU/(ft²yr)	6.04	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? yes

Task: First name: Surname: Signature:

Issued on: City:

Credit: Bronwyn Barry/PassiveHouseBB

Resources

Resources

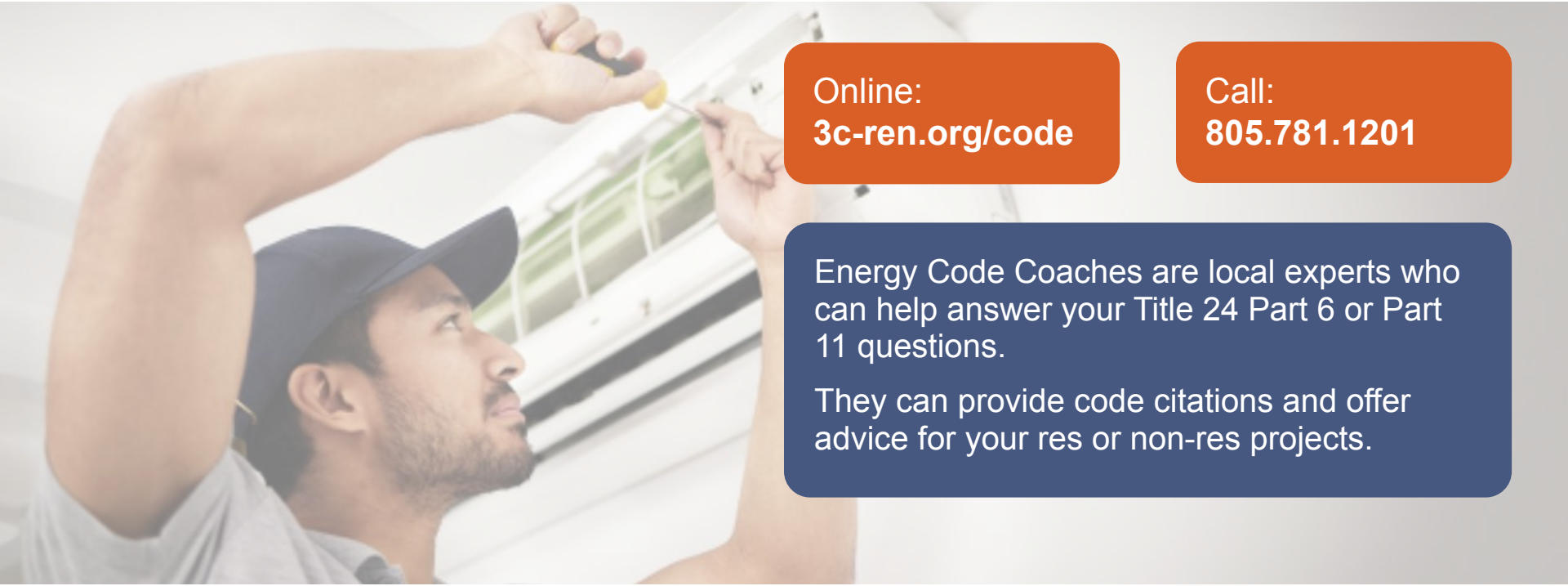
Building Database - https://passivehouse-database.org/index.php?lang=en
Certification Criteria - https://passivehouse.com/03_certification/02_certification_buildings/08_energy_standards/08_energy_standards.html
Certification Guide - https://passivehouse.com/03_certification/02_certification_buildings/09_guide/09_guide.html
Certified Components - https://database.passivehouse.com/en/components/
Certifiers Globally - https://passivehouse.com/03_certification/02_certification_buildings/03_certifiers/01_accredited/01_accredited.html
Certified Passive House Designer Training - https://passivehousenetwork.org/designer-training/
Certified Passive House Tradesperson Training - https://passivehousenetwork.org/tradesperson-training/
ISO 9972 - https://www.iso.org/standard/55718.html
Manager Declaration Sample - https://passipedia.org/_media/picopen/construction_manager_declaration.pdf
Manufacturers Directory - https://passivehousenetwork.org/manufacturers-directory/
North American Certifiers Circle - https://passivehousenetwork.org/wp-content/uploads/2023/01/NACC-Brochure-Jan-2023.pdf
Passipedia - https://passipedia.org/start
Passive House Certification - https://passivehousenetwork.org/certification/
Passive House Definition - https://passipedia.org/basics/the_passive_house_-_definition
Passive House - Historical Review - https://passipedia.org/basics/the_passive_house_-_historical_review
Passive House Planning Package (PHPP) - https://passivehouse.com/04_phpp/04_phpp.htm
Passivhaus: the route to zero carbon? - https://passivhaustrust.org.uk/guidance_detail.php?gId=40
PER-Factors for electricity use: Location & application specific decarbonization - https://passipedia.org/certification/passive_house_categories/per
Primary Energy Renewable PER - https://passipedia.org/basics/energy_and_ecology/primary_energy_renewable_per
Safe at Home PHN Report - https://passivehousenetwork.org/safe-at-home/
Sample Submission Documents - https://passipedia.org/certification/certified_passive_houses/example_documents
Summer Comfort - https://passipedia.org/planning/summer_comfort
Thermal Comfort - https://passipedia.org/basics/building_physics_-_basics/thermal_comfort
Vancouver Passive House Checklist - https://passivehousenetwork.org/wp-content/uploads/2024/07/Vancouver-Passive-House-Verification-Plan-Checklist-2023.pdf
Ventilation Duct Leakage Testing - https://passivehousenetwork.org/product/multifamily-ventilation-duct-leakage-targets-strategies-and-lessons-learned/

Thank you.

www.passivehousenetwork.org

Questions about Title 24?

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



Online:
3c-ren.org/code

Call:
805.781.1201

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.

Closing

Continuing Education Units Available

- Contact dresurreccion@co.slo.ca.us for AIA LUs

Coming to Your Inbox Soon!

- Slides & Recording

Upcoming Courses:

- 02/18 Builders Perspective: Heat Pump Water Heaters
- 03/10 2025 Energy Code in Practice: *Single Family Add & Alt*
- 03/12 Ask the Experts: Load Calculations
- 03/20 Contractor Power Hour with Electrify My Home (In-person in SB)

Any phone numbers who joined? Please share your name!

Thank you!

More info: **3c-ren.org**

Questions: **info@3c-ren.org**

Email updates: **3c-ren.org/newsletter**

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA