

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA

Introduction to the Passive House Standard

Ken Levenson – Passive House Network

April 17, 2025





Zoom Orientation

- Add an introduction in the chat. Be sure full name is displayed.
- Did you call in? Please share first and last name with us.
- Please mute upon joining
- Use the "Chat" to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- Session may be recorded and posted to 3C-REN's on-demand page
- · Slides/recording are shared after most events





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



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



3c-ren.org/commercial

Contractors can enroll at 3c-ren.org/contractors

Training



3c-ren.org/events 3c-ren.org/building

ENERGY CODE CONNECT

3c-ren.org/code

View past trainings at 3c-ren.org/on-demand

Technical Assistance



3c-ren.org/agriculture



ASSURANCE SERVICES

3c-ren.org/assurance

An introduction to Passive House



College of the Atlantic, Maine | OPAL Architecture

The Network Global Knowledge. Regional Context. Local Applications



Personal Start: A Townhouse Retrofit







Agenda

- 1. Why Passive House?
- 2. What's the logic?
- 3. The methodology
- 4. The Tools
- 5. More Examples



Why Passive House?

What is Passive House?



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

Building is not a neutral act

90% time indoors 40% global emissions >Unreliable >Expensive >Unhealthy

6

With growing extremes, it starts with occupants

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

Texas puts final estimate of winter storm death toll

at 246 Officials added 35 to the estimate of lives lost in the disaster, which knocked out nower in much of the

SHARE REPUBLISH ,



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

0







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

Empower architecture to drive performance

It's the enclosure

It's not the systems

Re-engage fundamentals

Empower building elements

Empower details

Empower architects/team

Empower builders







Decouple power & performance with fixed target

The Value of a Well Insulated Home

Average heating gains and losses by house type in kWh/m²a





Not relative improvement to a baseline.

Data: typical values for Northern European climates

shrinkthatfootprint.com

Zero Emissions Buildings & Zero Net Energy

Title 24 is to move California to zero net energy (ZNE).

California Public Utilities Commission NZE building definition:

 An energy-efficient building where, on a source energy basis, the actual annual consumed energy is less than or equal to the on-site renewable generated energy.



https://www.cpuc.ca.gov/industries-and-topics/elec trical-energy/demand-side-management/energy-ef ficiency/zero-net-energy In 2024 the US Department of Energy released a formal definition of what a zero emissions building is.

It's consists of three characteristics:

- 1. It must be very energy efficient.
- 2. It must not have any onsite emissions from energy use.
- 3. It must be powered only from renewables.



https://www.energy.gov/sites/default/files/202 4-06/bto-national-definition-060524.pdf

Empower electrification: "crush the heating demand"



Power grids under stress









Logic of Massachusetts Passive House Mandate



Crushing heating with thermal codes is **essential** to accomplish electrification of space heating – there is **no new winter peak**

Credit: Massachusetts DOER

What's the logic?

Precursors of Passive House

Vernacular, China





Fridtjof Nansen's polar ship, the "Fram", 1893

DTH zero-energy house, Denmark, 1973





The Philips Experimental House, Germany, 1974

Illinois Lo-Cal House, Wayne Shick, US 1976





Saskatchewan Conservation House w/ Harold Orr, Canada 1977

First Passive House, 1990



How we use fundamental ingredients 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



Power of a simple idea

"A Passive House is a building, for which thermal comfort (ISO 7730) can be achieved solely **by post-heating or** post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions - without the need for additional recirculation of air."

- Passive House Institute

Table 1 Passive House criteria

			Criteria ¹			Alternative Criteria ²
Heating			3			
Heating demand	[kBTU/(ft²yr)]	≤		4.75		-
Heating load ³	[BTU/(hr.ft²)]	s	•		3.17	
Cooling						
Cooling + dehumidification demand	[kBTU/(ft²yr)]	5	4.75 + variable allowance ⁴]	
Airtightness						-
Pressurization test result n ₅₀	[1/hr]	s	0.6]
×	50		1999 - 19			
Renewable Primary Energy (PER) ⁵			Classic	Plus	Premium	
PER demand ⁶	[kBTU/(ft²yr)]	5	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)]	2		19.02	38.04	with compensation of the above deviation by different amount of generation ⁸

Lowers demand and crushes peak loads.

Predictable Performance is THE thing.







Budgets: Pushing Toward Parity





/uploads/2022/10/Is-Cost-the-Barrier-to-Pas sive-House-Performance-May-2021-PHN.p df



https://passivehousenetwork.org/sa





CONSTRUCTION COST ANALYSIS OF HIGH-PERFORMANCE

zebx

MULTI-UNIT RESIDENTIAL BUILDINGS IN

BRITISH COLUMBIA

JUNE 2021

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.

July 2023

fe-at-home/

Project Types – Not Just Houses!



The House at Cornell Tech

Star Garment Factory

Betances V











Artisans Group, Olympia, WA

The Methodology

Integrated Methodology with 5 Key Elements



Element #1: Climate Specific Insulation

like a climate rated sleeping bag.



Element #2: Thermal Bridge Free Construction



Element #2: Thermal Bridge Free Construction



Element #2: Thermal Bridge Free Construction





Element #3: Airtight/Smoke Tight Enclosure



Element #3: Airtight Enclosure

Like a windbreaker over a fleece sweater.

Introduction to Passive House

www.passivehousenetwork.org
Element #4: High-Performance Windows w/ Solar Protection



Occupant Comfort



- PHI threshold values much more conservative than DIN 1946, ISO 7730 and others.
- Acts as a proxy for many thermal comfort factors (radiant temperature asymmetry, air stratification, air movement from convective looping, etc.)

Shading is considered and integrated





Element #4: High-Performance Windows w/ Solar Protection



Element #5: Hygienic Ventilation w/ Heat Recovery



The H/ERV (<u>h</u>eat/<u>e</u>nergy recovery ventilator) is the lungs of the building.

H/ERV's must be:

- Super-insulated
- Airtight
- Thermal bridge free
- Quiet
- Energy efficient
- Suitably located







Ventilation System Configuration



Introduction to Passive House

Element #5: Hygienic Ventilation w/ Heat Recovery

Fewer allergies, less asthma, more healthy.

Introduction to Passive House

Internal Uses & Heat Gains & Ventilation Requirements



THEN: Right size Heating & Cooling Systems



THEN: Renewables & Smart Systems



TE Studio, Minneapolis, MN

Smart controls & renewables should enhance high-performance, not compensate for poor performance!

Calculated Predictability = Optimized Design



Global Application



The Tools

Certified Professionals



The on-demand and hybrid formats allow students to leverage the benefits of on-demand & live online training to best meet their learning preferences. 35 AIA LU/HSW credits







Pacific Cohort Schedule

Summer 2025 - On-Demand / Live Online CPHD/C Training

July 1st start

Depending on your learning preferences, you can tackle this course in three ways:

- Focus on the on-demand content and view recordings of live online content. (Most flexible) Stick to the cohort schedule of live online sessions. (Best for clear pacing and making connections and community)
- Do a mix! Start before or after the cohort registration deadline, focus on the on-demand format at your pace, and attend the live online sessions as makes sense for you. (Most popular)

	On-Demand	Live Online Activities				
Week Starts	Content	Activity Date/Time	Activity	Led by		
6/30/25	Module 1: Introduction Module 2: Insulation	7/1/25 12-1 PM PT	Kick-Off	PHN		
7/14/25	Module 3: Airtightness Module 4: Thermal Bridging Module 5: Windows	lule 3: Airtightness Jule 4: Thermal Bridging Jule 5: Windows		CPHD Practitioner		
7/21/25	Webinar 1: Building Envelope Module 6: Ventilation	7/24/25 9-12 PM PT	Webinar 1: Building Envelope	PHN Trainer		
7/28/25	Module 7: Heating & DWH Module 8: Cooling Module 9: Certification	7/31/25 9-11:30 AM PT	Open Review	Ken Levenson		
8/4/25	Module 10: Economics Module 11: QA/QC Module 12: Bidding	8/7/25 12-1 PM PT	Q&A Session 2	CPHD Practitioner		
8/11/25	Webinar 2: Building Services & Economics Review Exam Prep Modules	8/14/25 9-12 PM PT	Webinar 2: Building Services & Economics	PHN Trainer		
8/18/25	Module 13: designPH Module 14: PHPP Review Exam Prep Modules	-	-	121		
8/25/25	Module 15: Exam Prep Course & Wrap-up Review Exam Prep Modules	÷	1.5	20		
9/1/25	Review Exam Prep Modules	9/4/25 9-11 AM PT	Exam Review	PHN Trainer		
9/8/25	Review Exam Prep Modules	9/11/25 9-10 AM PT	1/25 9-10 AM PT Tech Setup (Required)			
9/15/25	Exam	9/18/25 9-12 PM PT	PHI CPHD/C Exam	PHN with PH		

Certified Passive House Components



Building Certification









Certified Retrofits: EnerPHit





Two EnerPHit methods

Performance Method

	Heating	Cooling
Climate zone according to	Max. heating demand	Max. cooling + dehumidification demand
PHPP	[kBTU/(ft ² yr)]	[kBTU/(ft²yr)]
Arctic	11.09	
Cold	9.51	
Cool- temperate	7.92	equal to
Warm- temperate	6.34	Passive House requirement ₁
Warm	4.75	
Hot		
Very hot		

Component Based Prescriptive Method

Table 2: EnerPHit component criteria

Climate	Opaque envelope ¹ against				Windows (including exterior doors)				Ventilation		
	ground	2	ambient air			Overal	r ⁴	Glazing ⁵	Solar load ⁶	vent	liation
	Insu- lation	Exterior insulation	Interior in- sulation ²	Exterior paint ³	Max. heat transfer		ansfer	Solar heat gain	Max. specific solar load	Min. heat	Min. hu- midity re-
according to PHPP	Min. thermal resistance (R-value)		Cool colours	(U _{DW,installed})		med)	(SHGC)	cooling period	very rate ⁷	covery rate ⁸	
		[hr.ft².°F/BT	U]	19 - 11	(E	BTU/hr.ft	₽.°F]	-	[kBTU/(ft²yr)]		%
					C	<u> </u>	C				
Arctic		63.09	22.71		0.08	0.09	0.11	U_g - SHGC*0.7 < 0		80%	
Cold	Deter-	47.32	18.93	-	0.11	0.12	0.14	U_g - SHGC*1.0 \leq 0		80%	
Cool- temperate	PHPP from project specific beating	37.86	16.22		0.15	0.18	0.19	U _g - SHGC*1.6 ≤ 0		75%	
Warm- temperate		18.93	11.36	1525	0.18	0.19	0.21	U _g - SHGC*3.2 ≤ -0.6	32	75%	- 2
Warm	and cooling	11.36	7.57	-	0.22	0.23	0.25	-		-	
Hot	degree days against	11.36	7.57	Yes	0.22	0.23	0.25	÷		-	60 % (humid climate)
Very hot	ground.	22.71	12.62	Yes	0.18	0.19	0.21	-			60 % (humid climate)

Energy Modeling: bim2PH + designPH + PHPP +...



Blower Door: Pressurize & Depressurize





Roadmap to Building Certification



PHPP and Certification



 update with final ventilation air flow rates

More Examples, so far...

Highrises



Chelsea, NYC

Boston skyscraper named world's biggest 'Passive House' office

The building, which will use far less energy than a conventional design, is the latest example of the efficiency standard's growing popularity.

11 October 2023



Winthrop Center in downtown Boston is now the largest Passive House office space in the world. (Millennium Partners)

Affordable Housing



UK RIBA Sterling Prize Winner



Introduction to Passive House

www.passivehousenetwork.org

Museums



Government buildings



Brussels Environment, architectenbureau cepezed

Archive



Recreation & Emergency Services



Gale & Snowden, St Sidwell's Point, Exeter, UK



HCMA, Vancouver, BC

Embassy & Educational Center



Hotel Marcel: Certified Retrofit, New Haven CT

- 90,000 SF
- 165 Guest Rooms, Conf Center, Restaurant
- 1.5 MWh microgrid with over 1,000 solar panels





Credit: Becker + Becker Architects

Certified Retrofit Passire House Institute

Schools



Opal Architecture, Bar Harbor, Maine



Architecture Research Office, Brooklyn NY

Homes...



Next Steps...

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Financial incentives available.
Thank you.

Get trained and change your climate impact forever.

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

 \circ Contact dresurreccion@co.slo.ca.us for AIA LUs

Coming to Your Inbox Soon!

• Slides, Recording, & Survey – Please Take It and Help Us Out!

Upcoming Passive House Webinar:

O June 29 - Mechanical Systems in Detail with Passive House Network

Get Passive House Certified (*FREE)!

• <u>Open for Application: Certified Passive House Designer/Consultant</u> <u>Pacific Summer 2025 Cohort</u>

 REGISTRATION COMING SOON: 5-Day Passive Design/Build Bootcamp in Santa Barbara (Sept 29 – Oct 3)

*No-cost for those who live or work in San Luis Obispo, Santa Barbara, or Ventura Counties

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**



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