BROUGHT TO YOU BY

EVERSOURCE

PROUD SPONSOR OF

energize CONNECTICUT

On behalf of Eversource, a proud sponsor of Energize Connecticut, and in partnership with Connecticut Passive House, we are pleased to offer *Passive House Training* to support workforce development and help transform the energy efficiency and building construction industries in Connecticut.

CTPH

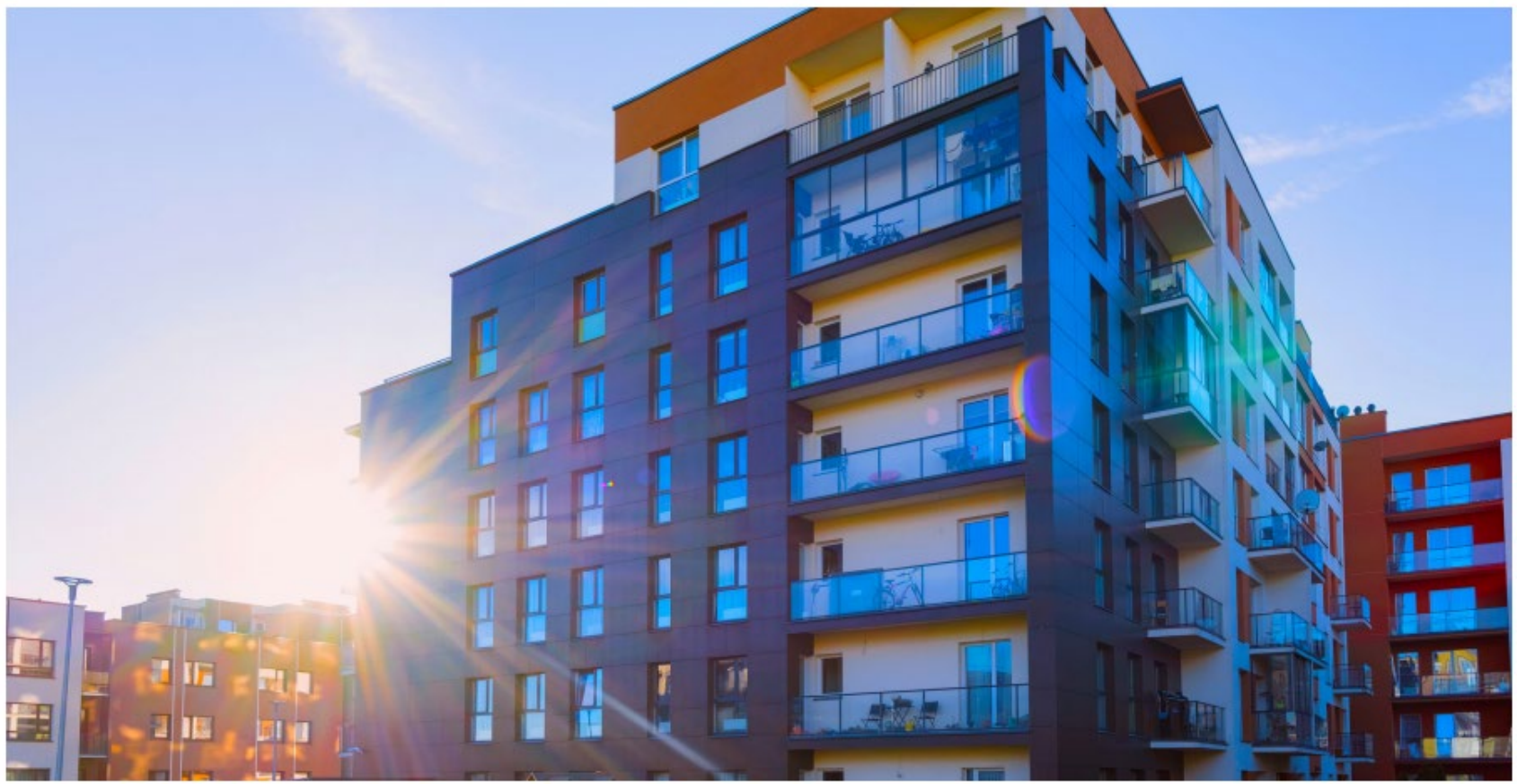
CONNECTICUT PASSIVE HOUSE

For more information, please visit EnergizeCT.com/passive-house
or email PassiveHouseTrainingCT@icf.com

EVERSOURCE

Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more



PASSIVE HOUSE INCENTIVE STRUCTURE FOR MULTI-FAMILY (5 UNITS OR MORE)				
Incentive Timing	**Activity**	**Incentive Amount**	**Max Incentive (Per Unit)**	**Max Incentive (Per Project)**
Pre-Construction	Feasibility Study[1]	Up to 100% of Feasibility Study Costs	N/A	$5,000.00
	Energy Modeling[2]	75% of Energy Modeling Costs (Before 90% Design Drawings)	$500.00	$30,000.00
		50% of Energy Modeling Costs (90% Design/50% Construction)	$250.00	$15,000.00
Post Construction	Certification[3]	Up to 100% of Certification Costs	$1,500.00	$60,000.00

1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.

EVERSOURCE

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PASSIVE HOUSE 101

The Path to PHIUS Certification

John Loercher
CPHC Trainer, **PHIUS**
CPHC**, Northeast Projects LLC**
JLoercher@PHIUS.org

VISION AND MISSION STATEMENT

The PHIUS mission

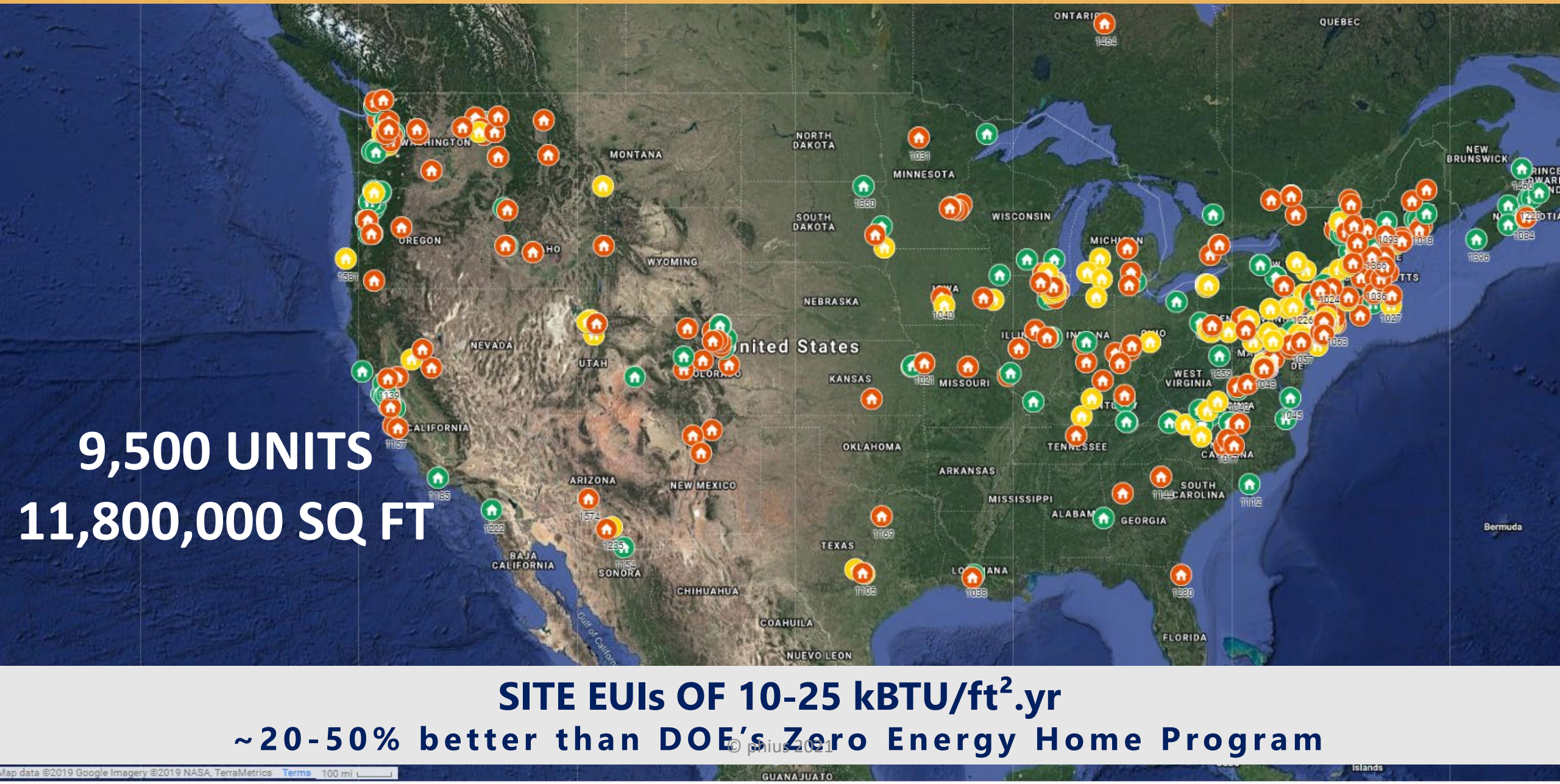
is to address the climate crisis through passive buildings that can both *mitigate* and *adapt* to climate change. As a society overall we must get to 100% renewable energy. Passive building is a design strategy that focuses on conservation first. It represents the best way to cost optimize buildings on the path to zero.

The PHIUS vision

is “to make high-performance passive building commonplace”.

PHIUS

820 PROJECTS IN NORTH AMERICA

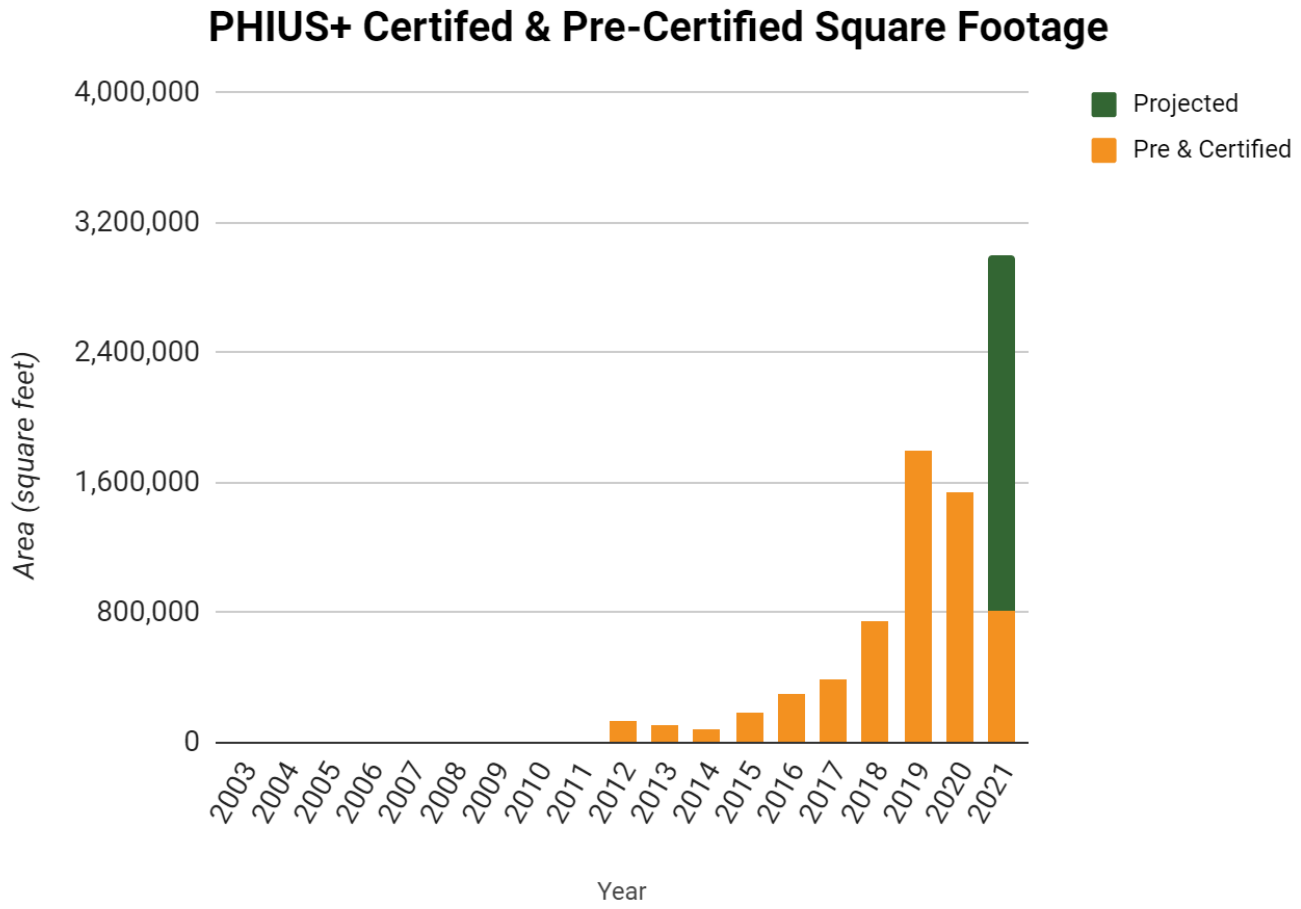


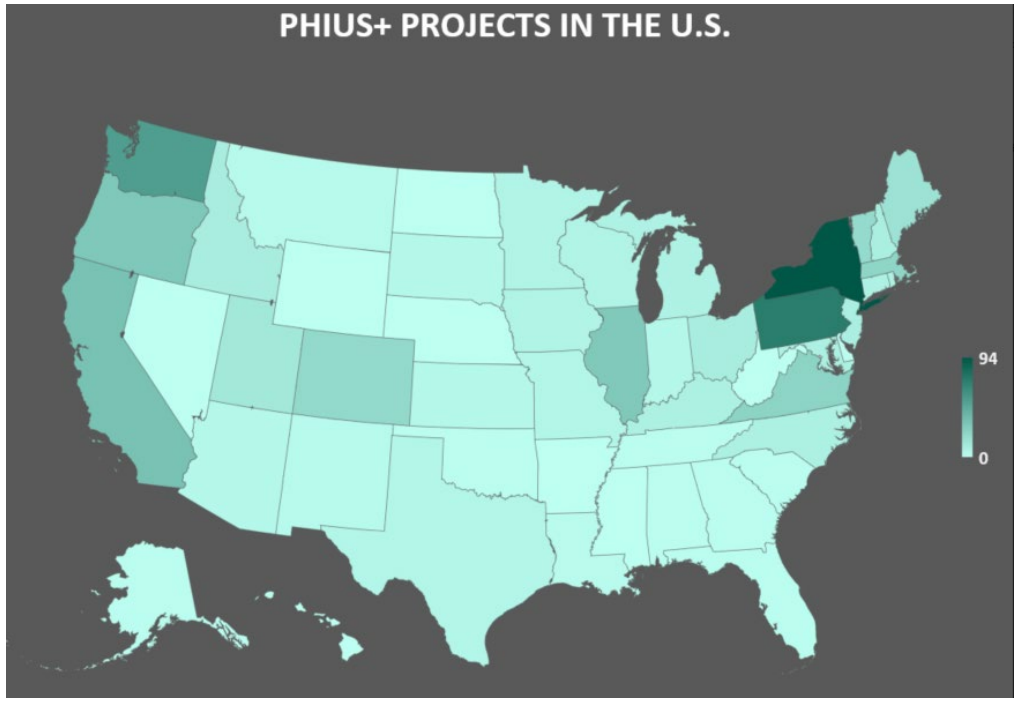
SITE EUIs OF 10-25 kBTU/ft^2.yr

~20-50% better than DOE's Zero Energy Home Program

PHIUS+ PROJECT CERTIFICATION

By the numbers



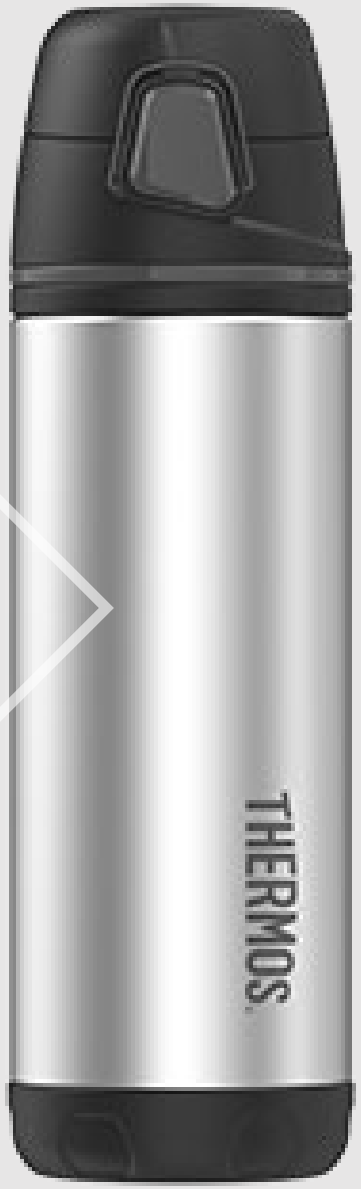


PASSIVE HOUSE 101:

What's a Passive Building?

John Loercher
CPHC Trainer, **PHIUS**
CPHC**, Northeast Projects LLC**
JLoercher@PHIUS.org

What is a passive building?

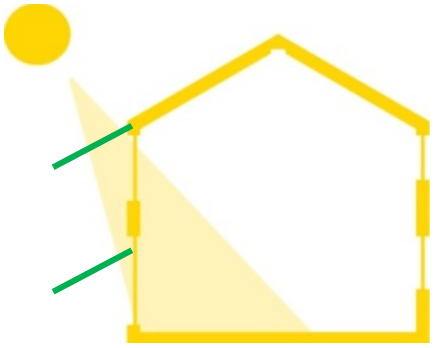


PASSIVE BUILDING PRINCIPLES

Thermal Control

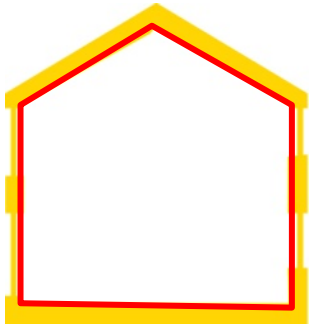
CONTINUOUS INSULATION

Radiation Control



OPTIMIZED WINDOWS & SOLAR GAINS

Air Control



AIR-TIGHT CONSTRUCTION

BALANCED VENTILATION WITH HEAT RECOVERY

MINIMIZED MECHANICAL SYSTEMS

WUFI Passive Calculation Methodology

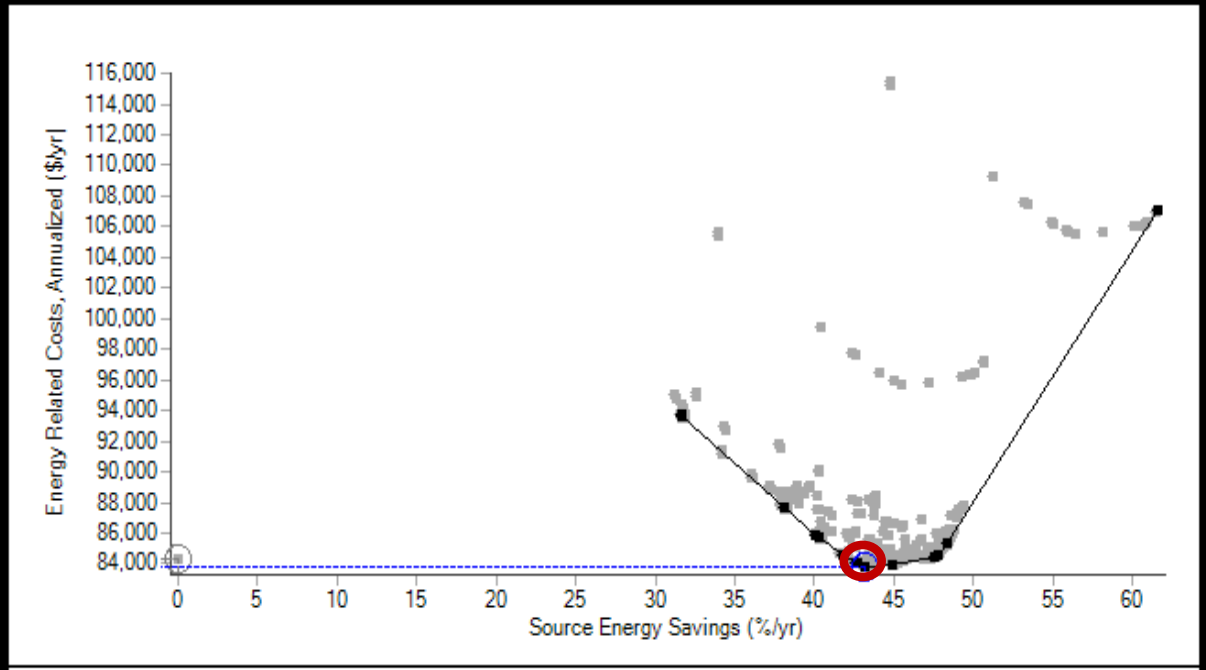
ENERGY BALANCE = 4 ENERGY 'BUCKETS'

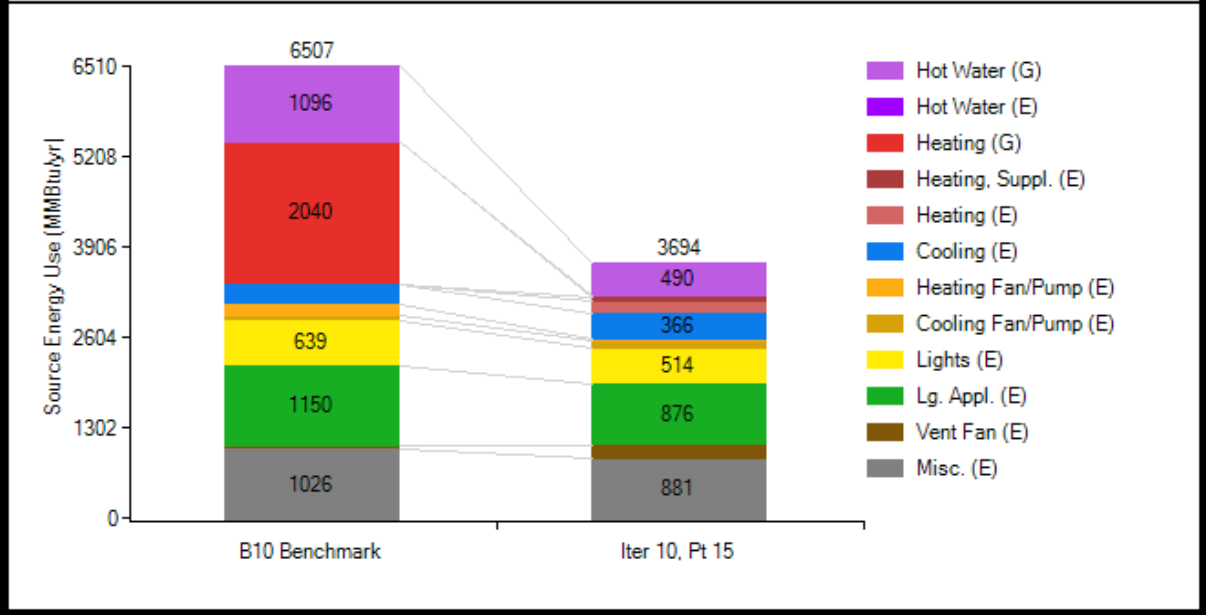
2 LOSS BUCKETS:
- Transmission Loss
- Ventilation Loss

2 GAIN BUCKETS:
- Solar Gains
- Internal Gains

Cost optimal sweet-spot for investment in conservation

- *Window selections constrained based on comfort*
- *Air-tightness set based on PHIUS target (durability)*
- *Ignore PV/cost of renewables!*





PASSIVE HOUSE 101:

Why Build to this Standard?

John Loercher
CPHC Trainer, **PHIUS**
CPHC**, Northeast Projects LLC**
JLoercher@PHIUS.org

U.S. Department of Energy:
HIGH PERFORMANCE STAIRCASE

IECC 2009	IECC 2012	ENERGY STAR v3	ENERGY STAR v3.1	ZERH	PHIUS+	PHIUS+ SourceZero
						Source Zero Renewable Energy System
					Balanced Ventilation HRV/ERV	Balanced Ventilation HRV/ERV
				SOLAR READY Depends on climate	SOLAR READY **ALWAYS**	SOLAR READY **ALWAYS**
				Eff. Comps. & H2O Distrib	Eff. Comps. & H_2O Distrib	Eff. Comps. & H_2O Distrib
				EPA Indoor airPLUS	EPA Indoor airPLUS	EPA Indoor airPLUS
				Ducts in Condit. Space	Ducts in Condit. Space	Ducts in Condit. Space
		HVAC QI w/WHV	HVAC QI w/WHV	HVAC QI w/WHV	Micro-load HVAC QI	Micro-load HVAC QI
		Water Management	Water Management	Water Management	Water Management	Water Management
		Independent Verification	Independent Verification	Independent Verification	Independent Verification	Independent Verification
IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2012/15 Encl./ES Win.	Ultra-Efficient Enclosure	Ultra-Efficient Enclosure
HERS **85-90**	HERS **70-80**	HERS **65-75**	HERS **55-65**	HERS **48-55**	HERS **35-45**	HERS **< 0**

First Passive, then Zero

Passive building provides a proven methodology for designing a Net Zero energy building.

Step 1 - Conservation - first through passive measures, then through active measures.

Step 2 – Renewable Energy - on-site or off-site renewable energy to offset remaining energy use.

With reduced loads, less renewable energy is needed, and less grid support is needed when the building isn't powered by renewable energy production. **Conservation efforts up-front will be critical for the wide-spread facilitation of Net Zero buildings into the existing electric grid.**

GETTING TO ZERO

with a passive building baseline

PASSIVE HOUSE 101:

How Does a Building Become Certified?

John Loercher
CPHC Trainer, **PHIUS**
CPHC**, Northeast Projects LLC**
JLoercher@PHIUS.org

BUILDING YOUR PROJECT TEAM

CPHC

- Required
- Involved Early in Design
- Completes Energy Modeling
- Assures that project will meet all requirements during design phase

CERTIFIED BUILDER

- Not Required, highly recommended
- Maintains quality and oversight during construction
- Helps ensure air-tightness target is met

PHIUS+ RATER

OR

PHIUS+ VERIFIER

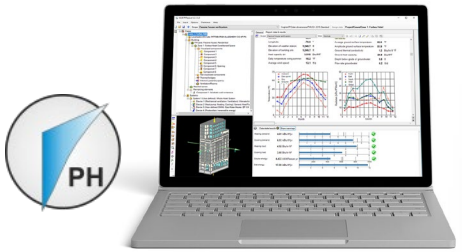
- Required
- Hired during design
- Completes multiple site visits/inspections

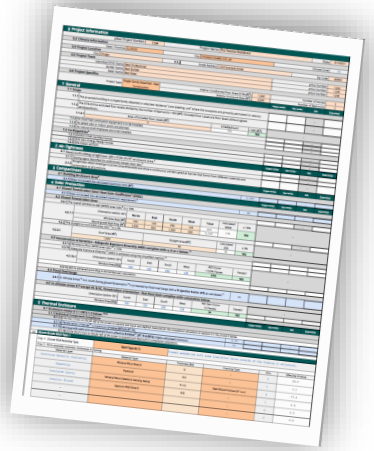
*Rater used for single family and low-rise multifamily
*Verifier used for non-residential and high-rise multifamily

CERTIFICATION PROCESS –TWO PARTS

PRE-CERTIFICATION: Design Stage Review

- CPHC Submits project
- Review completed by PHIUS
- Back-and-forth feedback process





FINAL CERTIFICATION: On-Site QA/Testing

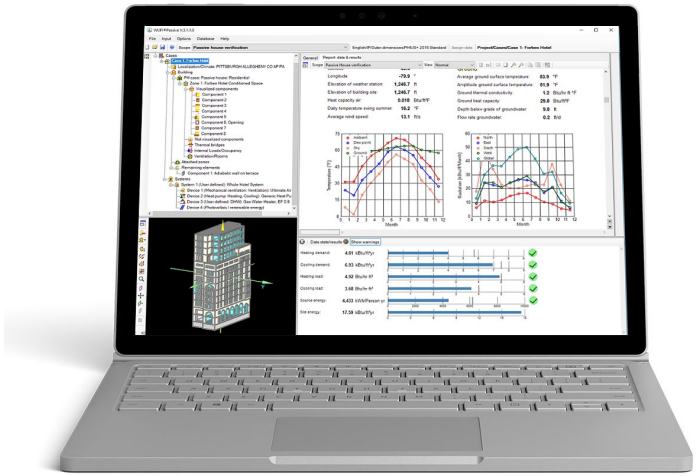
- Inspection completed by 3rd Party (PHIUS+ Rater/Verifier)
- Review of documents completed by PHIUS
- True-up final energy model to match "as-built"

PHIUS+ RATER

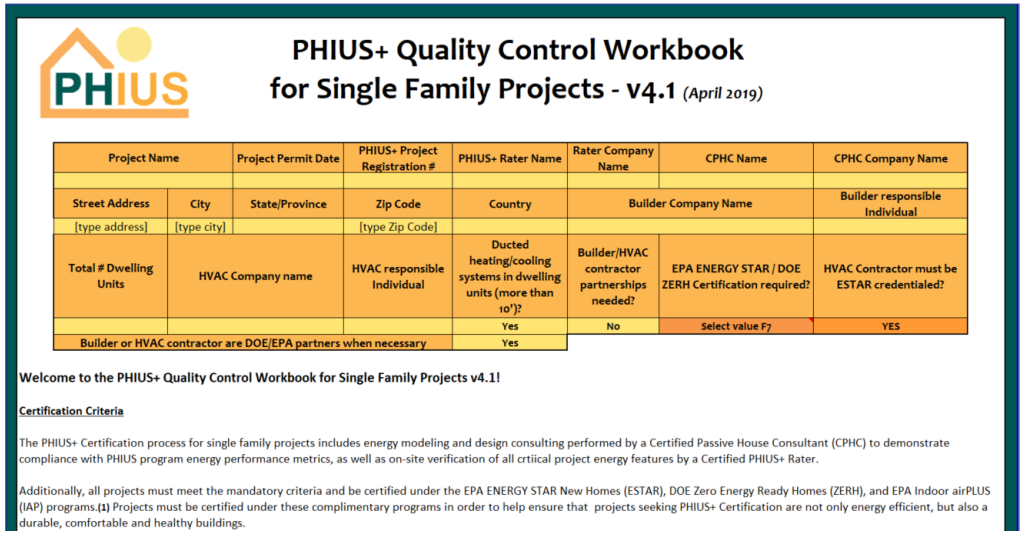
PHIUS+ VERIFIER

WHOLE-BUILDING PERFORMANCE BASED ON *MODELED* USE

QUALITY ASSURED *AS BUILT* ON-SITE



WUFI® Passive modeling software



PHIUS+ Quality Control Workbook for Single Family Projects - v4.1 *(April 2019)*

Project Name		Project Permit Date	PHIUS+ Project Registration #	PHIUS+ Rater Name	Rater Company Name	CPHC Name	CPHC Company Name
Street Address	City	State/Province	Zip Code	Country	Builder Company Name		Builder responsible Individual
[type address]	[type city]		[type Zip Code]				
Total # Dwelling Units	HVAC Company name		HVAC responsible Individual	Ducted heating/cooling systems in dwelling units (more than 10')?	Builder/HVAC contractor partnerships needed?	EPA ENERGY STAR / DOE ZERH Certification required?	HVAC Contractor must be ESTAR credentialed?
				Yes	No	Select value F7	YES
Builder or HVAC contractor are DOE/EPA partners when necessary				Yes			

Welcome to the PHIUS+ Quality Control Workbook for Single Family Projects v4.1!

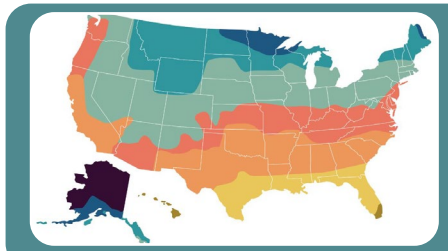
Certification Criteria

The PHIUS+ Certification process for single family projects includes energy modeling and design consulting performed by a Certified Passive House Consultant (CPHC) to demonstrate compliance with PHIUS program energy performance metrics, as well as on-site verification of all crtiical project energy features by a Certified PHIUS+ Rater.

Additionally, all projects must meet the mandatory criteria and be certified under the EPA ENERGY STAR New Homes (ESTAR), DOE Zero Energy Ready Homes (ZERH), and EPA Indoor airPLUS (IAP) programs.**(1)** Projects must be certified under these complimentary programs in order to help ensure that projects seeking PHIUS+ Certification are not only energy efficient, but also a durable, comfortable and healthy buildings.

MAIN CERTIFICATION REQUIREMENTS

REQUREIEMTNS FOR ALL PHIUS CERTIFICATIONS



SPACE CONDITIONING TARGETS

AIR-TIGHTNESS

PHIUS+ RATER

PHIUS+ VERIFIER

QUALITY ASSURANCE
ON-SITE TESTING/INSPECTION

VARIES

NET SOURCE ENERGY TARGET

OTHER REQUIREMENTS

1. Window Comfort
2. Limited risk of condensation on windows

PHIUS
Passive House Institute US

PHIUS WINDOW COMFORT & CONDENSATION RISK ASSESSMENT

Project Name	SAMPLE
Project #	SAMPLE
State	MASSACHUSETTS
City	BOSTON LOGAN INT ARPT
ASHRAE 99% Design Temperature [°F]	13.4

http://ashrae-meteo.info/

PHIUS+ Climate Data

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ambient Temp (°F)	26.6	31.1	38.8	47.5	58.8	66.0	74.1	71.1	64.6	54.0	43.3	36.0
Dewpoint (°F)	13.8	17.4	24.6	35.1	47.1	54.1	60.6	61.0	53.2	41.7	33.4	23.0

CONDENSATION RISK

ISO 13788 Calculation for Low Thermal Inertia Elements

Is this a Heating Climate?	TRUE
Use simple method for indoor humidity?	TRUE
High occupancy?	TRUE
U-value of window frame/glass [BTU/hr.ft².F]	0.4
Safety Factor	15%

Interior Surface Temperature of window frame/glass [°F]	49.4
Risk of condensation on interior surface acceptable?	YES
Critical fRsi	0.64
Critical Month	JAN
Critical CRF Rating	64

COMFORT REQUIREMENTS

Applies to all projects.

Windows >10' in height and above have the same required U-value.

Window Vertical Height (ft) - Use slider	7.0
Required Whole Window U-value [BTU/hr.ft².F]	0.24

3. Moisture control in assemblies
4. Moisture control at unavoidable thermal bridging

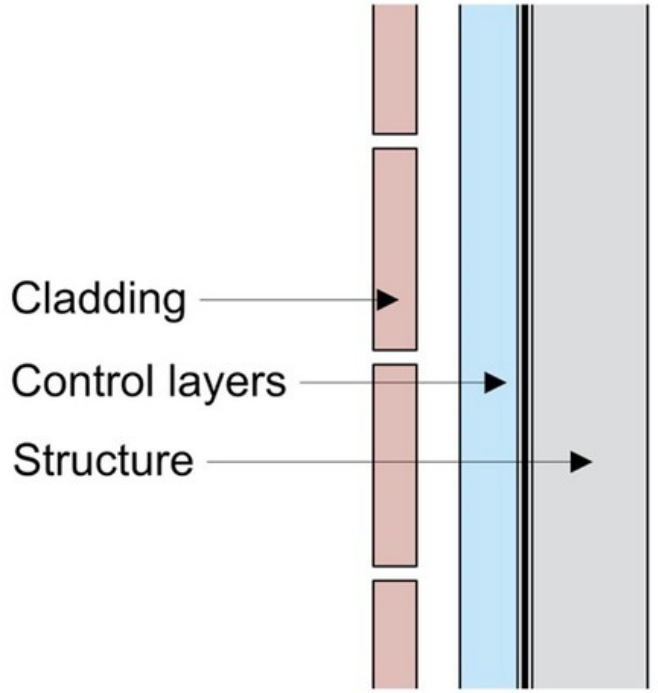


Image Source: Building Science Corporation - The Perfect Wall

ON-SITE QUALITY ASSURANCE TESTING/INSPECTION

- Built on US recognized systems (DOE ZERH, ENERGY STAR, EPA IAP, RESNET)
- Aligning with ES MFNC Program
- 3rd Party inspection process
- Multiple site visits
- Blower door testing
- Ventilation system balancing/commissioning
- Insulation inspection/IR Imaging

Critical for success. Provides assurance that the built product is what was planned.

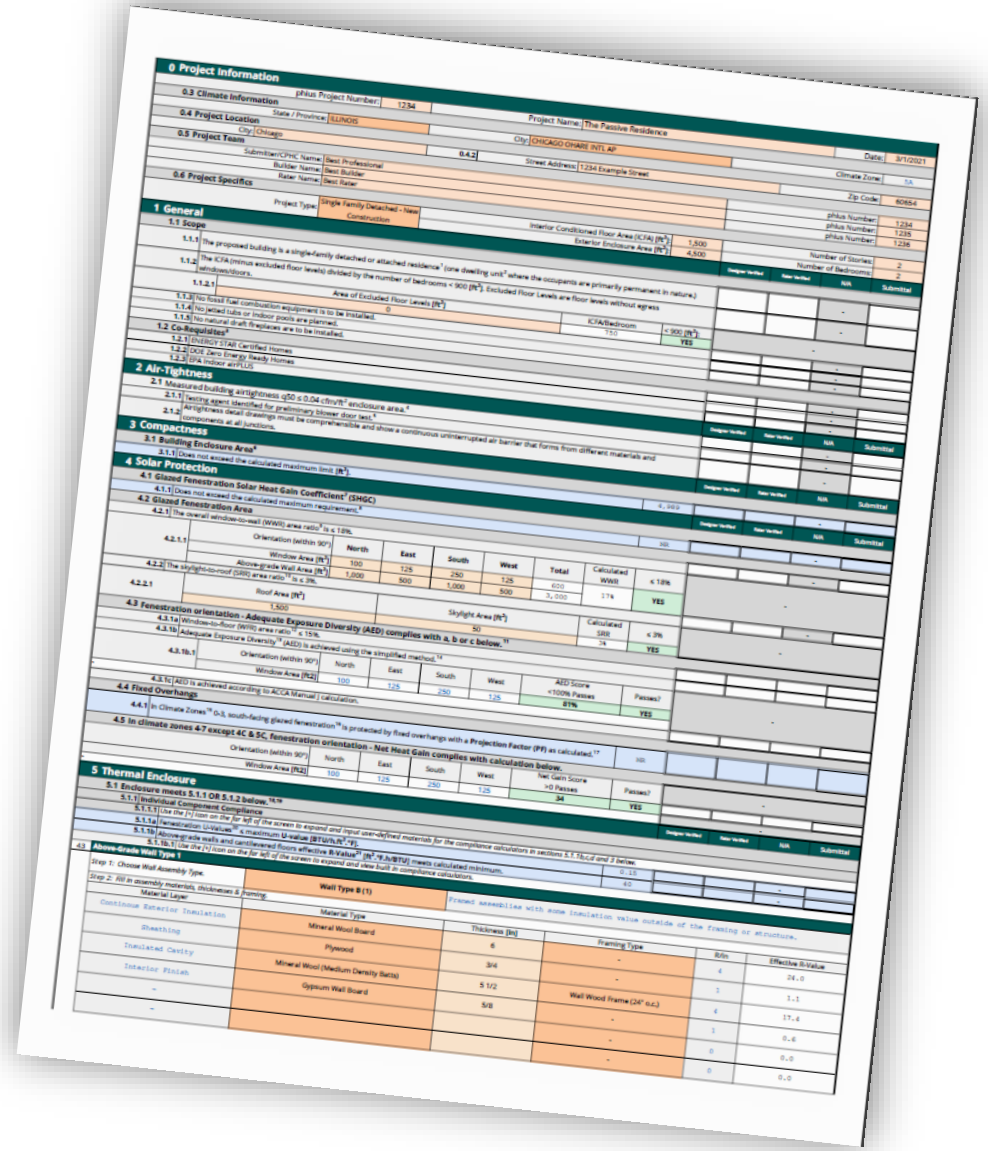
A *(new)* alternate approach for **phius CORE**…

phius CORE Prescriptive 2021

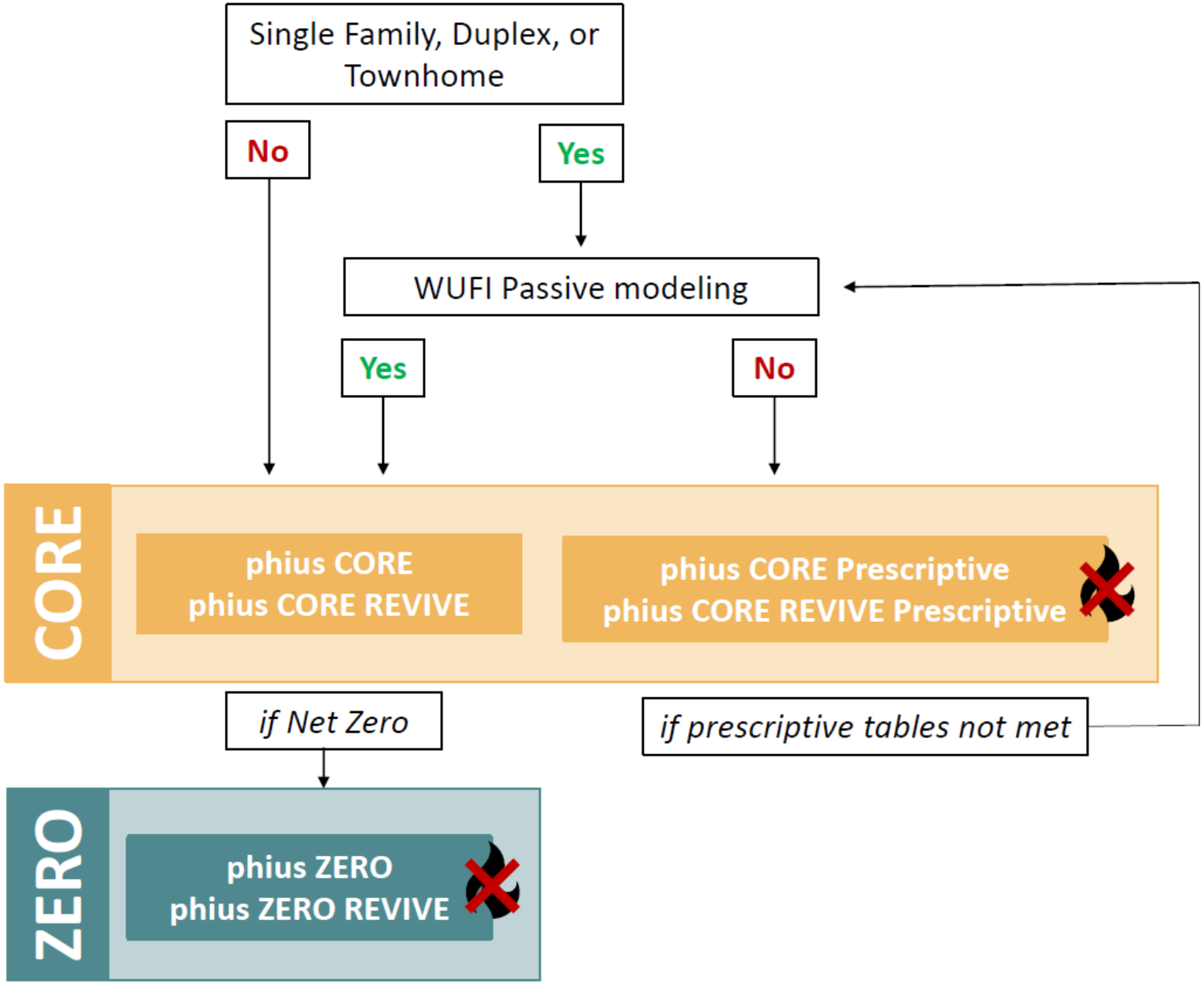
phius CORE Prescriptive 2021

General Scope Limitations

- Single-family detached or attached residences
- Floor Area / Bedrooms must be < 900 sf
- No fossil fuel combustion equipment
- No jetted tubs / indoor pools
- No natural draft fireplaces



Certification Path Decision Tree



U.S. Department of Energy:
HIGH PERFORMANCE STAIRCASE

IECC 2009	IECC 2012	ENERGY STAR v3	ENERGY STAR v3.1	ZERH	PHIUS+	PHIUS+ SourceZero
						Source Zero Renewable Energy System
					Balanced Ventilation HRV/ERV	Balanced Ventilation HRV/ERV
				SOLAR READY Depends on climate	SOLAR READY **ALWAYS**	SOLAR READY **ALWAYS**
				Eff. Comps. & H2O Distrib	Eff. Comps. & H_2O Distrib	Eff. Comps. & H_2O Distrib
				EPA Indoor airPLUS	EPA Indoor airPLUS	EPA Indoor airPLUS
				Ducts in Condit. Space	Ducts in Condit. Space	Ducts in Condit. Space
		HVAC QI w/WHV	HVAC QI w/WHV	HVAC QI w/WHV	Micro-load HVAC QI	Micro-load HVAC QI
		Water Management	Water Management	Water Management	Water Management	Water Management
		Independent Verification	Independent Verification	Independent Verification	Independent Verification	Independent Verification
IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2012/15 Encl./ES Win.	Ultra-Efficient Enclosure	Ultra-Efficient Enclosure
HERS **85-90**	HERS **70-80**	HERS **65-75**	HERS **55-65**	HERS **48-55**	HERS **35-45**	HERS **< 0**

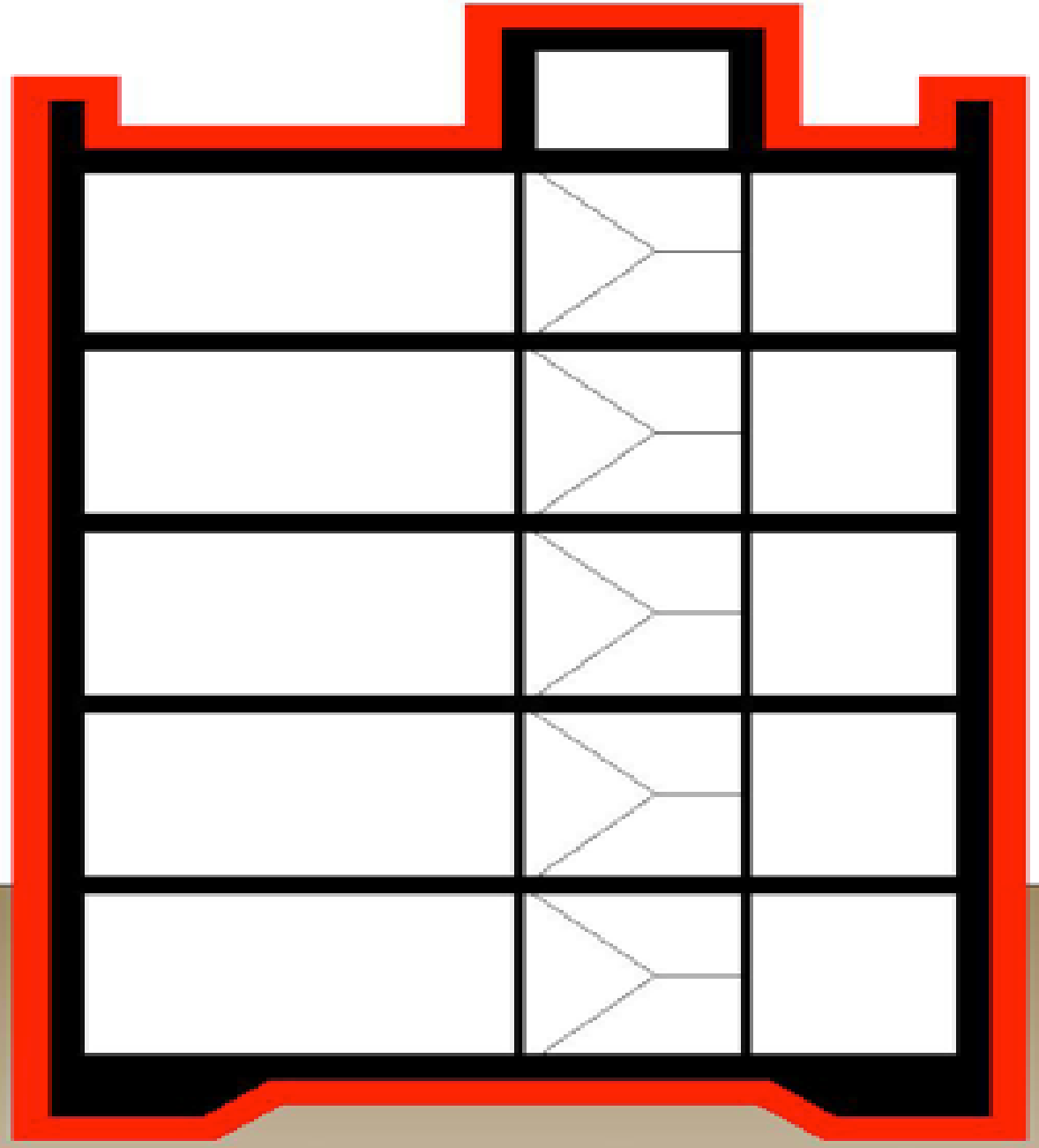
PASSIVE HOUSE 101:

Common Design Features

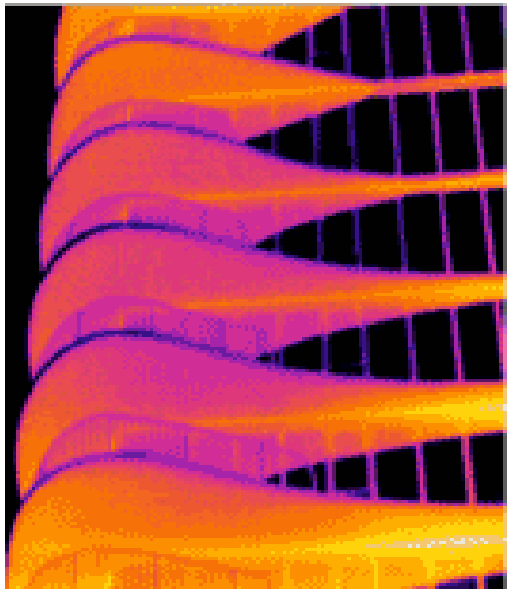
John Loercher
CPHC Trainer, **PHIUS**
CPHC**, Northeast Projects LLC**
JLoercher@PHIUS.org

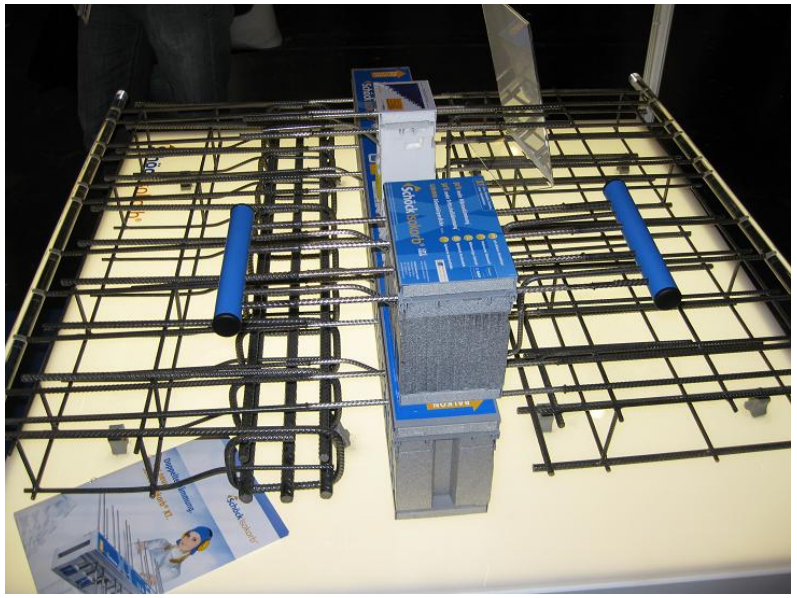
CONTINUOUS INSULATION

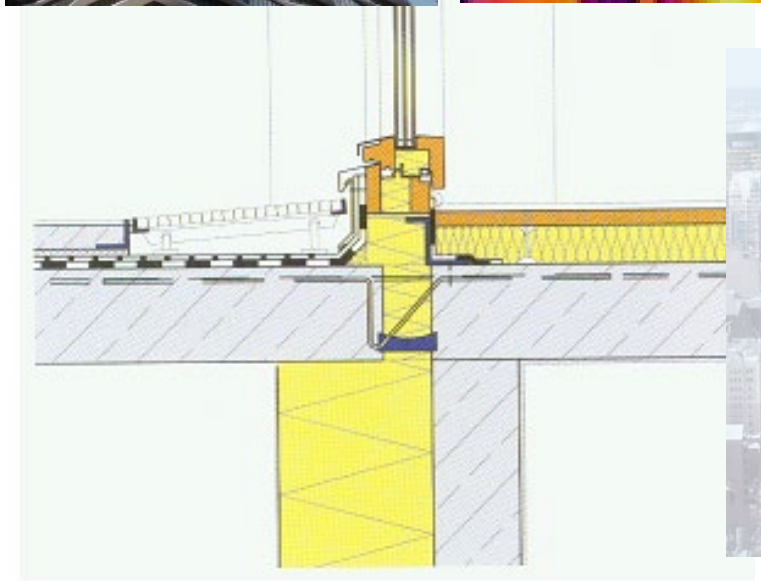
MINIMIZE LOSS/GAIN



STRUCTURAL THERMAL BREAKS

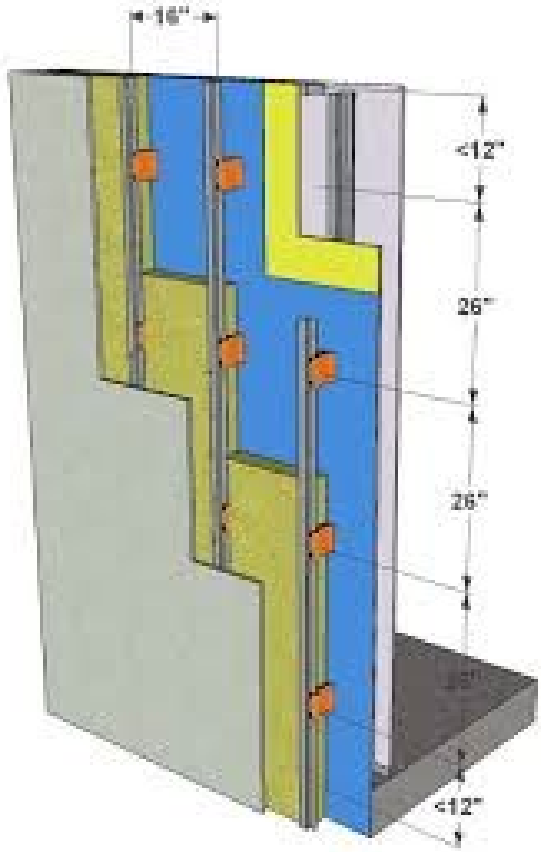


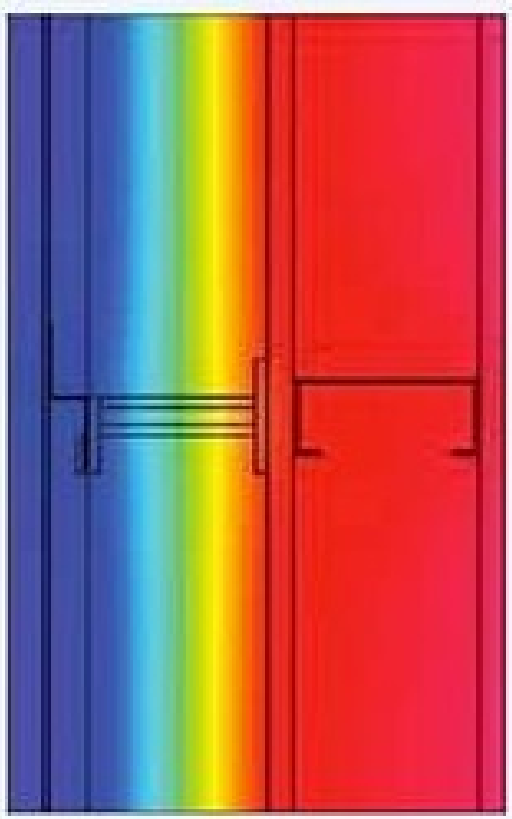




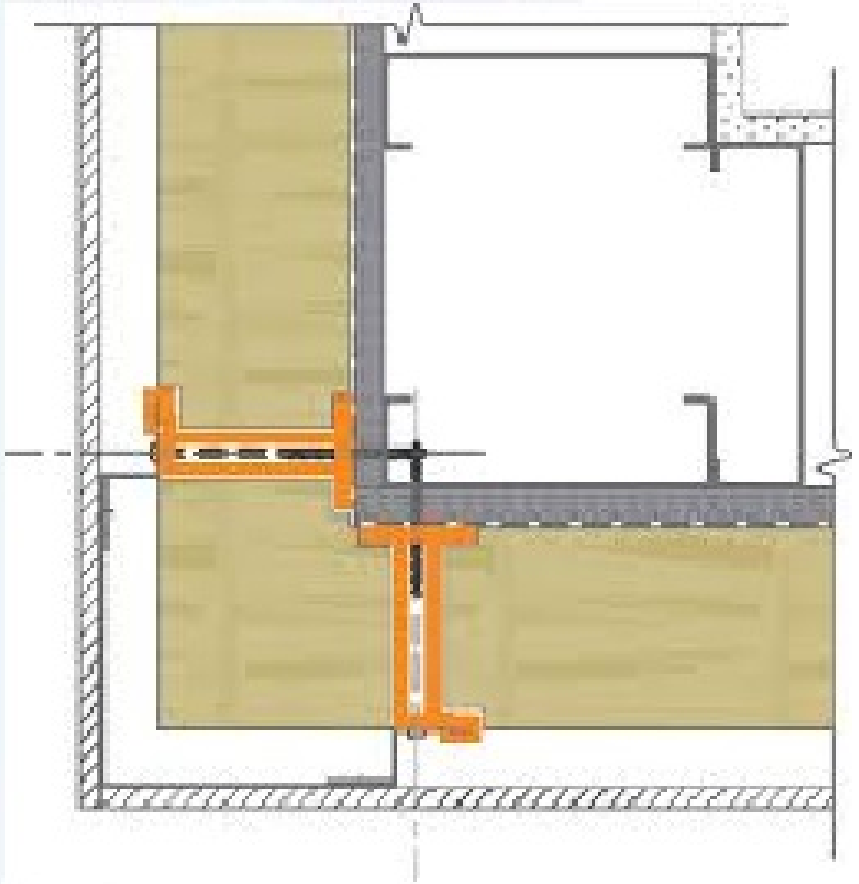
Source: Building Science Corporation Newsletter #49: Aqua Tower and Infra Red by Fluke Corp

THERMALLY BROKEN **FASTENERS**



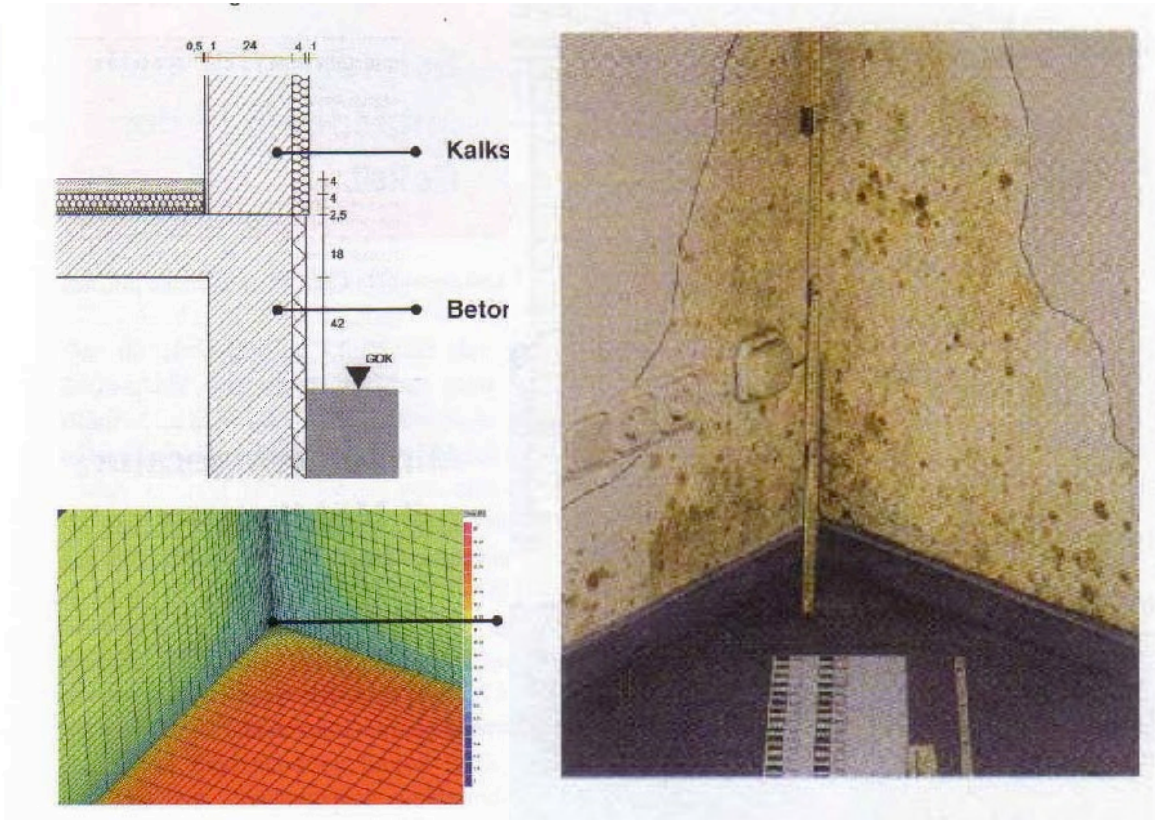


Cascadia Clip® system



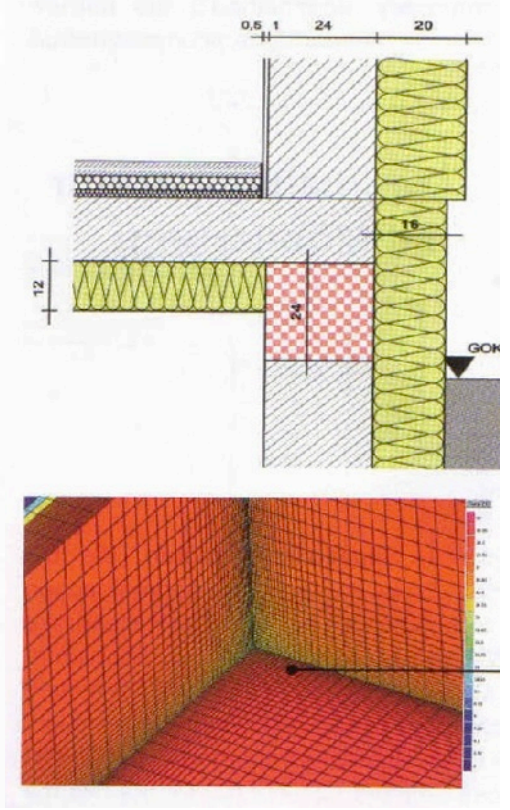
ELIMINATING THE THERMAL BRIDGE MINIMIZES HEAT LOSS CONDENSATION/BUILDING DETERIORATION

BAD = high heat loss + risk of condensation



Minimum temperature 48 F below dew-point, risk of condensation

GOOD = low heat loss, warm interior surface + no condensation



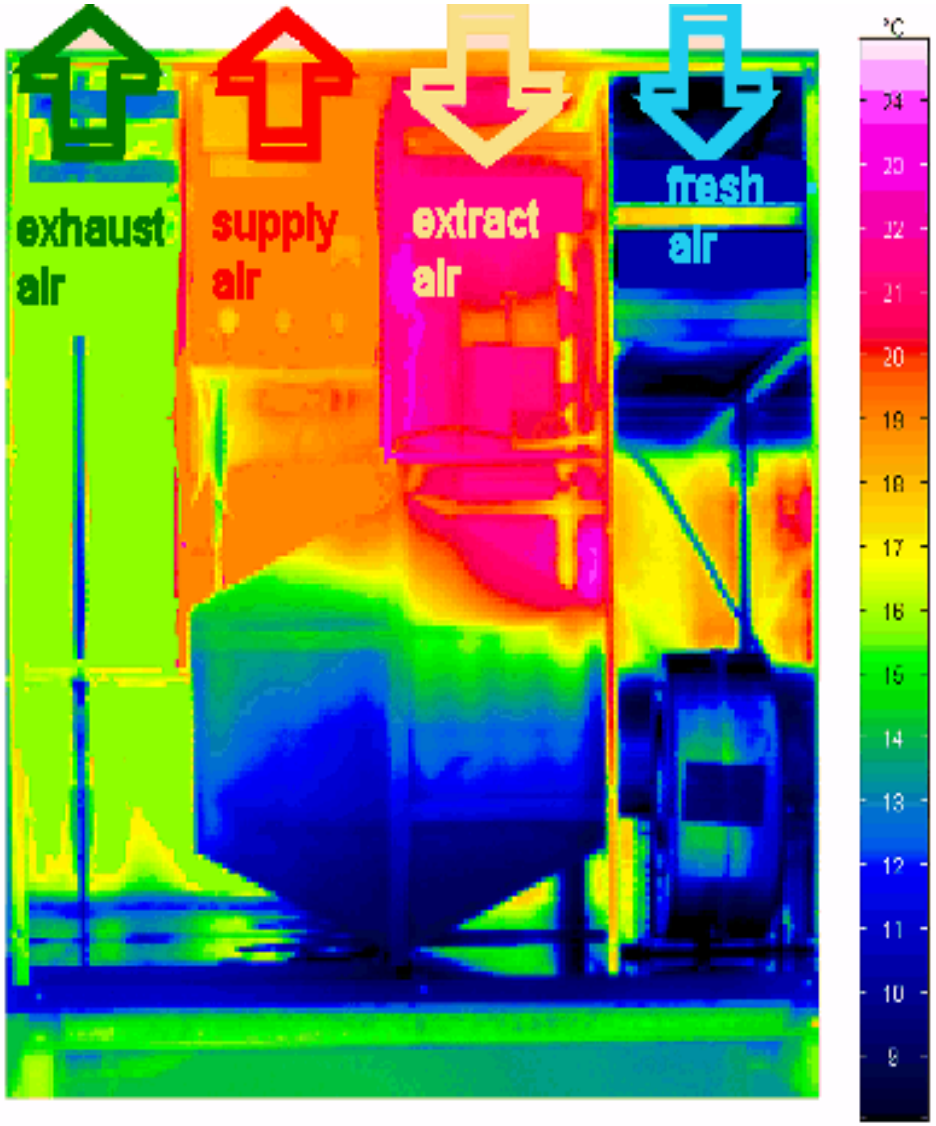
Minimum temperature 58 F above dew-point, no risk of condensation

AIR-TIGHT CONSTRUCTION

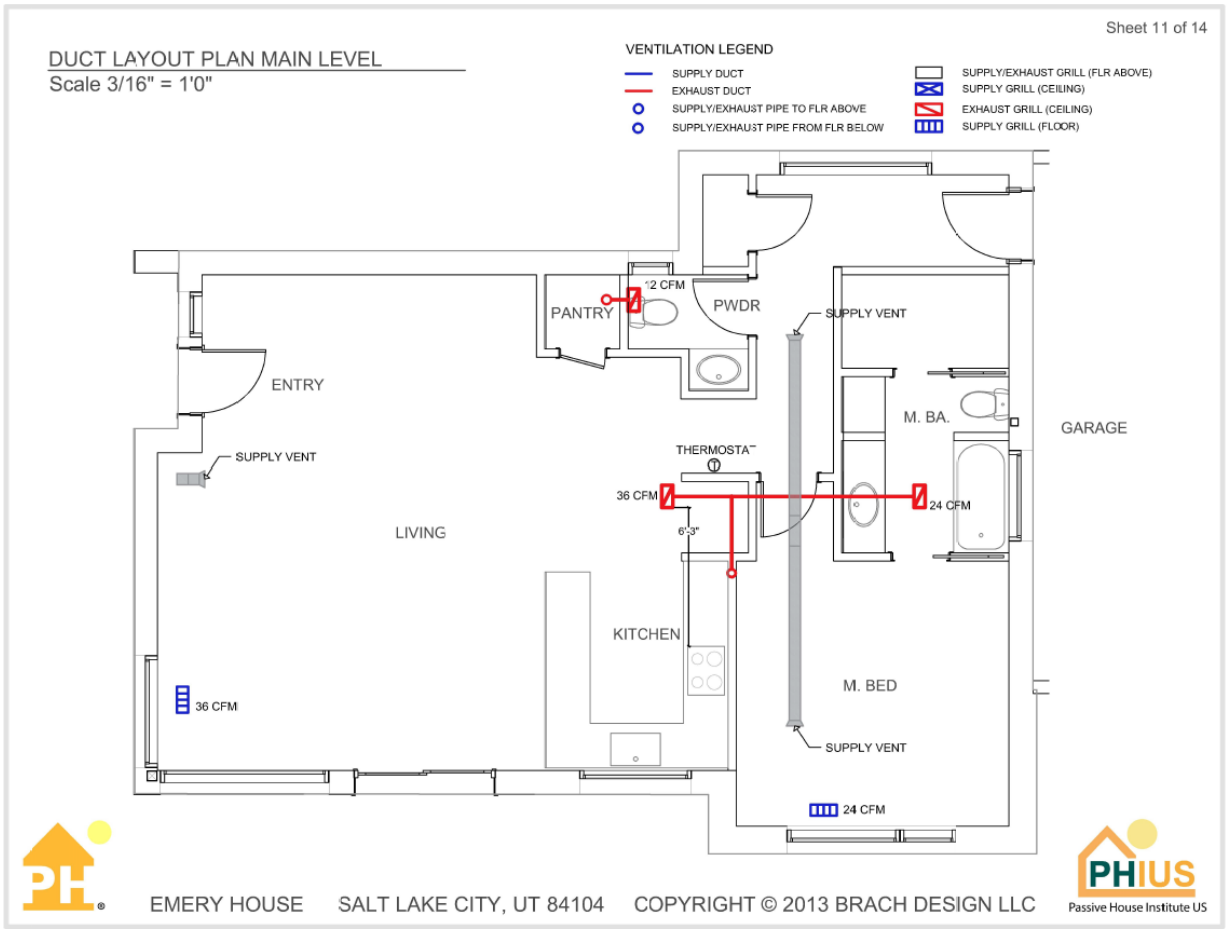
AIR BARRIER
WIND-TIGHT LAYER

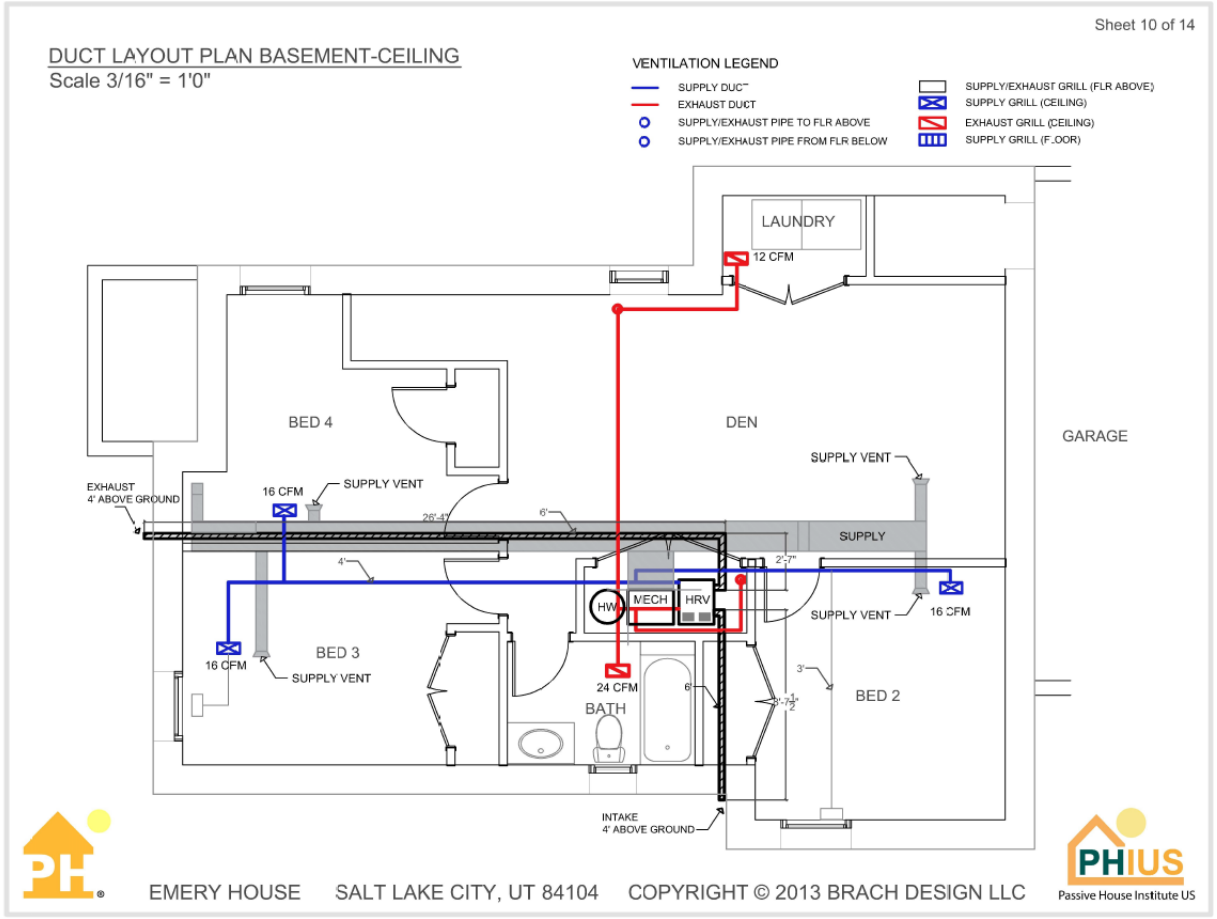
CONTINUOUS, BALANCED VENTILATION WITH HEAT RECOVERY

Centralized, semi-centralized, or per dwelling unit



SAMPLE BALANCED VENTILATION LAYOUT





MINIMIZED, EFFICIENT MECHANICAL SYSTEMS

Typically all-electric buildings, but not always.
High performance VRF or heat pump systems for heating/cooling
Heat pump water heaters for water heating, on-demand recirculation systems

PASSIVE HOUSE 101:

Additional Resources

John Loercher
CPHC Trainer, **PHIUS**
CPHC**, Northeast Projects LLC**
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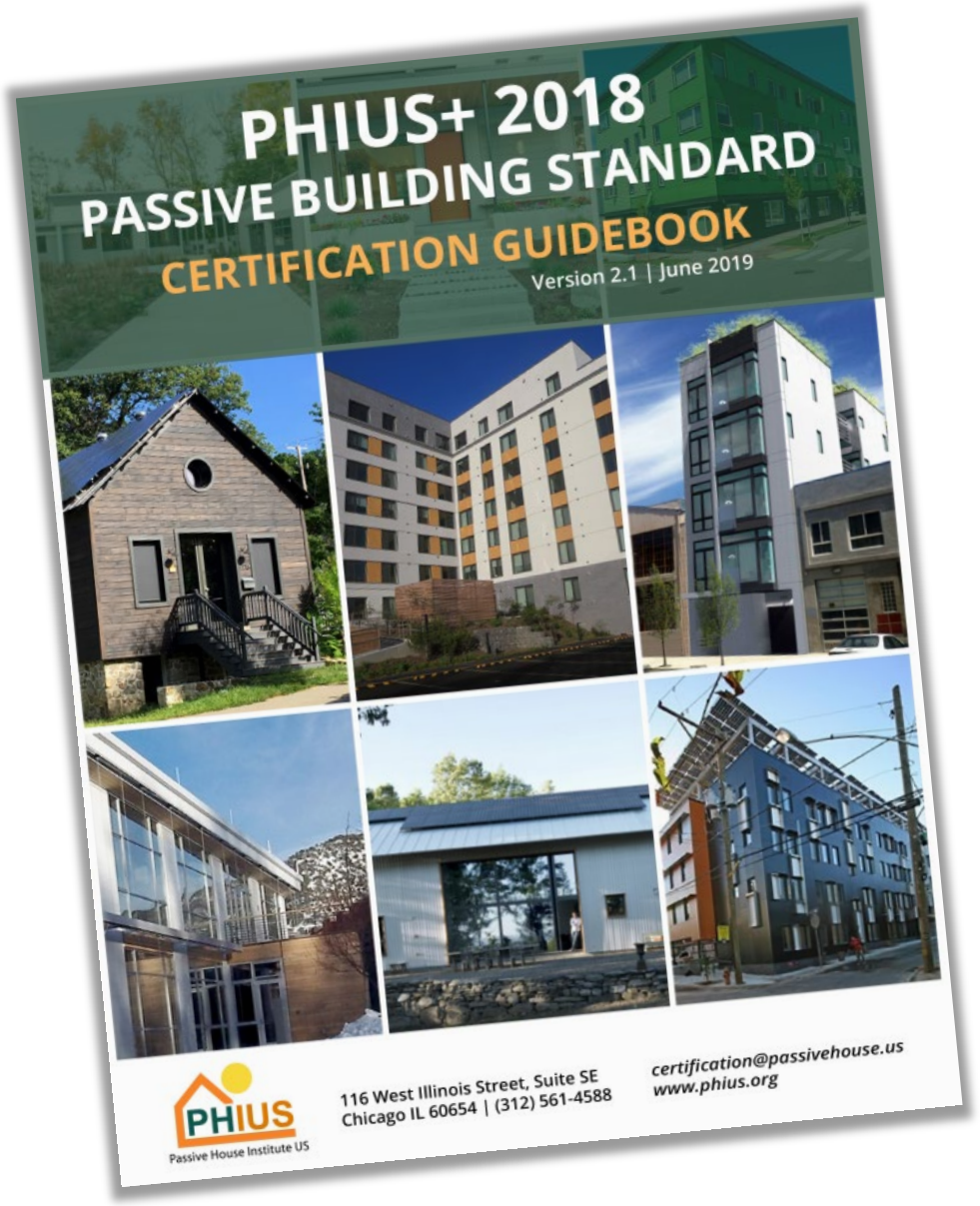
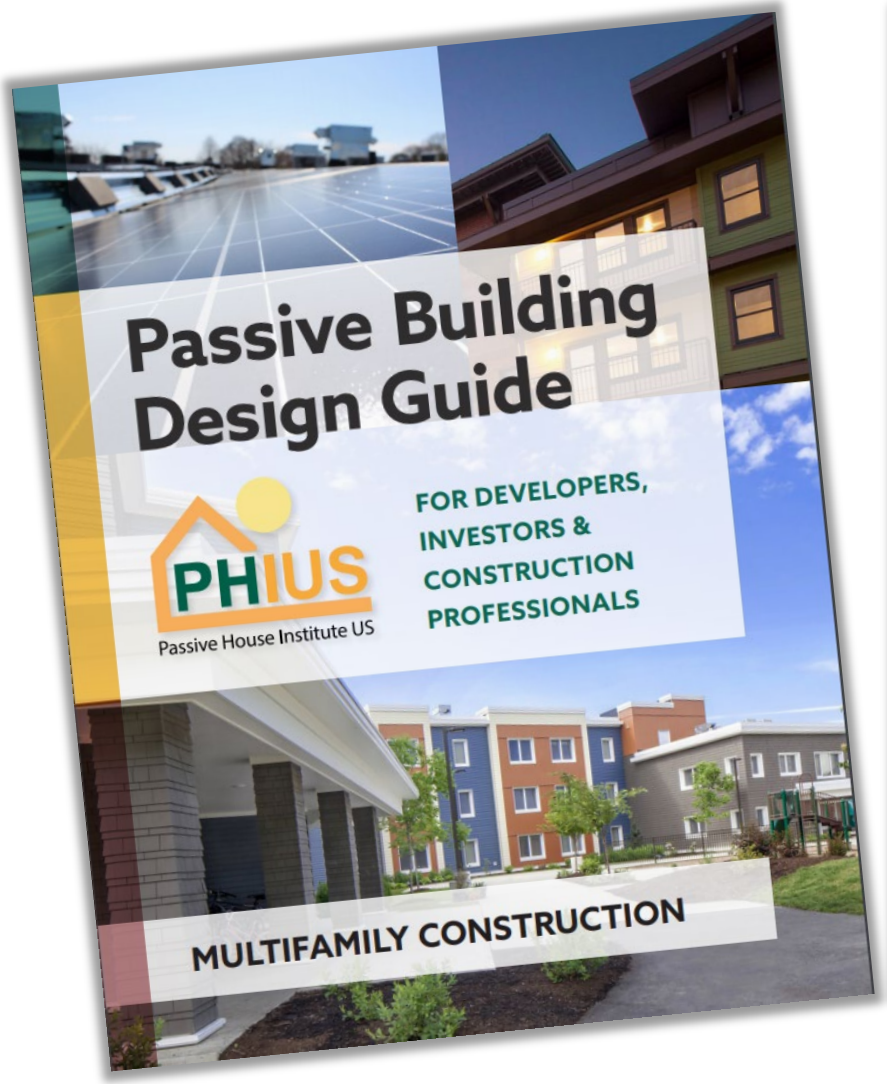


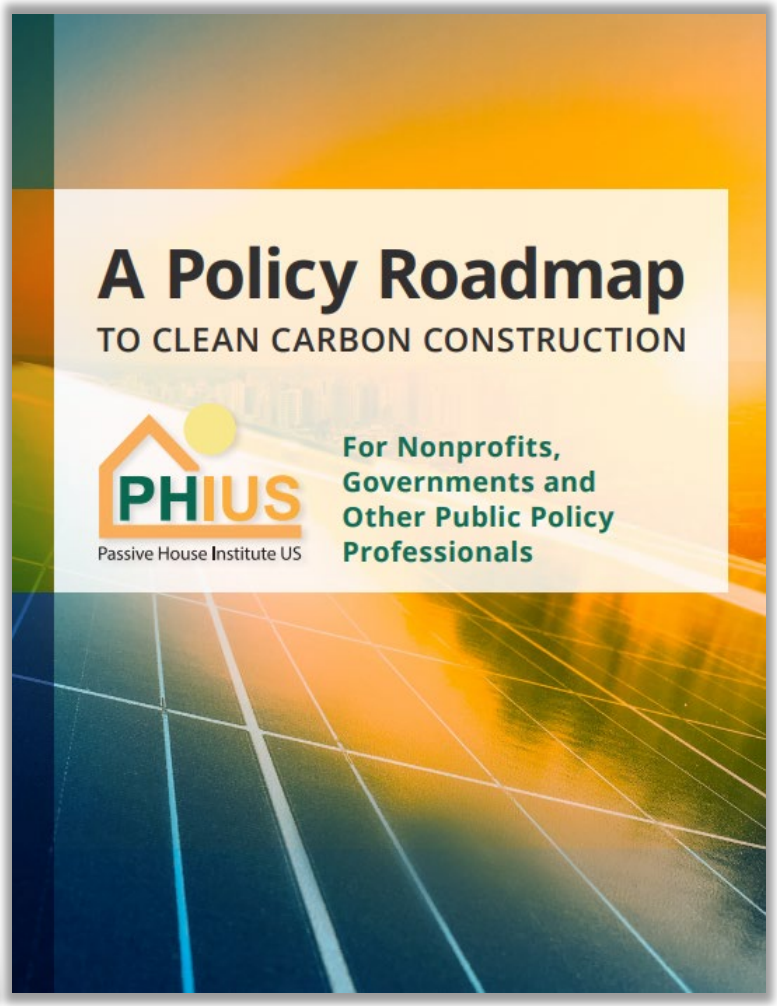
PHIUS+ CERTIFICATION GUIDEBOOK

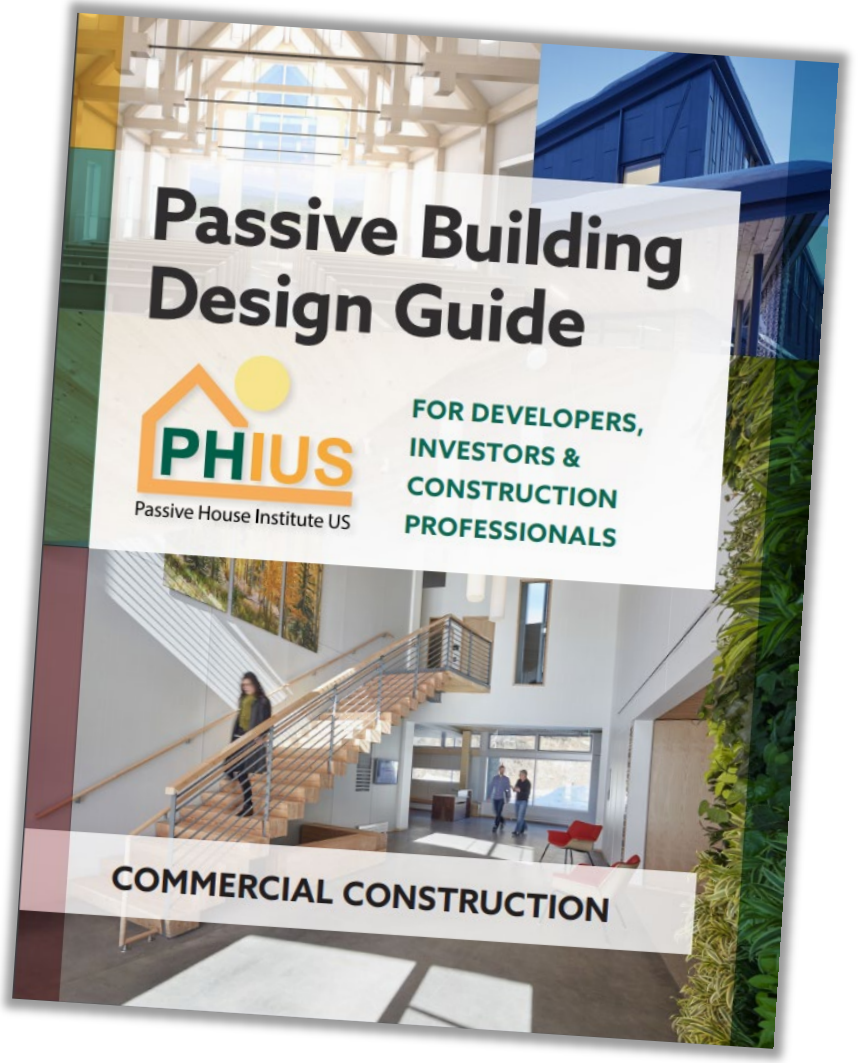
FREE Online

https://www.phius.org/PHIUS+2018/PHIUS+%20Certification%20Guidebook%20v2.1.pdf

Multifamily.PHIUS.org | Commercial.PHUS.org







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ALLIANCE

A program of PHIUS, the Alliance (PHAUS) provides a chapter/membership structure to support the growing community of passive building professionals in the United States.

Through networking opportunities and other forums, PHAUS members connect with one another and with industry representatives. In partnership with PHIUS technical staff, PHAUS provides training opportunities and disseminates technical information and research.

https://www.phius.org/alliance/join-support/join-the-alliance-

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