



# 2025 Greenbuild Summit

## Phius & Passive Building 101

*Lisa White | Co-Executive Director, Phius*

# Opening Poll

## Who is in the room?

1. Architects
2. Engineers
3. Builders
4. Manufacturers
5. Raters
6. Government
7. Other?

**Who works on mostly on residential projects?**

**Who works mostly on non-residential / commercial projects?**

# Opening Poll

**Who has worked on a project pursuing LEED Certification?**

**Who is familiar with passive building?**

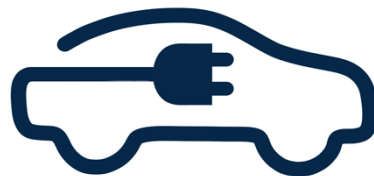
**Who is familiar with Phius?**


**Who has worked on a project pursuing Phius Certification?**

# What We're Going to Talk About



- Who is Phius?
- What is Passive Building?
  - Passive Building Principles
  - The Phius Standard
- Phius Certification Process
  - Key Team Members
  - Resources & Tools
- Passive Building Growth
- Verification and Cost Data
- Tools & Resources
- Next Steps / Further Education





**Phius' Mission:  
Every building  
supports the health  
of people and the  
planet.**

# What does Phius do?



Calculation based on ISO 52017-2, EN 673, EN 410

Product name: ALPEN 725 High Performance Element

Center of glass properties: Open HPF 725-7H No Grids

ASHRAE/IECC / DOE North American Climate Zone: North, East, West, South, West, Facing

Whole window installed U-value

Climate specific recommendations	U-value	BTU/hr ft <sup>2</sup> F	SHGC	
			SHGC	BTU/hr ft <sup>2</sup> F
8	1.02	0.18	0.558	0.703
7	1.00	0.18	0.558	0.678
6	1.00	0.18	0.558	0.664
5	1.00	0.18	0.558	0.686
4	1.01	0.18	0.558	0.692
Material Specific	1.01	0.18	0.558	0.695
3	1.02	0.18	0.558	0.702
2	1.01	0.18	0.558	0.698
1 East	1.03	0.18	0.558	0.716
1 West	1.03	0.18	0.558	0.716

ALPEN 725 High Performance	Frame height	U-frame		SHGC		U-value	SHGC
		U-frame	SHGC	SHGC	BTU/hr ft <sup>2</sup> F		
Almetal 250P 5ST	mm	in	W/m <sup>2</sup> K	BTU/hr ft <sup>2</sup> F	W/m <sup>2</sup> K	BTU/hr ft <sup>2</sup> F	W/m <sup>2</sup> K
Head	73	2.88	1.18	0.20	0.094	0.031	0.143
Sill	73	2.88	1.18	0.20	0.094	0.031	0.143
Left jamb	73	2.88	1.18	0.20	0.094	0.031	0.143
Right jamb	73	2.88	1.18	0.20	0.094	0.031	0.143

Valid through October 2018



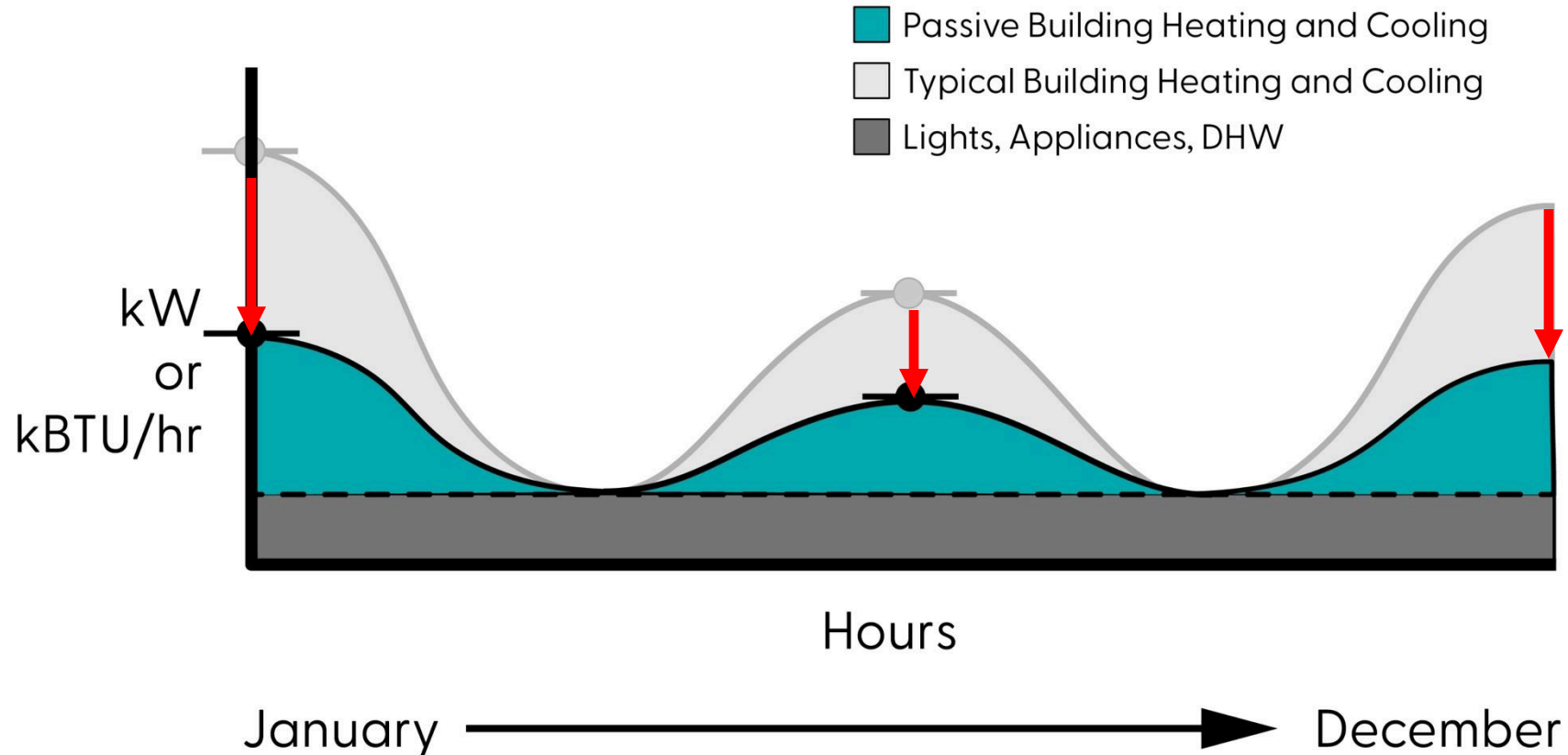


**What is passive  
building?**

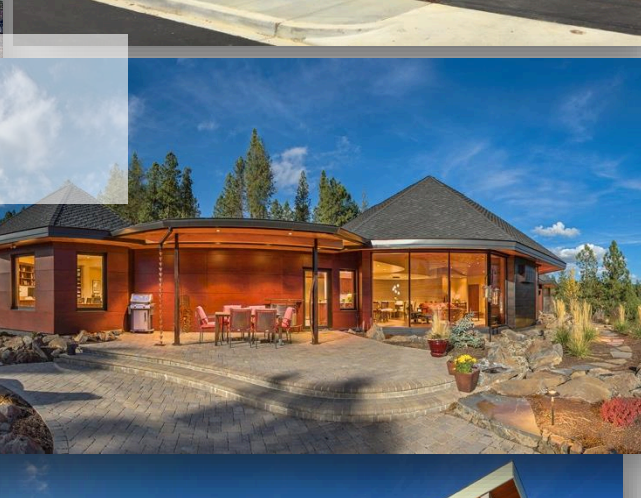
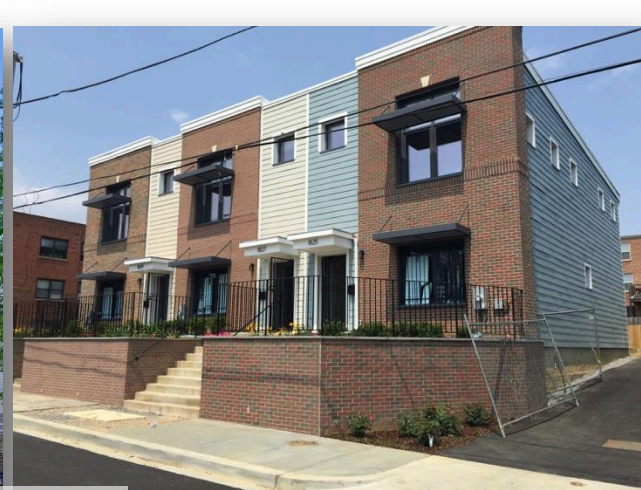




# Passive Building vs. Typical Building



© Phius



# What is passive building?

# Passive Building Delivers

**Healthy Interior**



**Comfort**



**Long-Term Affordability**



**Safety**



**Durability**



**Resilience**



# THE PRINCIPLES

# Passive Building Principles

## THERMAL CONTROL

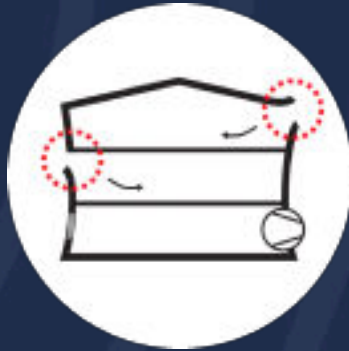


High  
Performance  
Insulation



Thermal Bridge  
Elimination

## AIR CONTROL

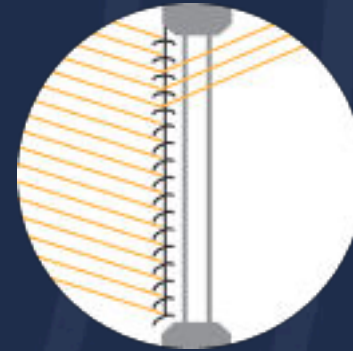


Air-Tightness



Enthalpy  
Recovery  
Ventilation

## RADIATION CONTROL

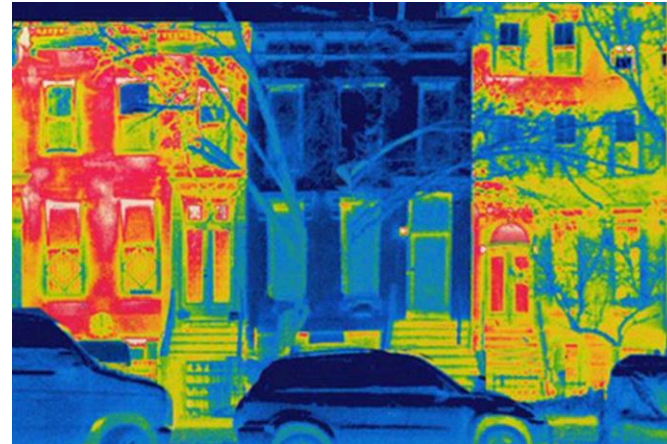
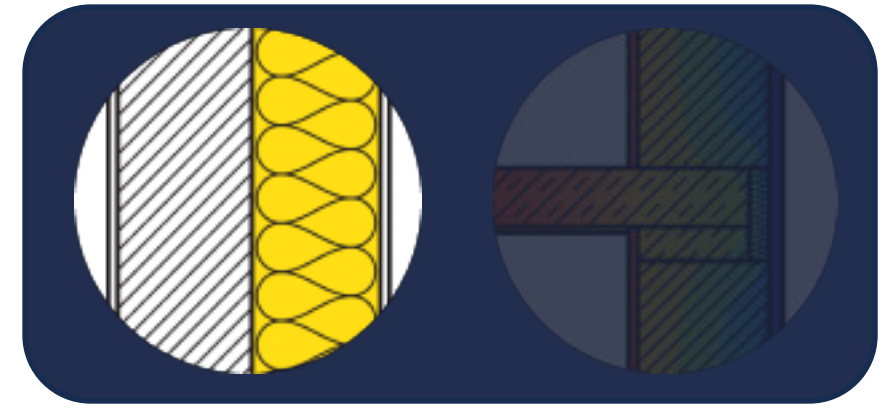


Shading /  
Daylighting



Climate  
Appropriate  
Glazing

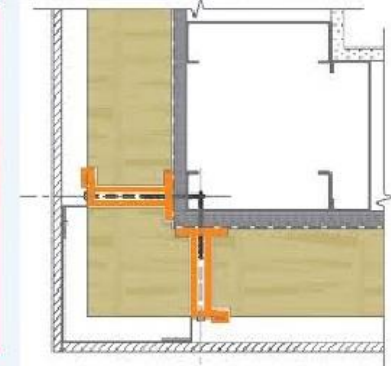
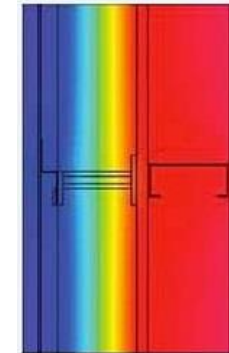
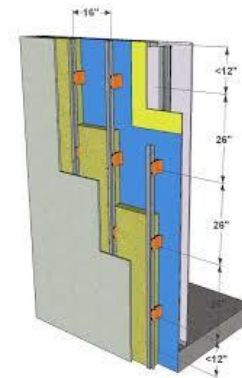
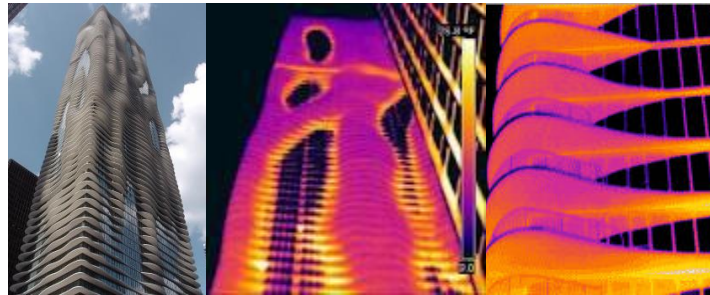
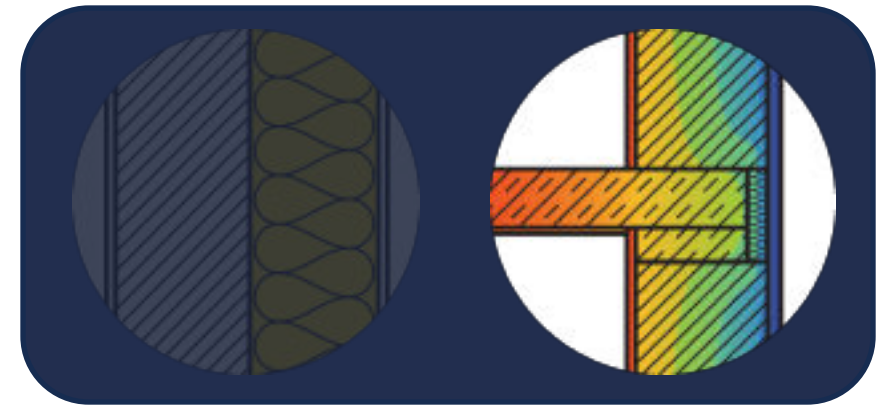
# Thermal Control: High Performance Insulation



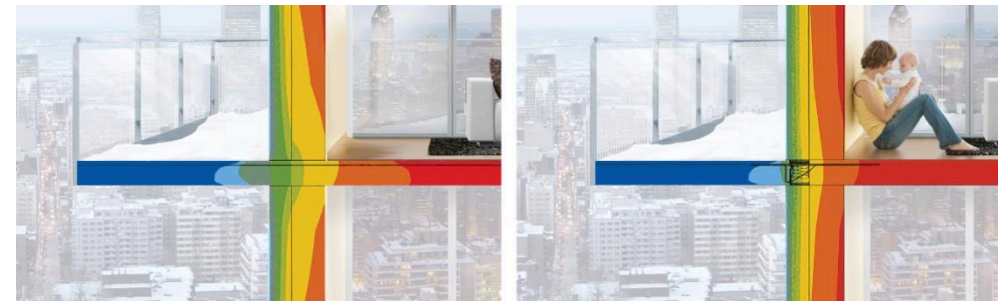
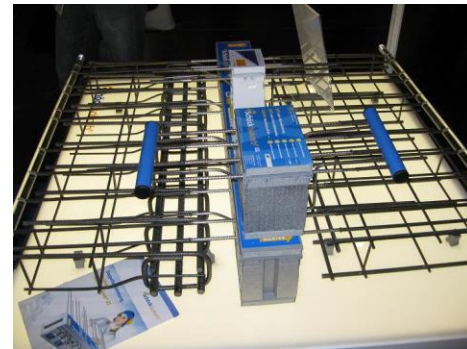
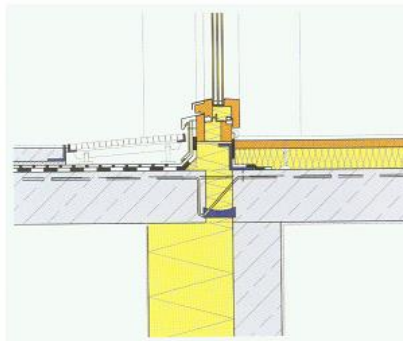
**“High Performance”** = Continuous, Quality-Installed,  
Climate Appropriate Amount



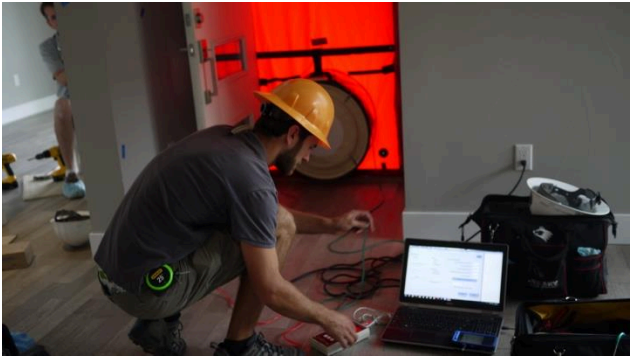
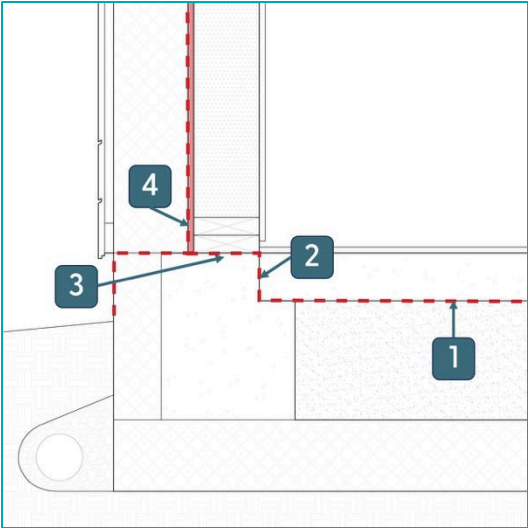
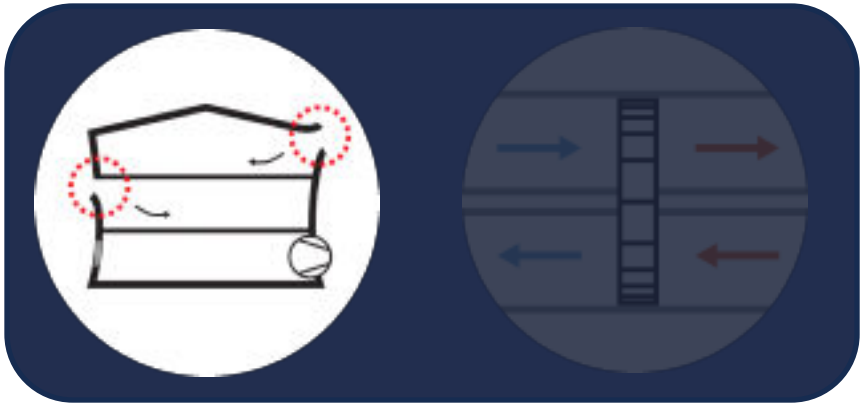
# Thermal Control: Thermal Bridge Elimination



Cascadia Clip® system

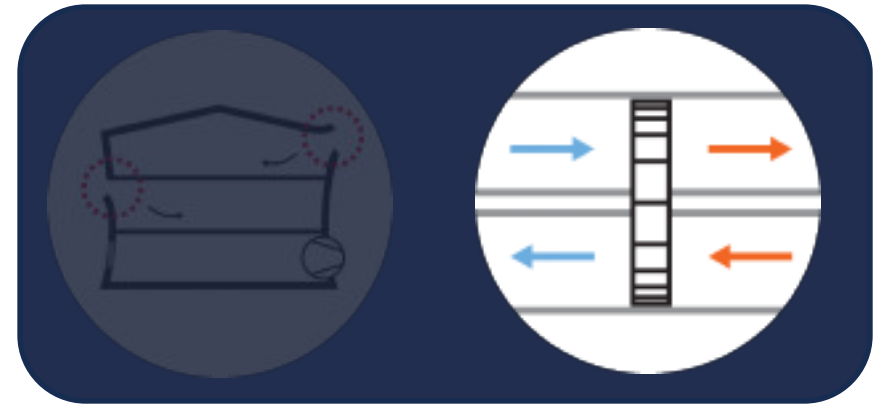


# Air Control: Enclosure Airtightness



PHIUS AIR-TIGHTNESS REQUIREMENT IS 5x LOWER THAN IECC 2024

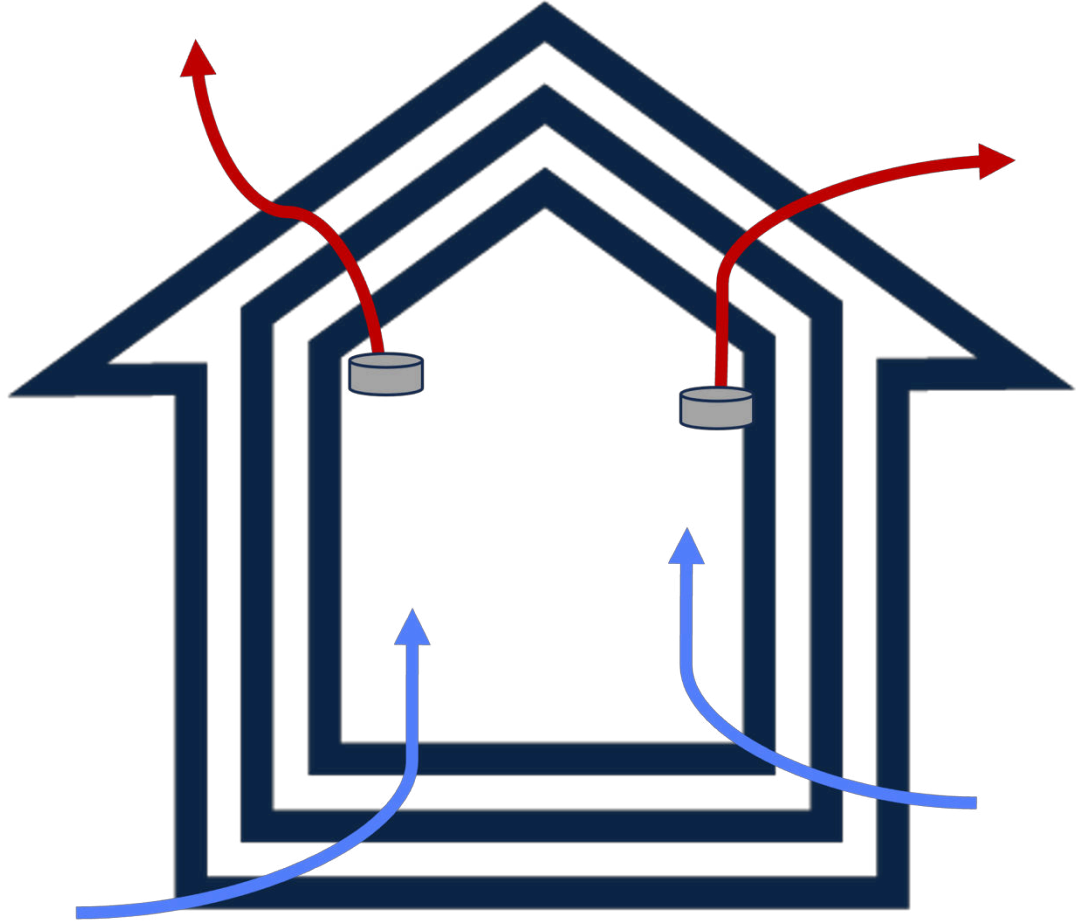
# Air Control: Balanced Ventilation with Heat and/or Moisture Recovery



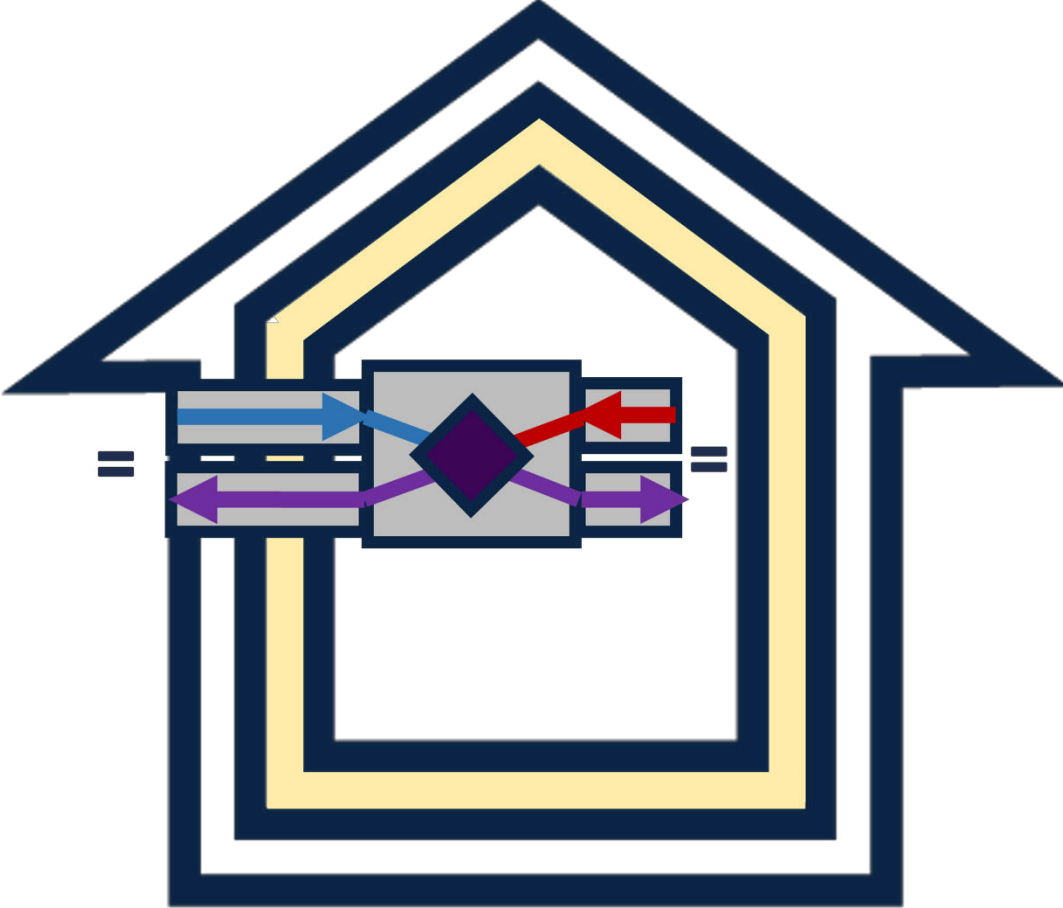
**Exhaust Only** Ventilation

**vs**

**Balanced** Ventilation

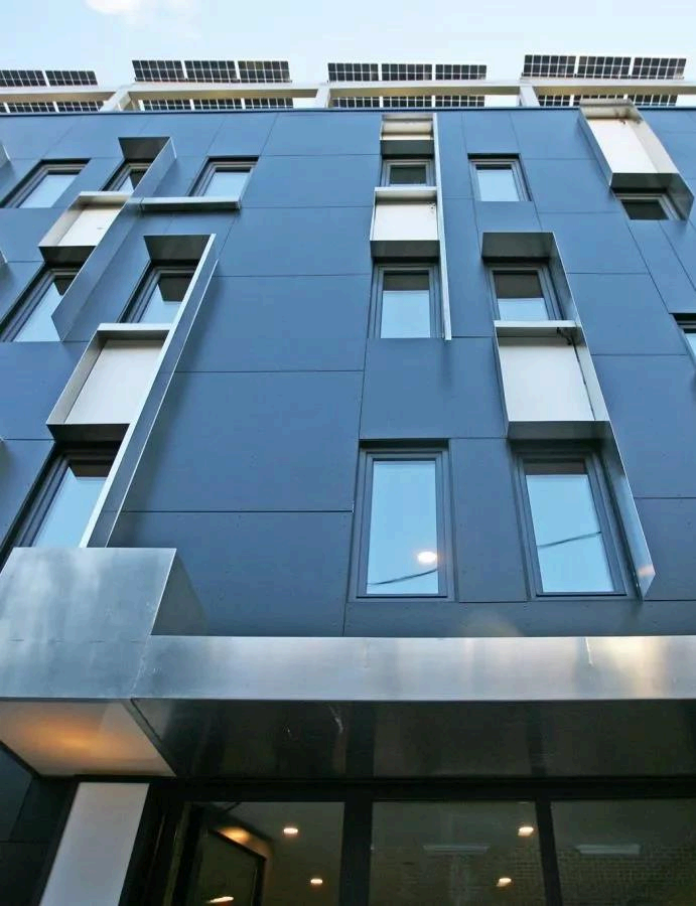
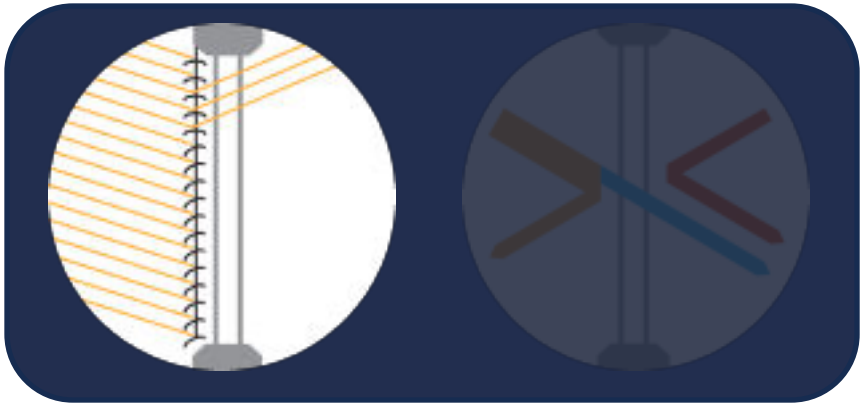


**Conventional**

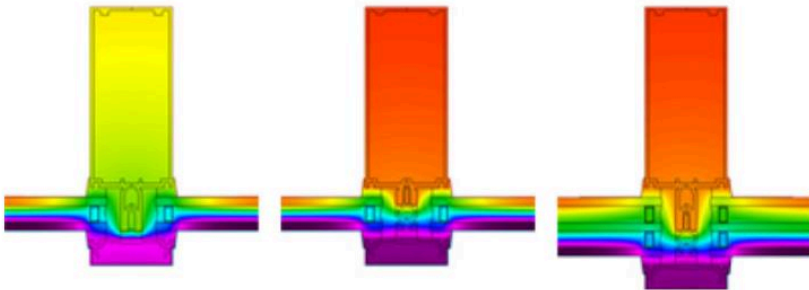
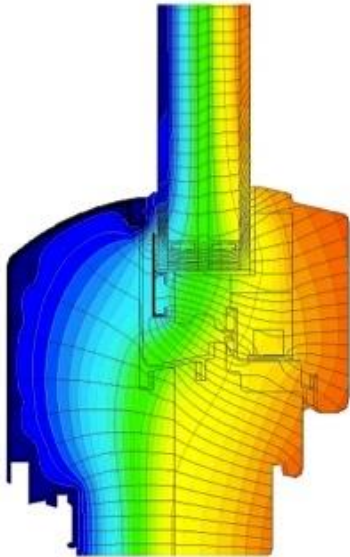


**High Performance**

# Solar/Radiation Control: Optimize Shading & Daylighting



# Solar/Radiation Control: Utilize Climate-Appropriate Glazing



1600 Wall System@1  
1" Insulating Glass

1600UT Wall System@1  
1" Insulating Glass

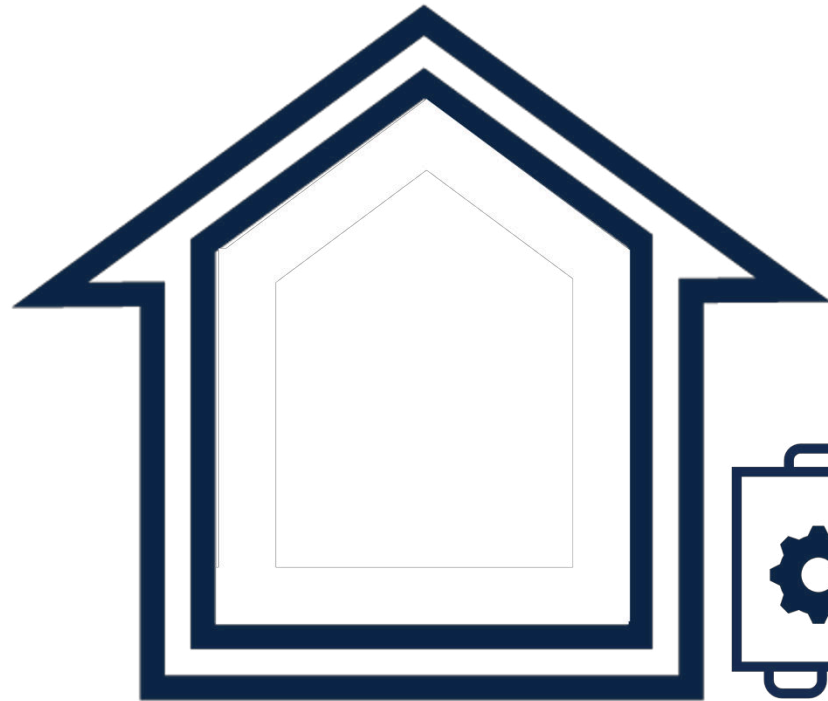
1600UT Wall System@1  
1-3/4" Insulating Glass





**Result =**

**Minimized Active Mechanical Systems**



**Conventional**



**High Performance**

# THE STANDARDS

*setting metrics based on the principles*



# The Phius Standard

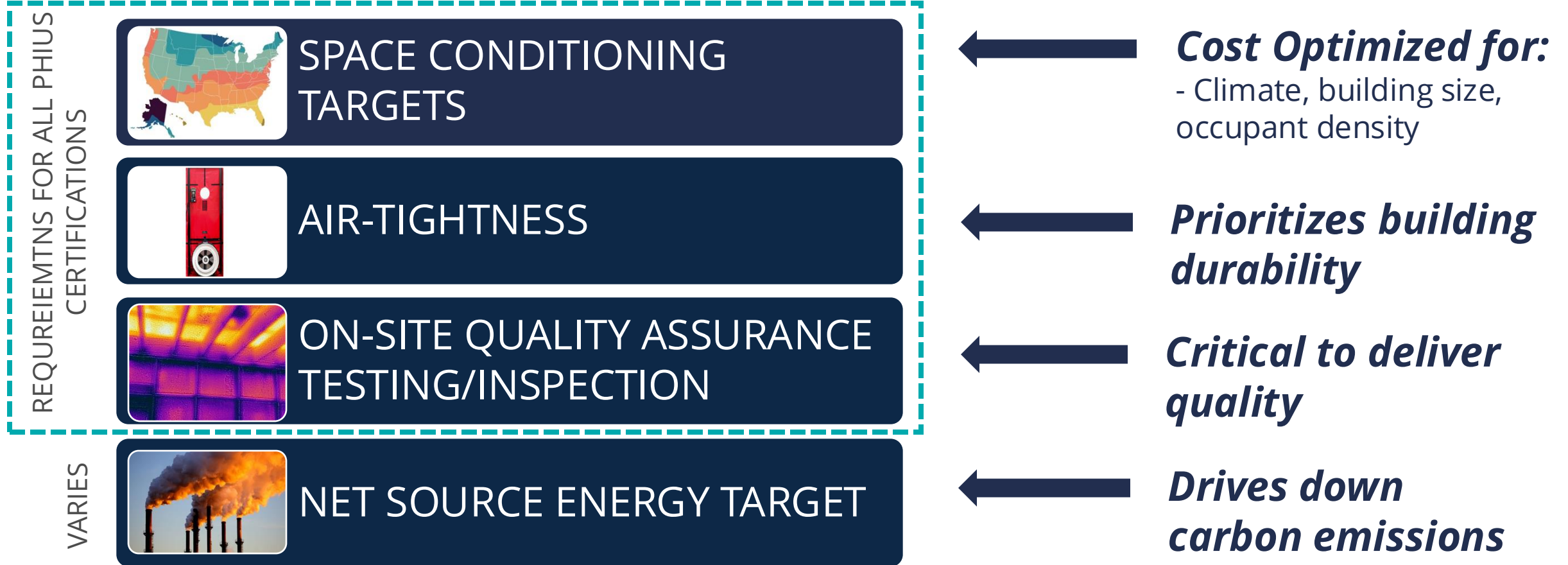
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*is a **climate-specific passive building standard** that **prioritizes passive building principles** and guides builders to success in the design and construction of high-performance buildings.*

*It provides a **quality-and-conservation-first framework for net zero building.***



# Phius Standard: 4 Main Pillars



# Phius Standard Framework

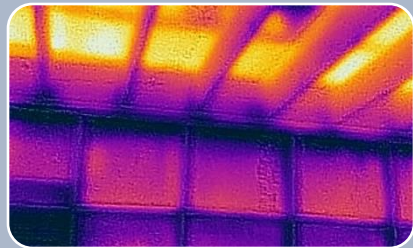
REQUIREMENTS FOR ALL  
PHIUS CERTIFICATIONS



SPACE CONDITIONING TARGETS



AIR-TIGHTNESS



QUALITY ELEMENTS + QA TESTING &  
INSPECTION

VARIABLES

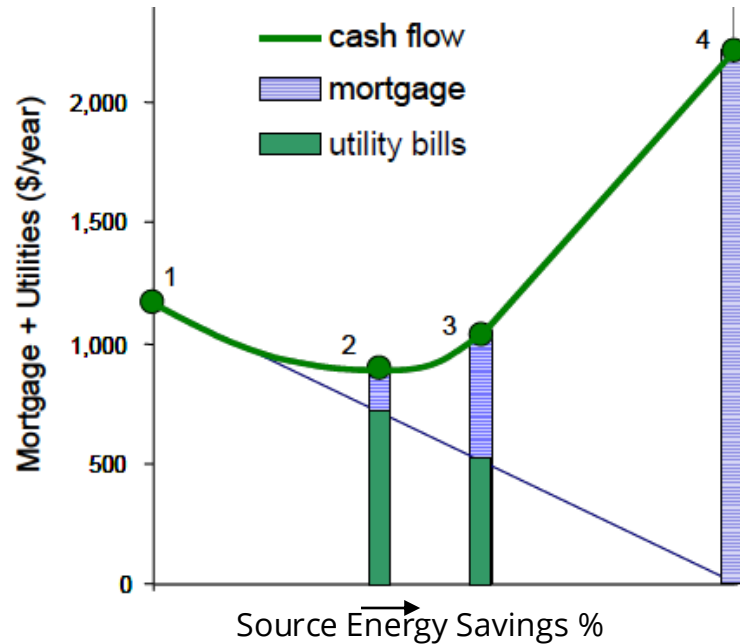


NET SOURCE ENERGY TARGET

How low can (and *should*) you  
go with **conservation** and  
**passive measures**,  
i.e. **when to stop?**

# Heating + Cooling Target Setting Methodology

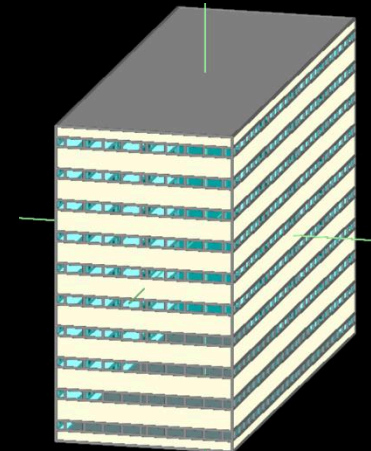
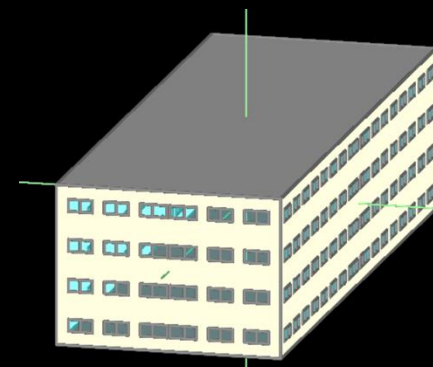
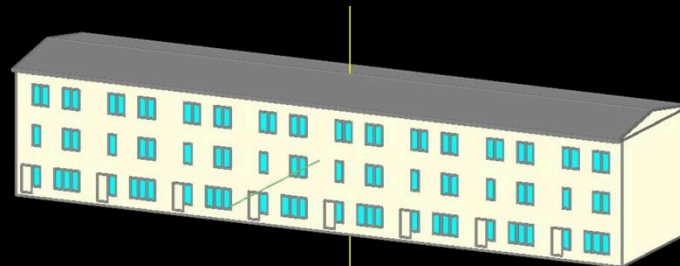
Setting Cost Competitive Space Conditioning Targets



**Heating and Cooling limits  
Optimized for:**

- Cost
- Energy Use
- Climate
- Building Type
- Occupant Density
- Dwelling Unit Density

See [Phius 2024 Criteria Calculator](#)

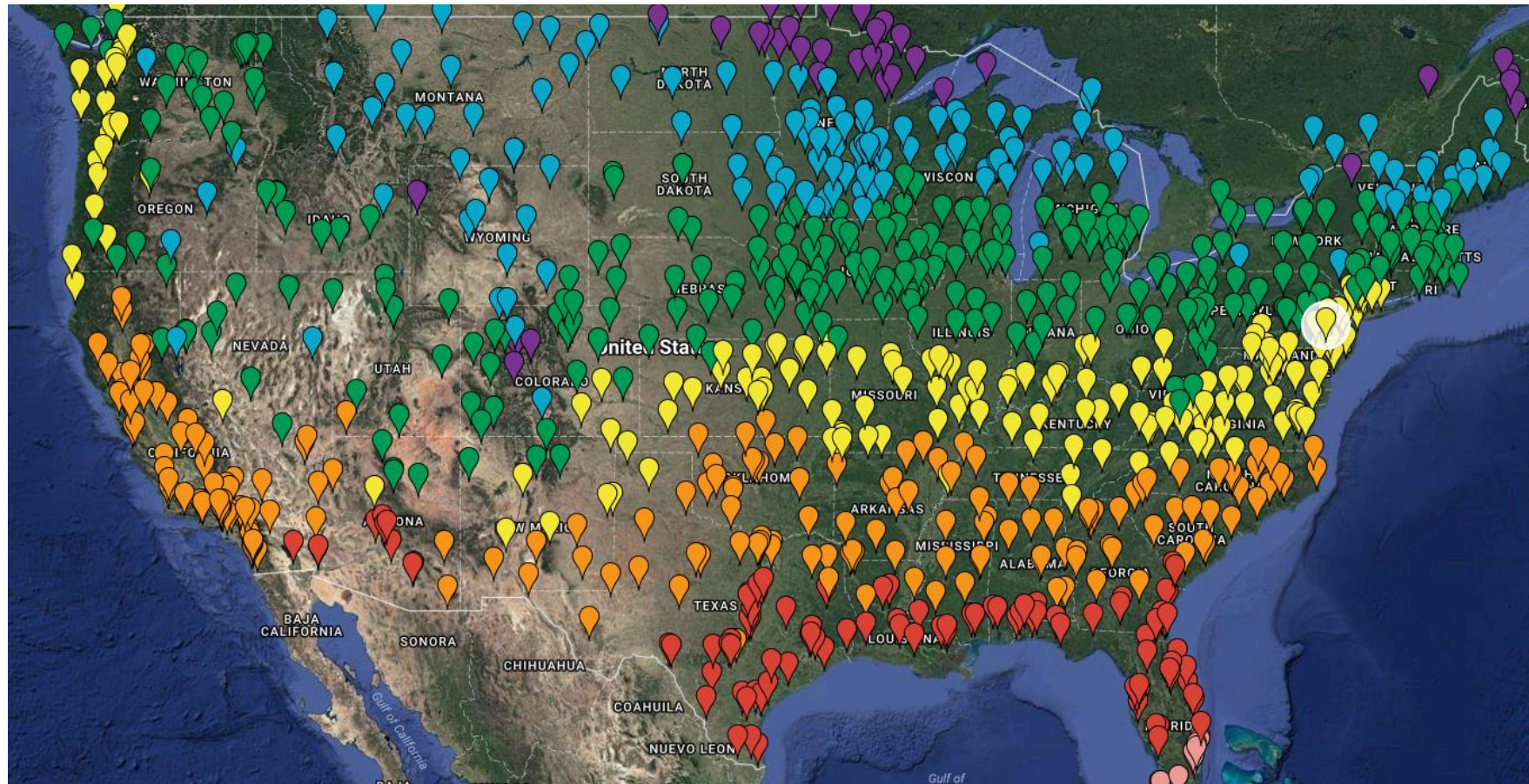




# Application of Passive Principles

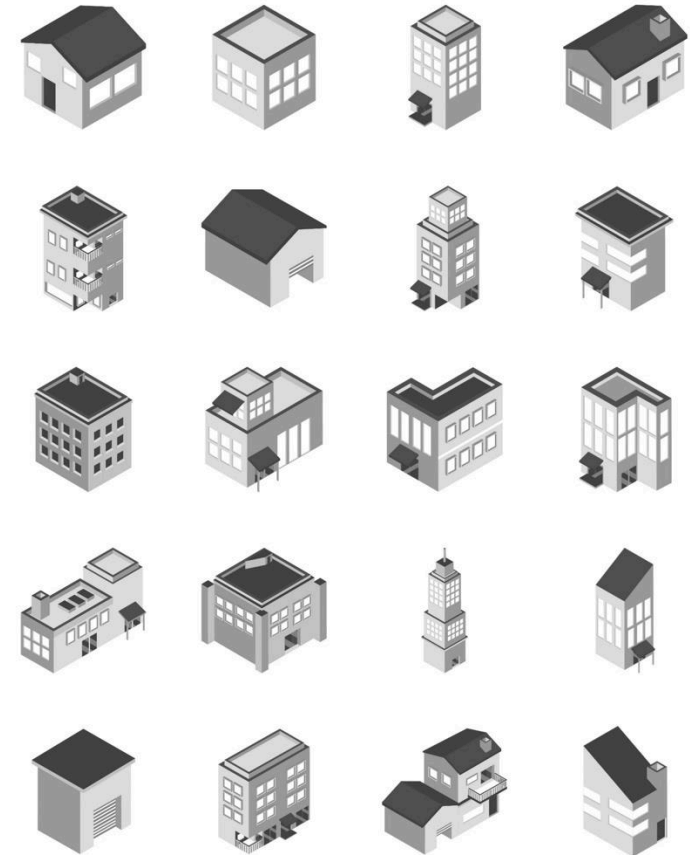
## “Sweet spot”

Based on climate



## “Sweet spot”

Based on type/size



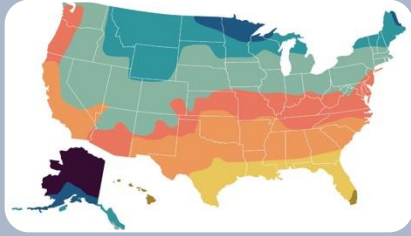
# Climate Zone 5A vs. 2A

Phius 2024 New Construction* Performance Criteria Calculator v24.1		
UNITS:	IMPERIAL (IP) ▾	
BUILDING FUNCTION:	RESIDENTIAL ▾	
STATE / PROVINCE	WISCONSIN ▾	
CITY	MILWAUKEE MITCHELL I ▾	
ASHRAE 169 Climate Zone	5A	
Envelope Area (ft <sup>2</sup> )	3,750.0	
iCFA (ft <sup>2</sup> )	1,500.0	
Dwelling Units (Count)	1	
Total Bedrooms (Count)	4	
Space Conditioning Criteria		
Annual Heating Demand	10.3	kBtu/ft <sup>2</sup> yr
Annual Cooling Demand	5.5	kBtu/ft <sup>2</sup> yr
Peak Heating Load	7.9	Btu/ft <sup>2</sup> hr
Peak Cooling Load	2.5	Btu/ft <sup>2</sup> hr
Source Energy Criteria		
Phius CORE	3775	kWh/person.yr
Phius ZERO	0	kWh/person.yr

Phius 2024 New Construction* Performance Criteria Calculator v24.1		
UNITS:	IMPERIAL (IP) ▾	
BUILDING FUNCTION:	RESIDENTIAL ▾	
STATE / PROVINCE	TEXAS ▾	
CITY	AUSTIN MUELLER MUNI ▾	
ASHRAE 169 Climate Zone	2A	
Envelope Area (ft <sup>2</sup> )	3,750.0	
iCFA (ft <sup>2</sup> )	1,500.0	
Dwelling Units (Count)	1	
Total Bedrooms (Count)	4	
Space Conditioning Criteria		
Annual Heating Demand	3.3	kBtu/ft <sup>2</sup> yr
Annual Cooling Demand	17.0	kBtu/ft <sup>2</sup> yr
Peak Heating Load	4.6	Btu/ft <sup>2</sup> hr
Peak Cooling Load	3.7	Btu/ft <sup>2</sup> hr
Source Energy Criteria		
Phius CORE	3775	kWh/person.yr
Phius ZERO	0	kWh/person.yr

# Phius Standard Framework

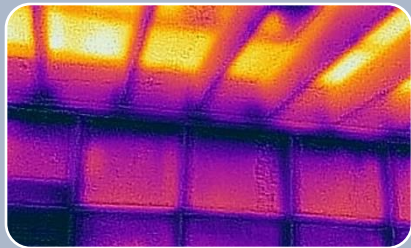
REQUIREMENTS FOR ALL  
PHIUS CERTIFICATIONS



SPACE CONDITIONING TARGETS/LIMITS



AIR-TIGHTNESS



QUALITY ELEMENTS + QA TESTING &  
INSPECTION

VARIABLES



NET SOURCE ENERGY TARGET

What is an ***acceptable*** level of air leakage, based on building durability?



# AIR-TIGHTNESS

**TARGET SET BASED ON BUILDING DURABILITY - PASS/FAIL BLOWER DOOR TEST**

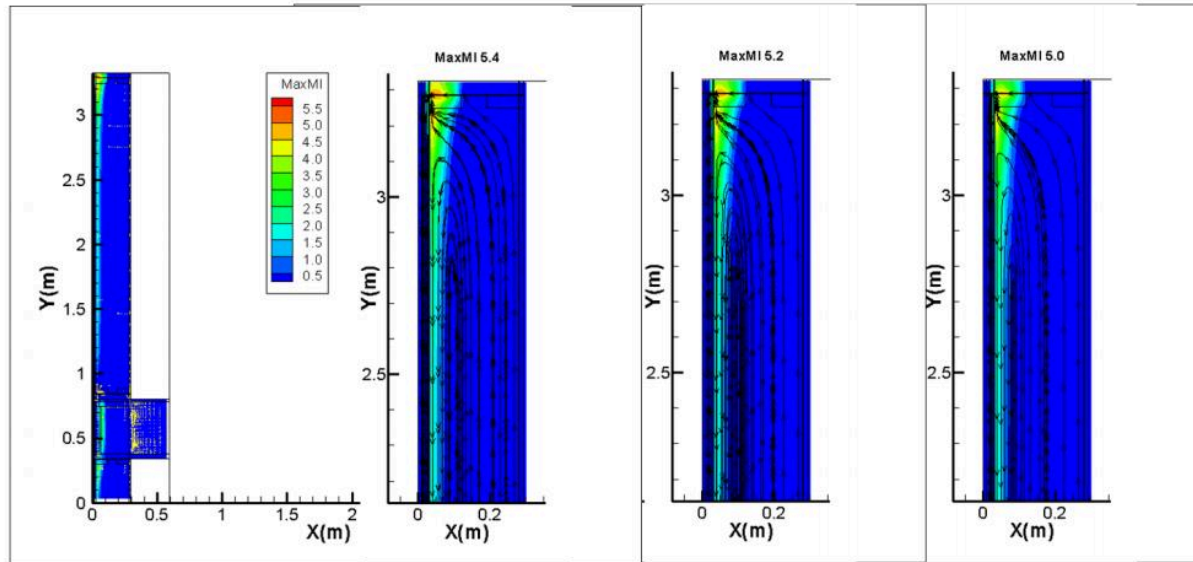


Figure 10. Predicted Mold Index at air tightness ratings 0.01, 0.02 and 0.04 cfm/sqft (left to right). Whole assembly for maximum mold index. Houston, TX.

**Performance Path Requirement\***  
**0.06 CFM<sub>50</sub>/ft<sup>2</sup> enclosure area**

*\*0.08 CFM<sub>50</sub>/ft<sup>2</sup> for buildings 5+ stories of non-combustible construction*

**0.04 CFM<sub>50</sub>/ft<sup>2</sup> for single family prescriptive path**

Testing Protocol: ANSI/RESNET/ICC 380-2016

Must complete a pressurization and depressurization test, use average.

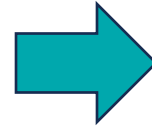


# AIR-TIGHTNESS

**Requirement**  
*0.06 CFM<sub>50</sub>/ft<sup>2</sup> enclosure area*



**Resulting “ACH50”  
requirement scales  
based on building size**



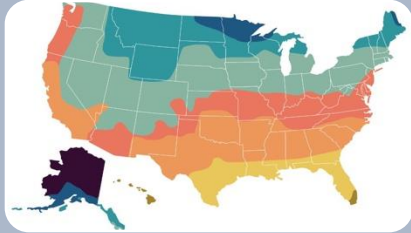
**~1.0-1.5  
ACH50**



**~0.4 - 1.0  
ACH50**

# Phius Standard Framework

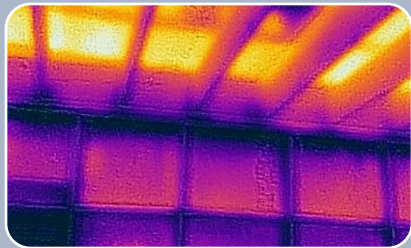
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SPACE CONDITIONING TARGETS/LIMITS



AIR-TIGHTNESS



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VARIABLES



NET SOURCE ENERGY TARGET

When do you **stop with**  
**conservation measures** (*passive*  
*and active*)...

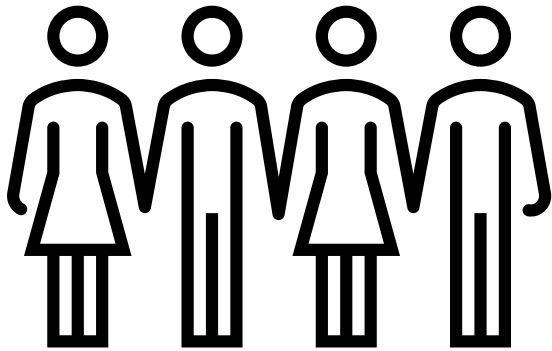
**and turn to renewable energy**  
to get to ZERO?

# Source Energy Limit

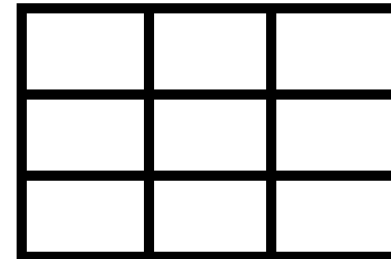


**After passive load reduction, utilize active conservation measures for even more savings:**

- Improved heating/cooling system efficiency
- Improved water heating efficiency
- Efficient appliances, lighting, etc.



**Residential = per person limit**



**Non-residential = per square foot limit**

# The Path to ZERO

**Phius CORE:** Targeting the sweet spot for on-site conservation through passive and active strategies

**Phius ZERO:** Targeting annual net zero operational energy



**BASELINE**  
(Building Code)

**PASSIVE BUILDING**

**RENEWABLES**





# Renewable Energy for CORE and ZERO

**On-site only for CORE**  
**Offsite options for ZERO**

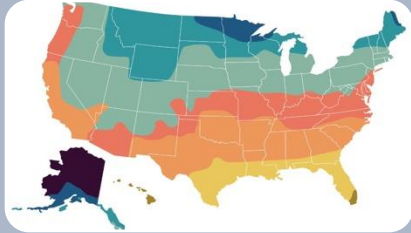


**Table N-4.2.0: Multipliers for Renewable Energy Procurement Methods**

Location	Renewable Energy Source	Renewable Energy Adjustment Factor	
		CORE	ZERO
On-Site	On-Site Renewable Energy System	Varies <sup>70</sup>	1.00
Off-Site	Directly Owned Off-Site Renewable Energy System	N/A	0.75
	Community Renewable Energy System	N/A	0.75
	Virtual PPA	N/A	0.75
	Green-e RECs	N/A	0.20

# Phius Standard Framework

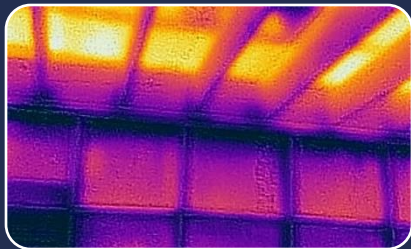
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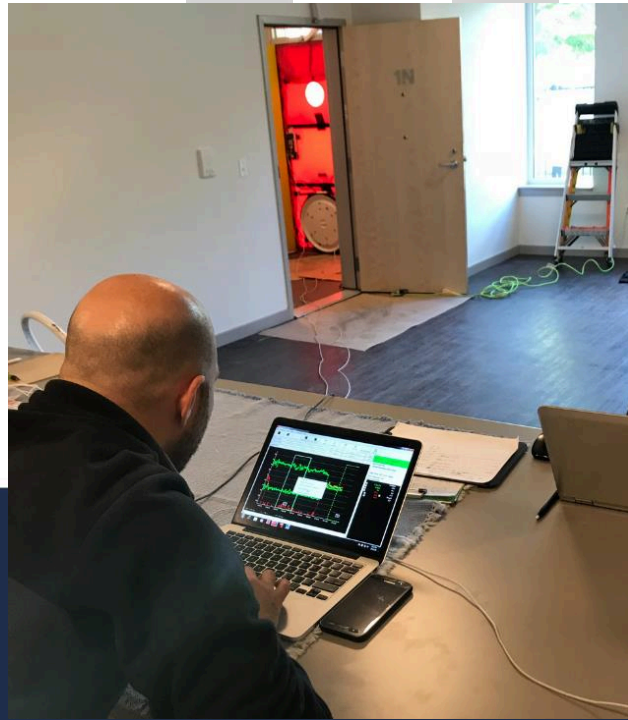
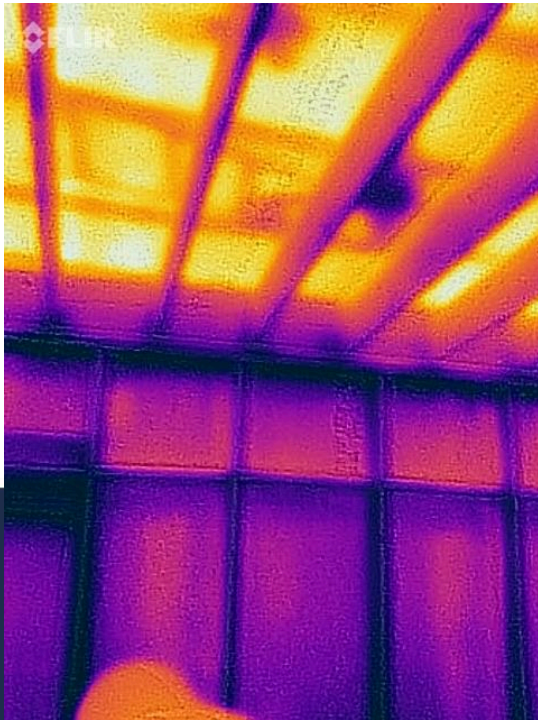


NET SOURCE ENERGY TARGET

How do we **ensure quality**  
construction and verification  
throughout the process?

# 3<sup>rd</sup> Party On Site Verification Process

Critical quality inspections by Phius Certified Rater or Verifier throughout construction process



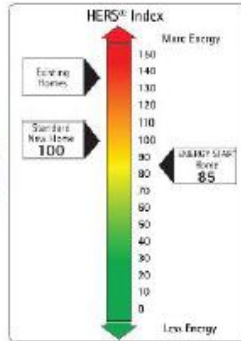
## Based on:

- EPA ENERGY STAR
- EPA Indoor airPLUS
- DOE Zero Energy Ready Home



# US Department of Energy

## HIGH PERFORMANCE STAIRCASE



	HVAC QI w/WHV	HVAC QI w/WHV	HVAC QI w/WHV
	Water Management	Water Management	Water Management
	Independent HERS Verification	Independent HERS Verification	Independent HERS Verification
IECC 2012 Enclosure	IECC 2012 Enclosure	IECC 2012 Enclosure	IECC 2015/18 Encl./ES Win.
HERS 70-80	HERS 60-70	HERS 50-60	HERS 35-45
IECC 2012	ENERGY STAR v3	ENERGY STAR v3.1	ZERH

SOLAR READY Depends on climate
Eff. Comps. & H2O Distrib
EPA Indoor airPLUS VI
Ducts in Condit. Space

	Renewable Energy to Get to Zero
Electrification Readiness	No Fossil-Fuel Combustion On-Site
Electric Vehicle Readiness	Electric Vehicle Readiness
Balanced Ventilation HRV/ERV	Balanced Ventilation HRV/ERV
SOLAR READY ALWAYS	SOLAR READY ALWAYS
Eff. Comps. & H2O Distrib	Eff. Comps. & H2O Distrib
EPA Indoor airPLUS VI	EPA Indoor airPLUS VI
Ducts in Condit. Space	Ducts in Condit. Space
Micro-load HVAC QI	Micro-load HVAC QI
Water Management	Water Management
Independent HERS Verification	Independent HERS Verification
Ultra-Efficient Enclosure	Ultra-Efficient Enclosure
HERS 30-40	HERS < 0
phius CORE	phius ZERO

What are other **best practice quality-related** elements that do not show up in the energy assessment?

# Window Comfort

(& Condensation Risk Assessment)



## Maximum U-Value Allowed Based on:

- Window Height
- Climate

See [Calculator](#) & [Webinar](#)

### Phius Window Comfort & Condensation Risk Assessment Tool v3.6



Required input cells.	Requirement met.
Required dropdown menu inputs.	Requirement not met.
Calculated from another sheet.	Threshold

Project Name

Test

Project #

4-digit Phius Project Number

Window Label

Manufacturer\_Product Type

State

ILLINOIS

Climate Location

CHICAGO OHARE INTL AP

### COMFORT REQUIREMENTS

Applies to vertical fenestration in all project types.

For stacked windows, include the full height of all mullioned windows.

Windows >16' in height have the same U-value requirement as 16' tall windows.

Window Vertical Height	10.0	ft
Required Whole Window U-value*	0.15	BTU/hr.ft <sup>2</sup> .F

\* Uninstalled whole window U-Value used. Do not include frame-to-wall psi-value for compliance.

### CONDENSATION RISK

ISO 13788: Low Thermal Inertia Elements

Input Data:  Class 2 typical	Fenestration Type	Any other type of fenestrati
	Input humidity class here	2. Dwellings / Office
	Frame U-Value	0.25 BTU/hr.ft <sup>2</sup> .F
	Safety Factor	15%
Result:	Risk acceptably low?	YES (Pass)

# Appropriate Moisture Design in Assemblies



## Three options for compliance:

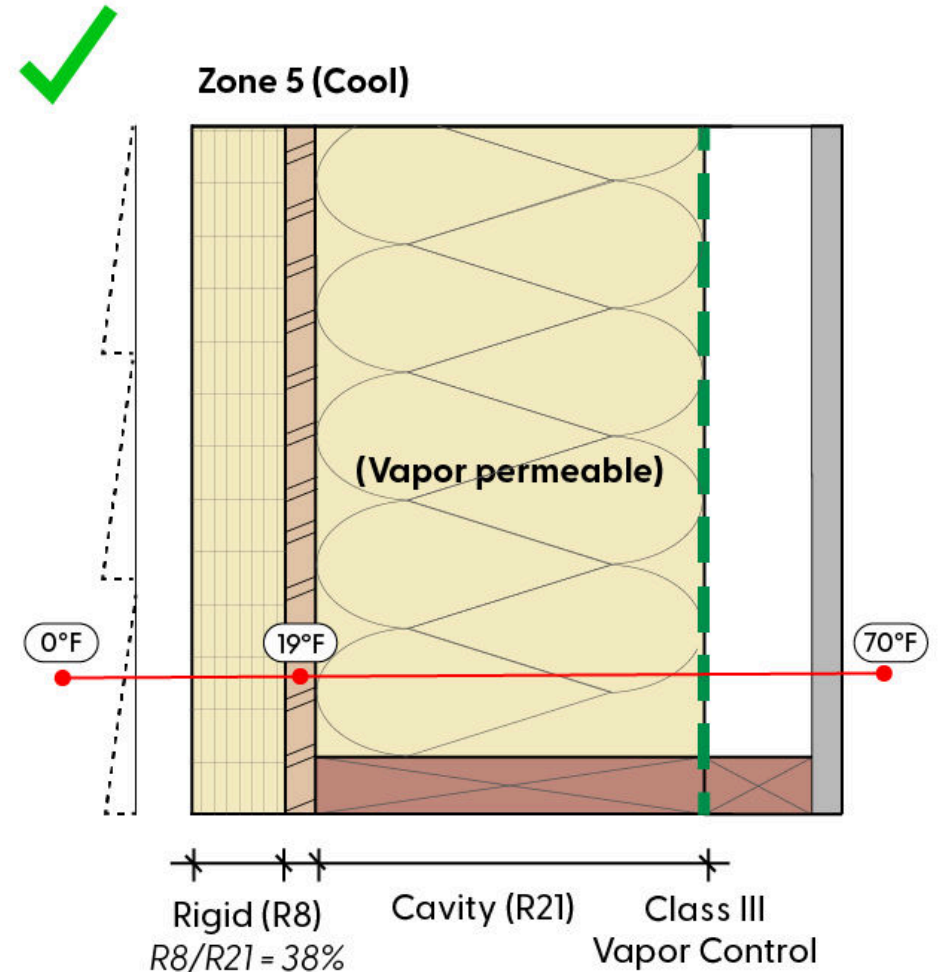
1. Follow prescriptive requirements in Guidebook Appendix B
2. Pass by simulation in WUFI Pro
3. Sign off by professional engineer

### Appendix B - Opaque Assembly Moisture Control Guidelines

*Excerpted from Straube (2012), Section 3.4.1, with revisions.*

Vapor control requirements vary by assembly type. Higher insulation value leads to colder exterior surfaces and less heat available to evaporate water in the assemblies.<sup>57</sup>

### B-1 General Moisture Control Guidelines

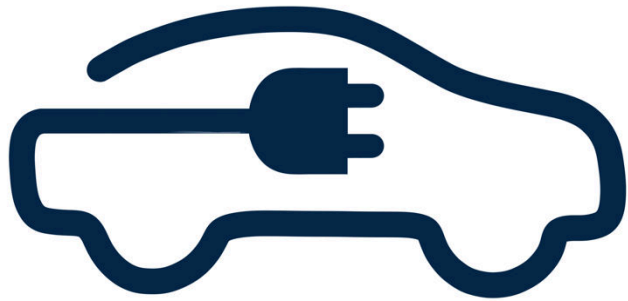


How do we push **even further**  
toward **decarbonization**?

# ELECTRIC VEHICLE READINESS

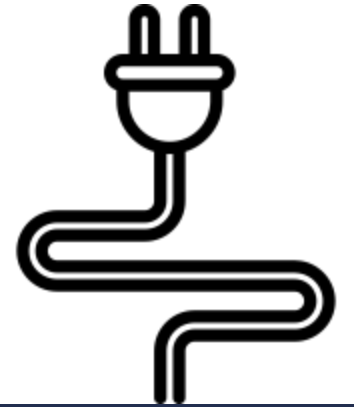
# COMBUSTION AND ELECTRIFICATION

***Required for all  
Residential Phius  
projects  
(if parking is planned)***



## ***Phius CORE***

*On-Site Combustion OK,  
BUT Electrification Readiness  
required*



## ***Phius CORE Prescriptive & Phius ZERO***

*No fossil fuel combustion allowed*



**Bringing it all together**

**Passive to ZERO**

# *Phius ZERO*

*Certification Framework*

Offsite RE

***ZERO Net Source Energy Target***

Onsite  
Renewable  
Energy

## *Phius CORE*

***CORE Net Source Energy Target***

Active Conservation  
Strategies

***Space Conditioning Demand & Load  
Targets***

Passive Conservation  
Strategies

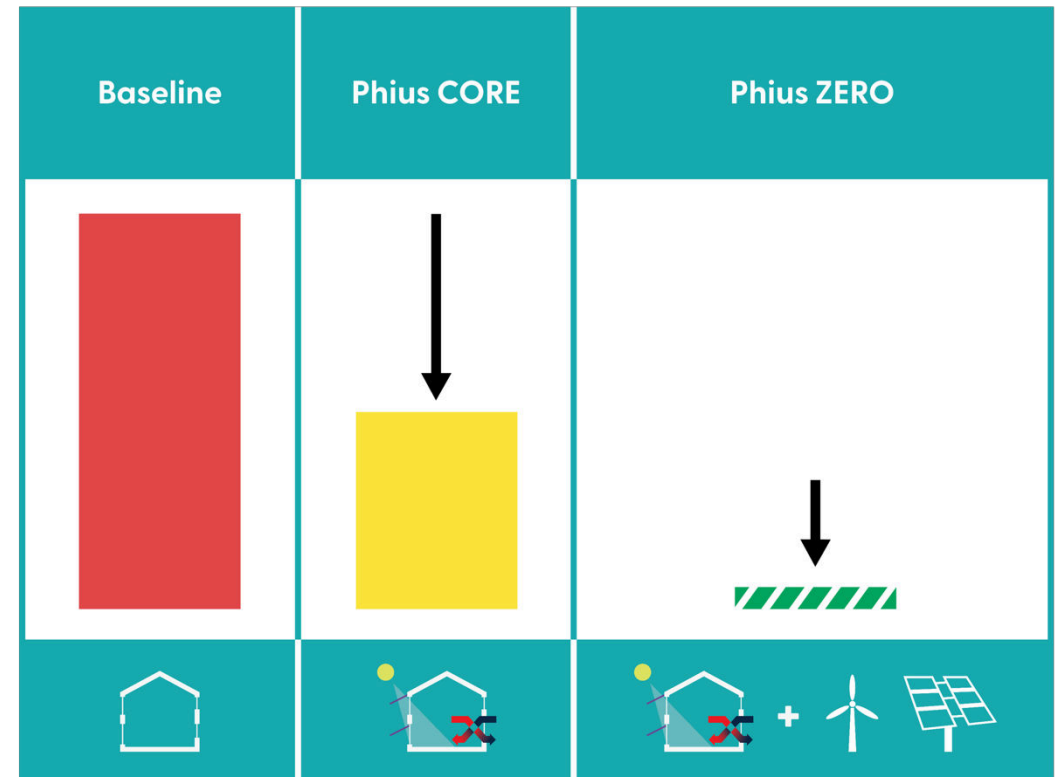
Quality, Health, Durability, Safety

***Air-Tightness  
Moisture Control Requirements  
3rd Party Pre-Requisite Programs***

# First Passive, then Zero

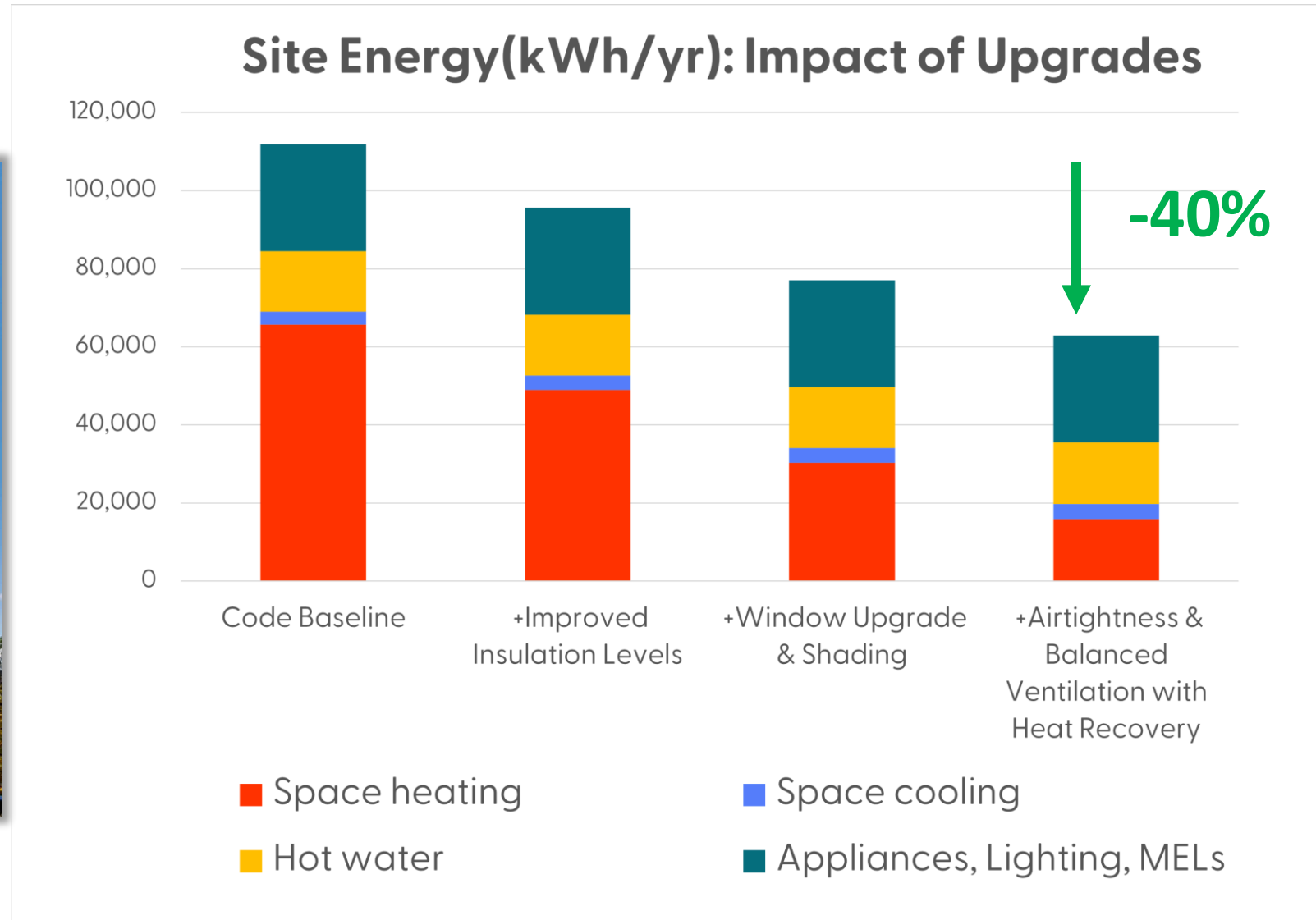
**Step 1 - Conservation** - first through passive measures, then through active measures.

**Step 2 - Renewable Energy** - On-site or off-site renewable energy to offset remaining energy use.



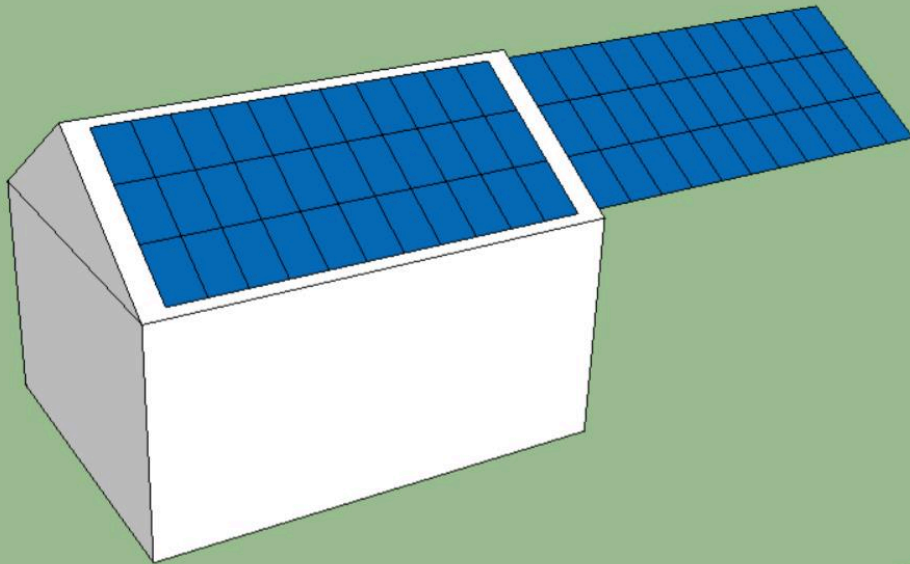
Conservation efforts up-front are critical for facilitating more renewables onto the grid. With reduced loads, less renewable energy is needed, and less grid support is needed when the building isn't powered by renewable energy production.

# Sample 3-Flat in Chicago → Upgrade from Code Baseline

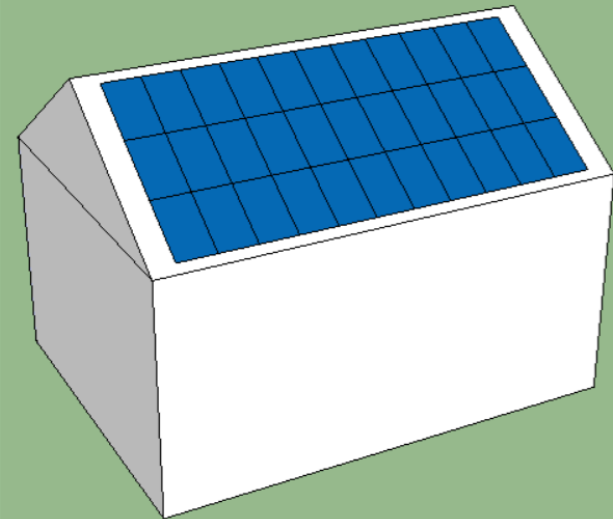


# Sample Project: Rooftop PV Required for Net Zero

**CODE BUILDING**



**PHIUS COMPLIANT**



**-40%**

An alternate approach for  
**Phius CORE...**  
for single family homes

***Phius CORE Prescriptive***

# Prescriptive Path

## Certification Framework

### Phius CORE

Active Conservation Strategies

**Prescriptive Rules on Equipment & Appliances**

Passive Conservation Strategies

**Prescriptive Rules on Passive Measures**

Quality, Health, Durability, Safety

**Air-Tightness  
Moisture Control Requirements  
3rd Party Pre-Requisite Programs**

# Phius & LEED v5 for Design & Construction



Energy & Atmosphere		33	27
Prereq	Operational Carbon Projection and Decarbonization Plan	Required	Required
→ Prereq	Minimum Energy Efficiency	Required	Required
Prereq	Fundamental Commissioning	Required	Required
Prereq	Energy Metering and Reporting	Required	Required
Prereq	Fundamental Refrigerant Management	Required	Required
→ Credit	Electrification	5	4
→ Credit	Reduce Peak Thermal Loads	5	5
→ Credit	Enhanced Energy Efficiency	10	7
→ Credit	Renewable Energy	5	4
Credit	Enhanced Commissioning	4	3
Credit	Grid Interactive	2	2
Credit	Enhanced Refrigerant Management	2	2

Location & Transportation		15	15
Credit	Sensitive Land Protection	1	1
Credit	Equitable Development	2	2
Credit	Compact and Connected Development	6	6
Credit	Transportation Demand Management	4	4
→ Credit	Electric Vehicles	2	2

Water Efficiency		9	8
Prereq	Water Metering and Reporting	Required	Required
→ Prereq	Minimum Water Efficiency	Required	Required
Credit	Water Metering and Leak Detection	1	1
→ Credit	Enhanced Water Efficiency	8	7

Indoor Environmental Quality		13	11
Prereq	Construction Management	Required	Required
→ Prereq	Fundamental Air Quality	Required	Required
Prereq	No Smoking or Vehicle Idling	Required	Required
Credit	Enhanced Air Quality	1	1
Credit	Occupant Experience	7	7
Credit	Accessibility and Inclusion	1	1
→ Credit	Resilient Spaces	2	2
Credit	Air Quality Testing and Monitoring	2	-

→ Directly Supports

→ Complements

Images Source: Introduction to LEED v5 for Design and Construction course: [usgbc.org/education/sessions/introduction-lead-v5-design-and-construction-12857116](https://usgbc.org/education/sessions/introduction-lead-v5-design-and-construction-12857116)



# THE CERTIFICATION PROCESS

*putting the standards into practice*





# Assembling a Team



## DESIGN

- Highly recommended
- Involved Early
- Energy Modeler
- Verifies compliance throughout design
- Corresponds with Phius

## CONSTRUCTION

- Highly recommended
- Maintains quality and oversight

- Required
- Early involvement recommended
- Site visits/inspections
- Verifies compliance at final construction
- Corresponds with Phius

\*Rater - single family and small multifamily

\*Verifier - non-residential and large multifamily



# Quality-Assured Certification Process

## DESIGN CERTIFICATION

- Energy model (or checklist) to verify compliance
- Review by Phius Certification Team
- Iterative feedback process



---

## FINAL CERTIFICATION

- Inspection throughout construction by Phius Certified Rater / Verifier (3<sup>rd</sup> Party)
- Documentation review by Phius Certification Team
- Match energy model to “as-built” conditions



Phius QA/QC workbook

# Certification Process



## Phase 0

### Feasibility Study

- Determine if certification is feasible for the project

The image displays three overlapping spreadsheets from a software tool, likely eQuest, used for energy modeling and LEED certification analysis. The spreadsheets are titled 'Project Name: St. Joseph School' and are organized into three columns representing different design cases: 'Proposed Design (Case 1)', 'PHUS+ 2016 (Case 2)', and 'PHUS+ 2016 (Case 3)'. Each spreadsheet contains a detailed breakdown of energy use, including sections for 'Electric System', 'Lighting', 'HVAC', 'Mechanical System', and 'Energy Summary'. The data is presented in a grid format with various metrics, units, and values. At the bottom of each spreadsheet, there are several charts and graphs, including 'WITHOUT PV' and 'WITH PV' scenarios, which show energy usage over time or across different systems. The overall layout is complex and technical, typical of a professional engineering or architectural software output.

# Certification Process



**Phase 1**  
Paperwork

## **Inquiry**

- Project team requests a quote, invoice & contract.

## **Registration**

- Invoice paid, contract signed, project number created.

The project is now publicly visible on phius' project database. A project DropBox folder is shared with the design team.

**Pre-Design  
(PD)  
or  
Schematic Design  
(SD)**

**Milestone 1**  
Project Registered

# Certification Process



## Phase 2 Design

## Milestone 2 Design Certification

### Design Review

- CPHC Upload
- phius Review & Feedback
- CPHC Response
- Repeat

The design is certified by phius. An official letter of design certification will be sent to the design team.

**Design Development  
(DD)  
&  
Construction Drawings  
(CD)**

**Bidding & Procurement**

# Certification Process



**Phase 3**  
Construction

**Milestone 3**  
Final Certification

## Onsite Review

- Rater/Verifier performs site visits.

## Final Review

- Rater/Verifier Upload
- phius Review & Feedback
- Rater/Verifier Response
- Repeat

The as-built project is certified by phius. A plaque and certificate will be sent to the project team.

**Construction  
Administration  
(CA)  
&  
Commissioning  
(Cx)**

**Post-Construction  
(PC)**



# Final Certification Contingent on:

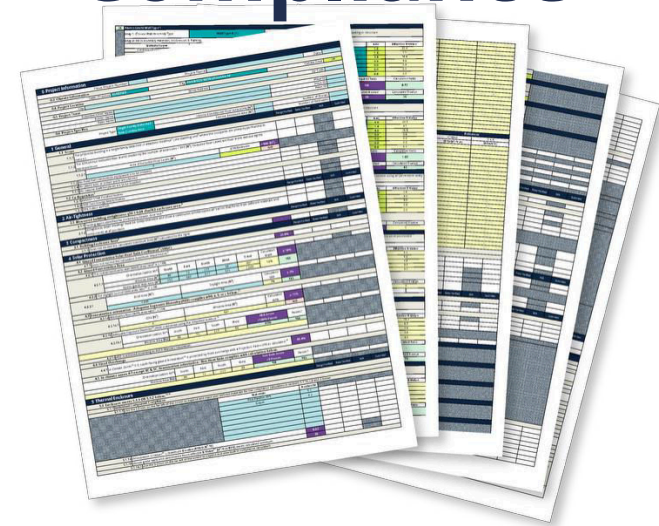
**(1) Modeled Performance**



 **WUFI® Passive modeling software**

**OR**

**(2) Prescriptive Checklist Compliance**



**On-Site Quality Assurance, Testing, & Inspection**



**What about all of our  
existing buildings?**



# Phius REVIVE 2024 Framework

**REVIVE 2021**= Phius' legacy retrofit program

**REVIVE 2024**= Retrofit program out & in continued development

## New Framework:

1. **Phase in** a retrofit plan over time (optional)
2. Use **outage resilience** as the guiding principle for enclosure upgrades (*rather than cost optimization, how the existing program is framed*)
3. Do this at the best life-cycle cost, including cost of carbon, operating and embodied. (**ADORB** cost)

# Policy & Program Expansion



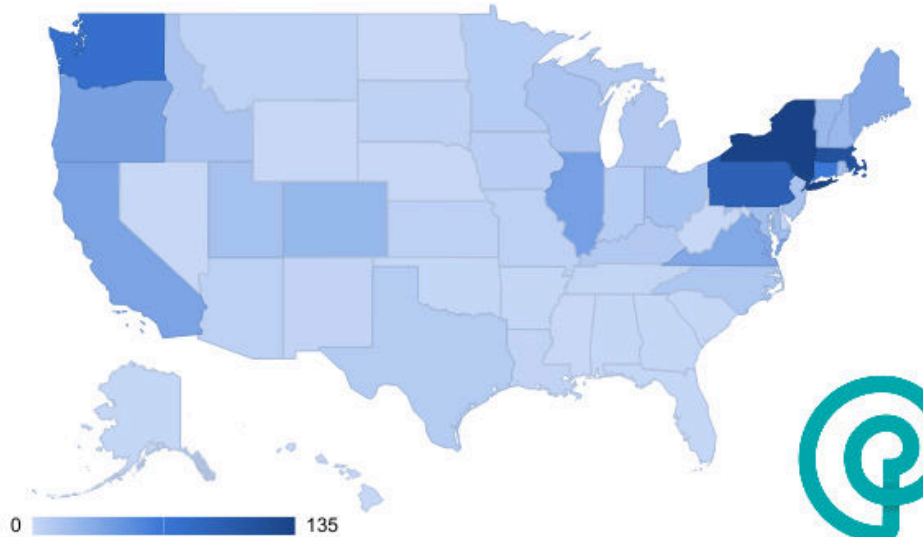
# Phius Project Statistics (Total Registered)



**32 million square feet total projects**



**33k dwelling units**



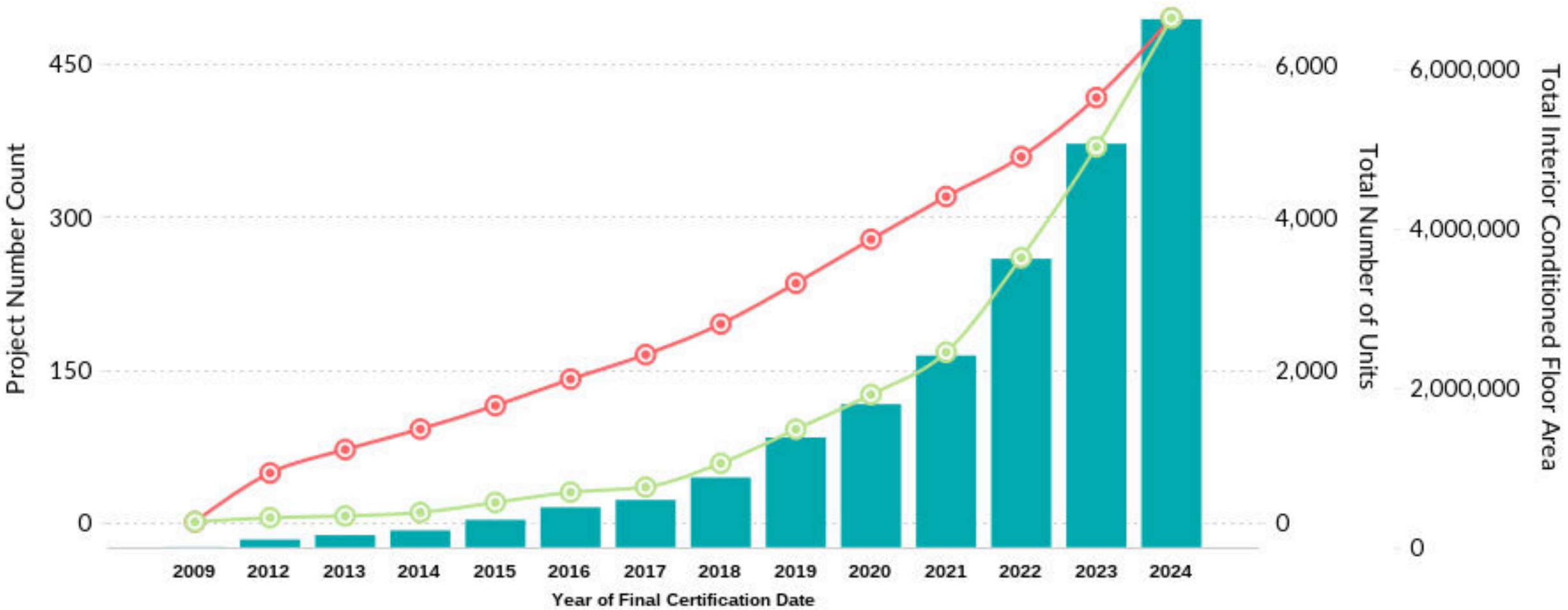
**+ 0 to 10% additional cost**



**- 40 to 70% energy use**

# Phius Certified Project Growth

Project Number Count   Total Number of Units   Total Interior Conditioned Floor Area



# ASHRAE 227P Passive Building Design Standard



BSR/ASHRAE Standard 227P

## Public Review Draft Passive Building Design

**Advisory Public Review (September 2023)  
(Draft Shows Complete Proposed New Standard)**

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at [www.ashrae.org/standards-research-technology/public-review-drafts](http://www.ashrae.org/standards-research-technology/public-review-drafts) and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at [www.ashrae.org/bookstore](http://www.ashrae.org/bookstore) or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

The appearance of any technical data or editorial material in this public review document does not constitute endorsement, warranty, or guaranty by ASHRAE of any product, service, process, procedure, or design, and ASHRAE expressly disclaims such.

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**ASHRAE, 180 Technology Parkway Peachtree Corners, GA 30092**



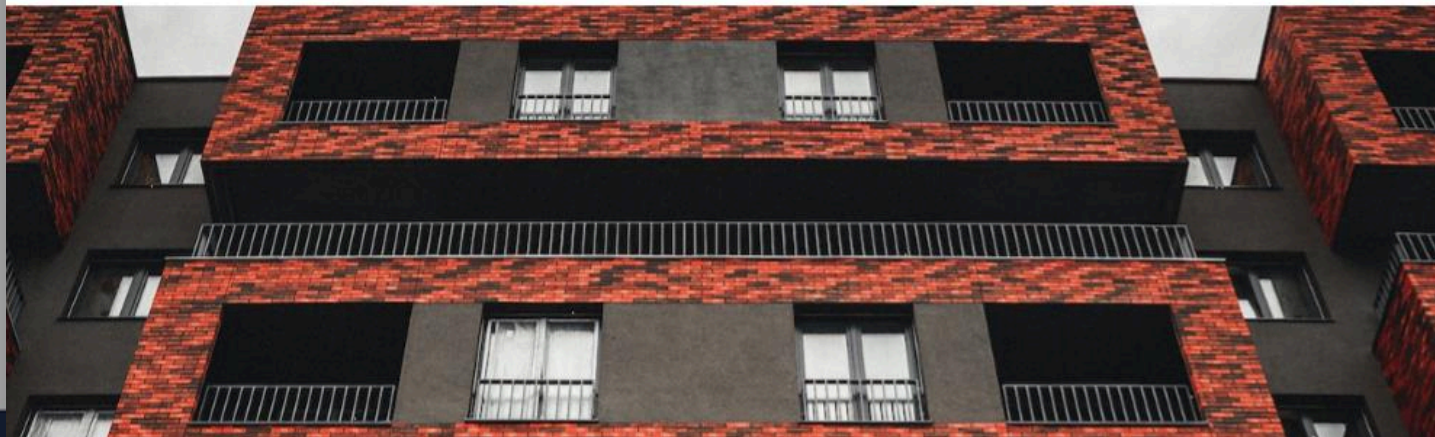
# Massachusetts Opt-In Stretch Code

MULTIFAMILY HOUSING

## Boston's new stretch code requires new multifamily structures to meet Passive House building requirements

Phius certifications are expected to increase with tougher green building standards.

BY PETER FABRIS, CONTRIBUTING EDITOR | MAY 30, 2023



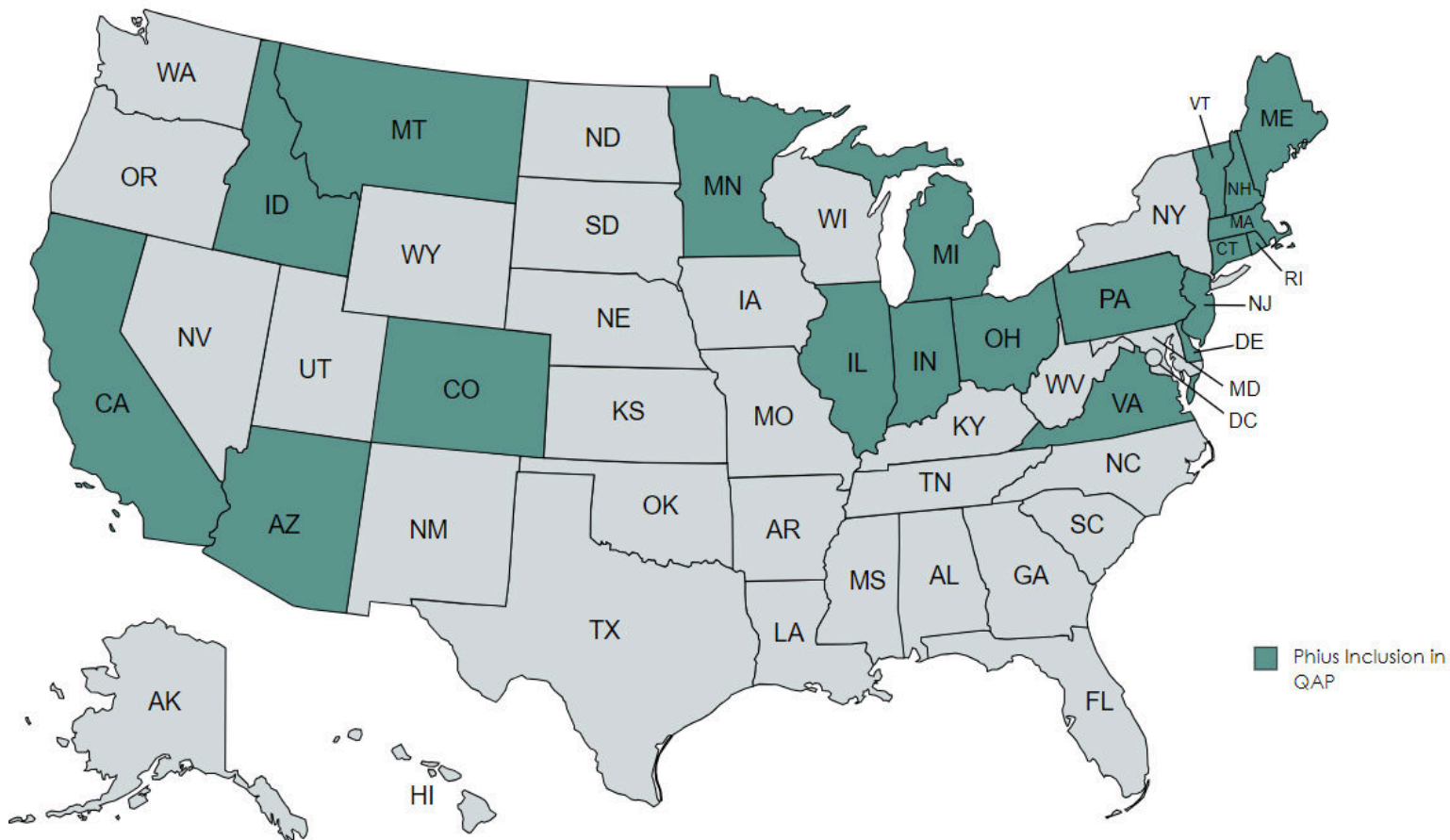
**ALL new multifamily buildings over 12,000 square feet must be passive!**

**51 jurisdictions (including Boston!) have opted in.**

**Most started as of Jan 1, 2024**



# Low Income Housing Tax Credits (LIHTC) Inclusion in Qualified Allocation Plans



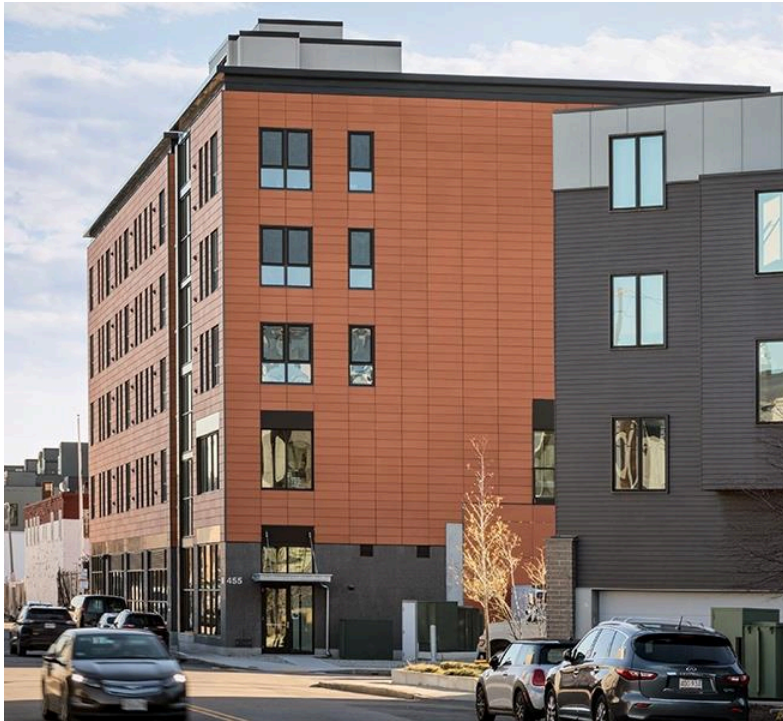
**22 States  
& Expanding!**

# Verified Performance + Cost Data

# Verified Performance

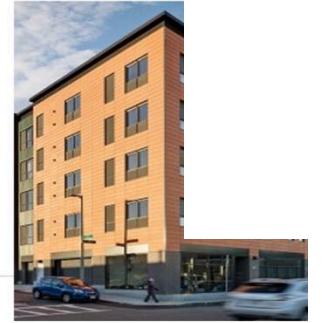
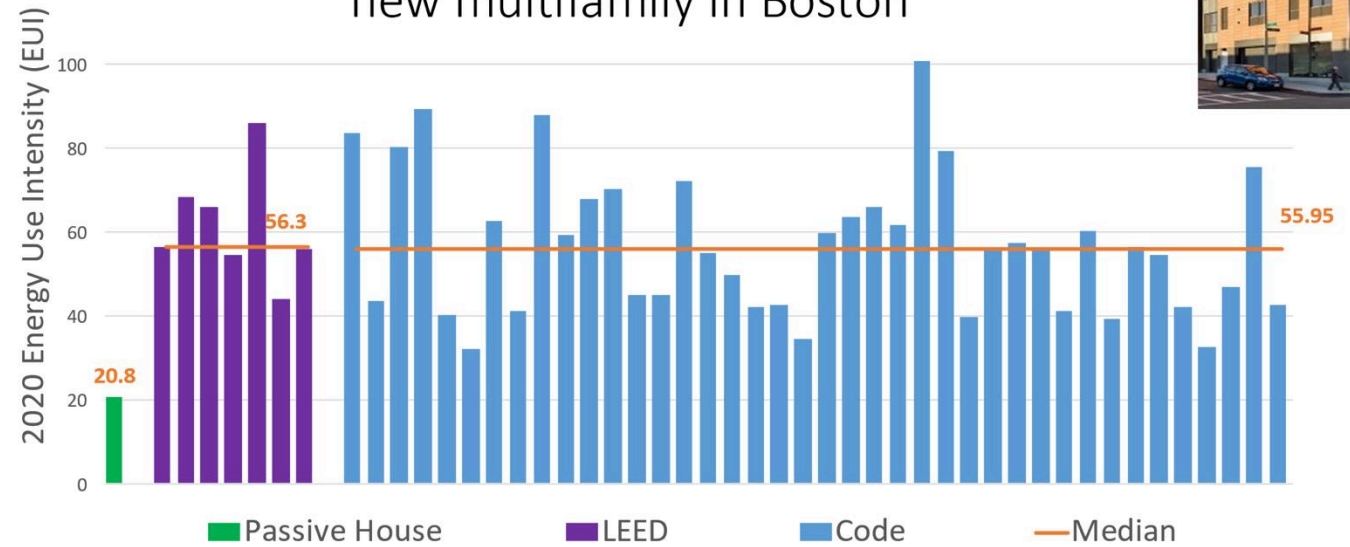
*Distillery North – South Boston, MA*

PHIUS+



## Performance: Distillery, Boston 2020

PH Uses 63% less energy per sq. ft. than median new multifamily in Boston

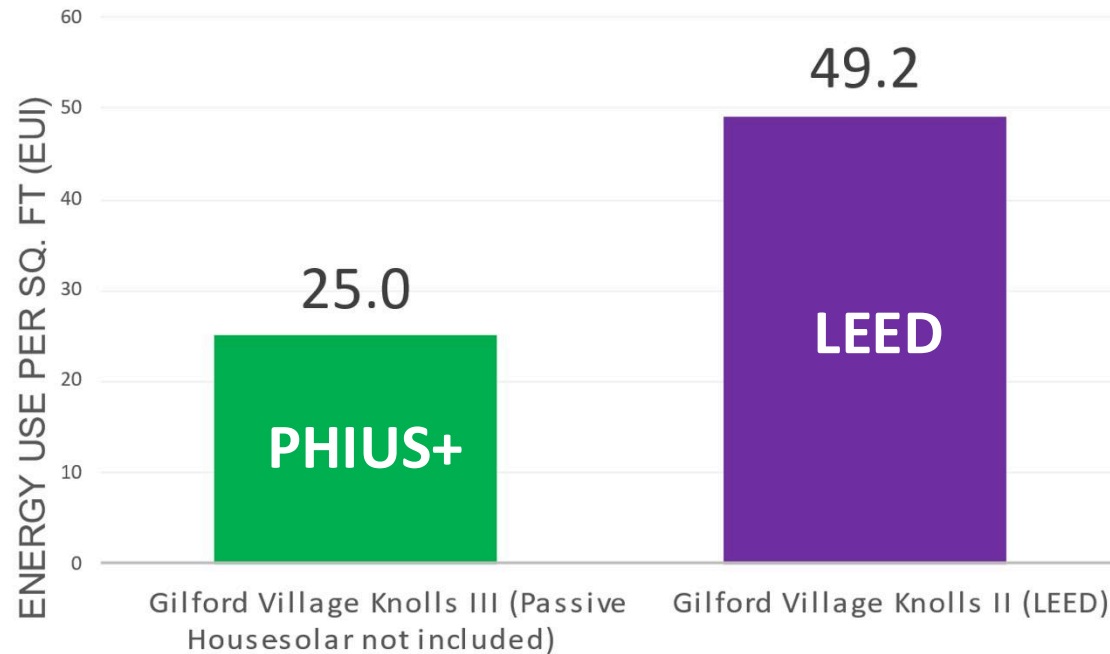


Data from Boston Energy Disclosure 2020 sorted for new construction multifamily built since 2008; Cross checked for LEED certification; properties with suspected lack of full building energy report are removed.

# Verified Performance

## *Gilford Village Knolls III – Gilford, NH*

**PH uses 49% less energy per sq. ft. than Gilford Village Knowles II LEED built 2008**  
(same building, different standard)

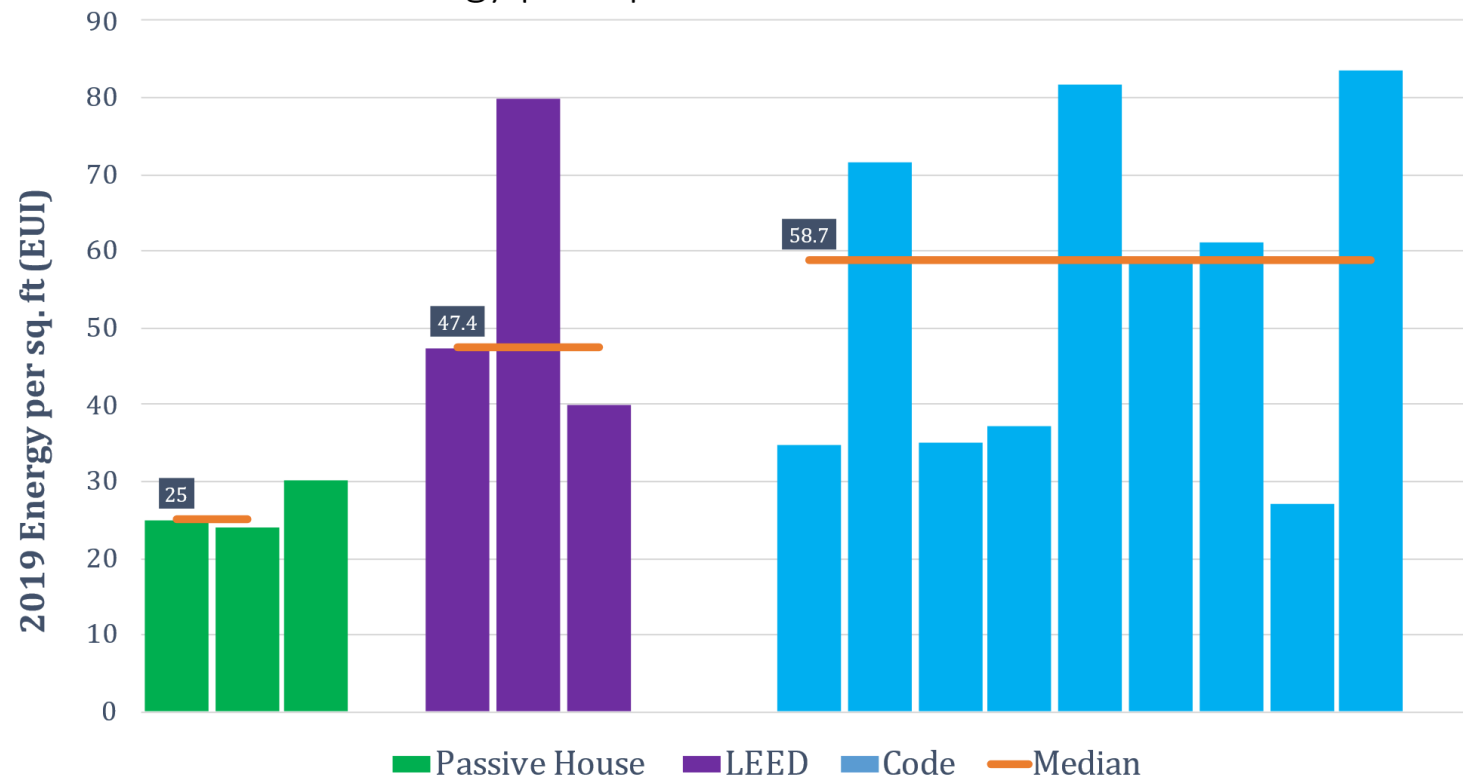


Graphic representation of study by Resilient Building Group (2020 Report of average 3 year energy usage data ending in 2019)

# Verified Performance - Philly

## PH Performance: Philadelphia 2019 Affordable

57% less energy per sq. ft. than Median Code Built



Data from Philadelphia Energy Disclosure 2019 cross checked for LIHTC multifamily; Credit to Green Building ~~United~~ Katie Ba

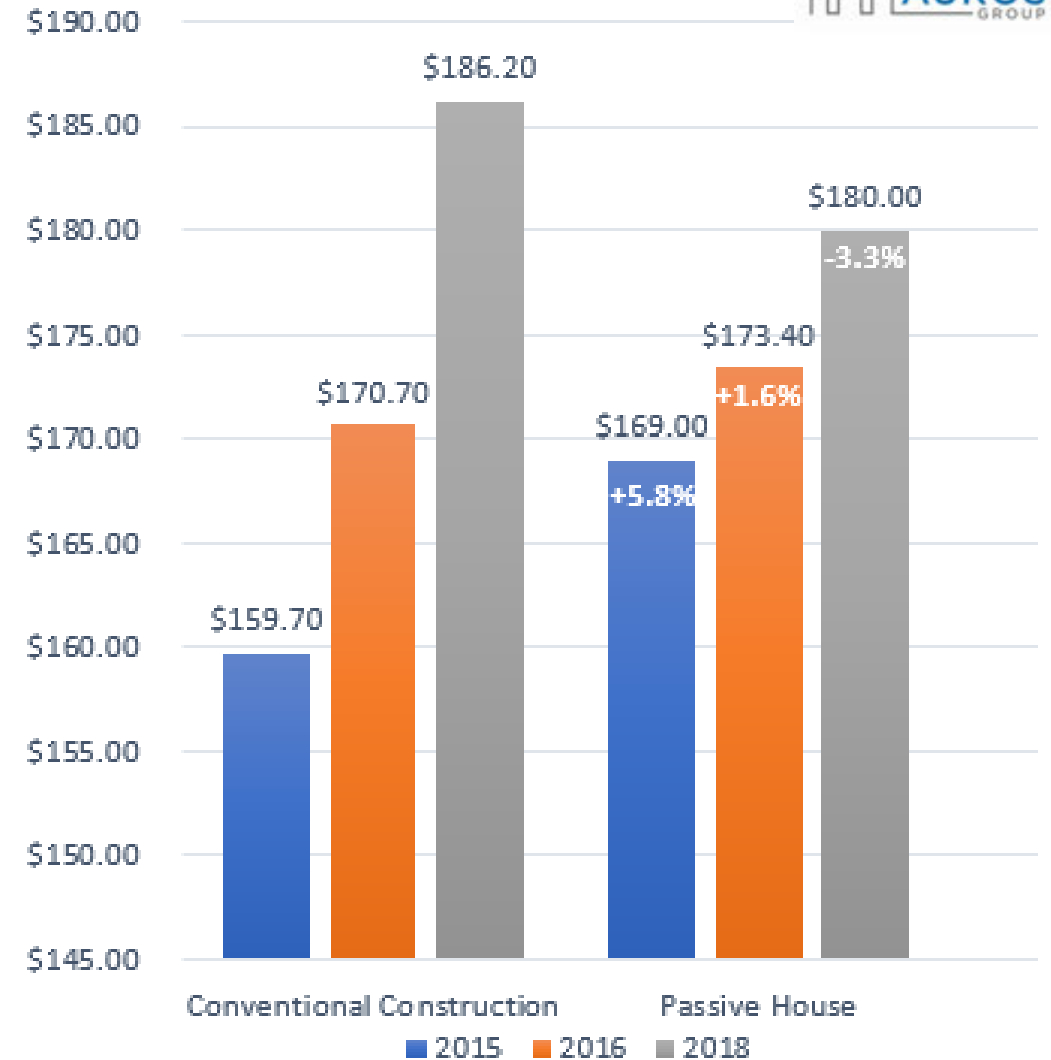
# Pennsylvania Housing Finance Agency

Passive costs less with *experience*

**First Year = +5.8%**  
**Second Year = +1.6%**  
**Fourth Year = -3.3%**

Source: "How a PA affordable housing agency is making ultra-efficient buildings mainstream" Pittsburgh Post-Gazette December 31, 2018 & PHFA

Note: Low-income housing tax credits were not awarded in 2017





# Village Center | Brewer, ME – CZ 6A



**+2.5% incremental cost**

**CHOM (Community Housing of Maine)**

**48 dwelling units**

**PHIUS+ 2015, Certified in 2016**



# Elm Place | Milton, VT – CZ 6A

## +2.14% incremental cost\*

- + Upgrading insulation, air sealing
- + Upgrading windows
- + Adding cold climate ASHP
- Hydronic heating system and cooling only ASHP

Project	Site EUI	Energy Cost
Elm Place	20.2 kBTU/ft <sup>2</sup> yr	\$20k/yr
Baseline* in Study	40.3 kBTU/ft <sup>2</sup> yr	\$28k/yr
RBES Code Building	54.5 kBTU/ft <sup>2</sup> yr	\$31k/yr

\*Baseline used ERVs



# Massachusetts Clean Energy Center (Mass CEC)

OWNER & PROJECT	LOCATION	UNITS	AWARD	INCREMENTAL COST
<a href="#"><u>Beacon Communities Old Colony Phase Three C</u></a>	South Boston	55	\$120,000	<a href="#"><u>3.5%</u></a>
<a href="#"><u>Community Builders North Commons</u></a>	Northampton	53	\$212,000	<a href="#"><u>4.3%</u></a>
<a href="#"><u>Homeowner's Rehab Inc.'s Finch Cambridge</u></a>	Cambridge	98	\$147,000	<a href="#"><u>1.4%</u></a>
<a href="#"><u>NeighborWorks Southern Mass's Holbrook Center Senior Housing</u></a>	Holbrook	72	\$131,200	<a href="#"><u>1.6%</u></a>
<a href="#"><u>NorthShore Community Development Corporation's Harbor Village</u></a>	Gloucester	30	\$120,000	<a href="#"><u>1.8%</u></a>
<a href="#"><u>Preservation for Affordable Housing Mattapan Station</u></a>	Mattapan	135	\$540,000	<a href="#"><u>2%</u></a>
<a href="#"><u>Preservation of Affordable Housing The Kenzi at Bartlett Station</u></a>	Roxbury	52	\$168,000	<a href="#"><u>1%</u></a>

# Finch Cambridge | Cambridge, MA - CZ 5A

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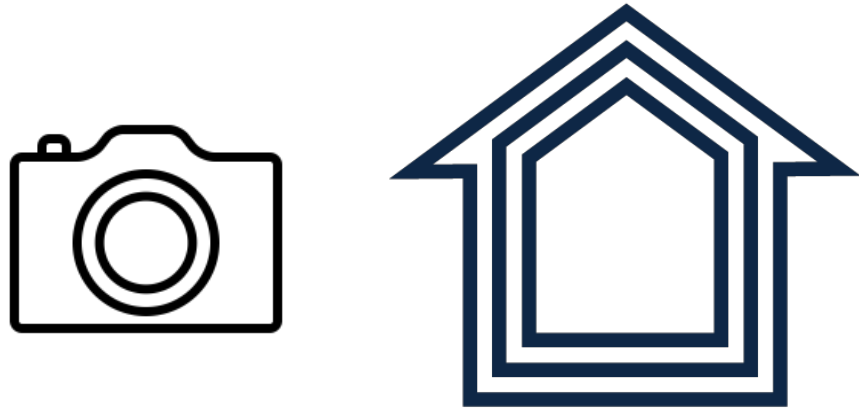
## **+1.4% incremental cost**

- + Balanced ventilation (28%)
- + Enclosure – insulation, doors (22%)
- + Upgrading windows (12%)
- + Air sealing (5%)
- + Sunshades (3%)
- + Soft Costs (28%)

# Key Tools & Resources




# Phius Prescriptive Path



**SNAPSHOT TOOL!**  
**Like a recipe for your passive project.**

### Phius CORE Prescriptive 2021 Snapshot

*Input or select data in teal cells*



State	UTAH
City	SALT LAKE CITY INT ARPT [!]
ASHRAE (169-2021) Climate Zone	5B
iCFA* (ft <sup>2</sup> )	2000
Number of Bedrooms*	4
Number of Stories	2

\*per dwelling unit

#### 1 General

1.1.2	iCFA divided by Number of Bedrooms <small>(Calculated Value based on Inputs)</small>	Maximum Limit	900	ft <sup>2</sup>
		OK, Meets Limit	500	ft <sup>2</sup>

#### 3 Compactness

3.1.1	Envelope Area <small>(Maximum Envelope to Floor Area Ratio)</small>	Maximum	5998	ft <sup>2</sup>
			3.00	

#### 4 Solar Protection

4.1.1	Whole Window SHGC	Maximum	NR	
4.4.1	Projection Factor for Fixed Overhangs	Minimum	NR	

#### 5 Thermal Enclosure

5.1.1a	Fenestration / Openings	Maximum Whole U-Value	0.18	(BTU/h.ft <sup>2</sup> .°F)
5.1.1b	Walls & Overhang Floors - Effective R-value	Minimum Effective R-Value	35	(ft <sup>2</sup> .°F.h/BTU)
5.1.1c	Roofs / Ceilings	Minimum Effective R-Value	66	(ft <sup>2</sup> .°F.h/BTU)
5.1.1d	Whole Slab Foundations, Below-Grade Walls, Floors of Conditioned Basements & Crawl Spaces	Minimum Effective R-Value	17	(ft <sup>2</sup> .°F.h/BTU)
5.1.1e	Ceilings of Unconditioned Basements or Crawl Spaces & Pier and Beam Floors	Minimum Effective R-Value	22	(ft <sup>2</sup> .°F.h/BTU)

#### 6 Moisture Risk Limitation

6.2.1	Fenestration Condensation Resistance	Minimum	61%	
-------	--------------------------------------	---------	-----	--

#### 7 Mechanical Ventilation

7.2.1	Sensible Recovery Efficiency, Heating Mode	Minimum	79%	
7.2.2	Total Recovery Efficiency, Cooling Mode	Minimum	NR	
7.2.5	Total Length of Fresh Air Ducts to Outside	Maximum	25	ft

#### 8 Mechanical Systems

*Select System Type*

8.2.1	Air Source Heat Pump	Minimum COP @ 5F	1.8	
		Minimum SEER	15.0	

## 5 Thermal Enclosure

5.1.1a	Fenestration / Openings	Maximum Whole U-Value	0.18	(BTU/h.ft <sup>2</sup> .°F)
5.1.1b	Walls & Overhang Floors - Effective R-value	Minimum Effective R-Value	35	(ft <sup>2</sup> .°F.h/BTU)
5.1.1c	Roofs / Ceilings	Minimum Effective R-Value	66	(ft <sup>2</sup> .°F.h/BTU)
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5.1.1e	Ceilings of Unconditioned Basements or Crawl Spaces & Pier and Beam Floors	Minimum Effective R-Value	22	(ft <sup>2</sup> .°F.h/BTU)

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## 8 Mechanical Systems

Select System Type

8.2.1	Air Source Heat Pump	Minimum COP @ 5F	1.8
		Minimum SEER	15.0



# Phius Certification Guidebook

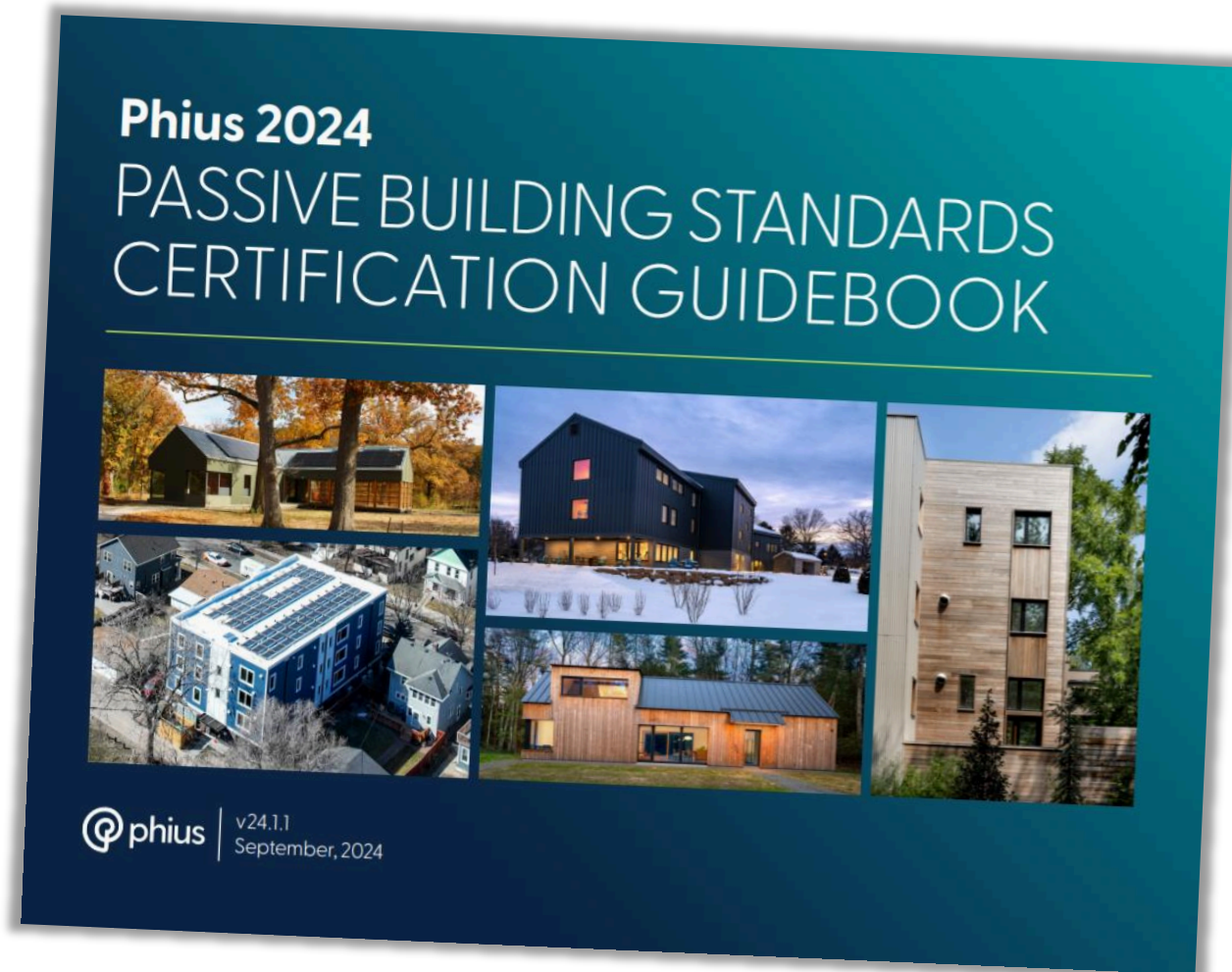
## Contains:

General Design Tips / Guidance

Certification Requirements

Step-by-Step WUFI Passive Energy Modeling Protocol

& much more!



## Certified Project Database

Q Search

SEARCH

### PROJECT TYPE

- Addition
- New Construction
- Retrofit

### BUILDING FUNCTION

- Dormitory
- Government / Public
- Hotel
- Mixed-Use
- Multifamily
- Office
- Other Non-Residential
- School / Education
- Single-Family

### LOCATION

- Canada
- United States
- Japan
- Mexico
- South Korea

### PROGRAM VERSION

Show all

### STATUS

Show all

### ASHRAE CLIMATE ZONES

Show all

Showing 1-10 of 655 results



#### 69 Hillside Avenue

Single-Family • Retrofit  
4A - Mixed - Humid

1713 sq. ft.

Completed 2020



#### Habitat for Humanity Columbia County - Ancramdale

Multifamily • New Construction  
5A - Cool - Humid

2788 sq. ft.

Completed 2020



#### Rolling Bay Passive

Single-Family • New Construction  
4C - Mixed - Marine

2342 sq. ft.



#### Susie Clemens House

Multifamily • New Construction  
4A - Mixed - Humid

5757 sq. ft.

Completed 2019

# Projects Database

<https://www.phius.org/certified-project-database>

## 1500 Projects

→ 580 Buildings Fully Certified

~8775 Dwelling Units

~9 Million Square Feet

→ 900 Buildings In Progress

## Database Filters by:

Type

Location

Climate Zone

Function

etc

# Phius Certified Window Database

www.phius.org/window-database

~1000 listings:

Metric / IP toggle!

Database Filters by:

Manufacturer

Whole Window U-Value

Solar Heat Gain Coef. (SHGC)

Climate Zone Rec.

Frame Material

# panes

etc

Window Database

SELECT PRODUCT TYPE

Windows Doors

Search windows

Showing 1–20 of 978 windows

MANUFACTURER	SERIES NAME	U-VALUE, WHOLE WINDOW	SHGC-COG	OPERATION TYPE	FRAME MATERIAL
Peerless Products Inc	<a href="#">Peerless Artovo Operable Window</a>	0.16 BTU/hr·ft <sup>2</sup> ·°F	0.260	Operable	Vinyl
Inline Fiberglass Ltd	<a href="#">Inline Series 325 Awning</a>	0.18 BTU/hr·ft <sup>2</sup> ·°F	0.407	Operable	Fiberglass
EnerLux Windows & Doors	<a href="#">EnerLux Low Profile Fixed Window</a>	0.20 BTU/hr·ft <sup>2</sup> ·°F	0.616	Fixed	Fiberglass
EnerLux Windows & Doors	<a href="#">EnerLux Fixed Casement Window</a>	0.16 BTU/hr·ft <sup>2</sup> ·°F	0.309	Fixed	Fiberglass
EnerLux Windows &	<a href="#">EnerLux Fixed</a>	0.23 BTU/hr·ft <sup>2</sup> ·°F	0.359	Fixed	Fiberglass

Clear all filters

Imperial Metric

MANUFACTURER

Choose manufacturer

U-VALUE, WHOLE WINDOW  
BTU/HR·FT<sup>2</sup>·°F

0.09 to 0.50

SHGC-COG

0.00 to 0.99

ASHRAE CLIMATE ZONES

Show all

OPERATION TYPE

Combination

Fixed

Operable

FRAME MATERIAL

# Phius Resource Library – 750+ listings

<https://www.phius.org/resource-library>

TOPIC

- Building Components
- Building Science
- Cost Data
- Embodied Carbon
- Energy Modeling
- Financing / Incentives
- Indoor Air Quality
- Mechanical Systems
- Microgrids / Grid-Interactive Buildings
- Passive Building
- Phius Standards
- Phius Updates
- Policy
- Product Certification
- Project Certification
- Renewable Energy
- Research
- Retrofit
- Selling Passive
- WUFI Passive / Plus / Pro
- Zero Energy

RESOURCE TYPE

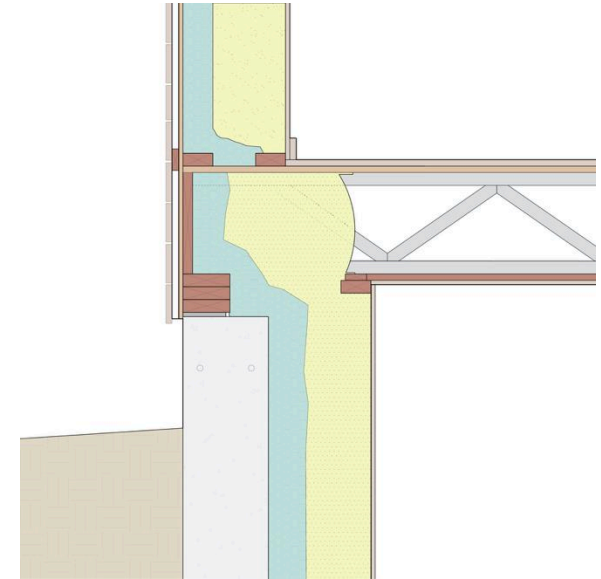
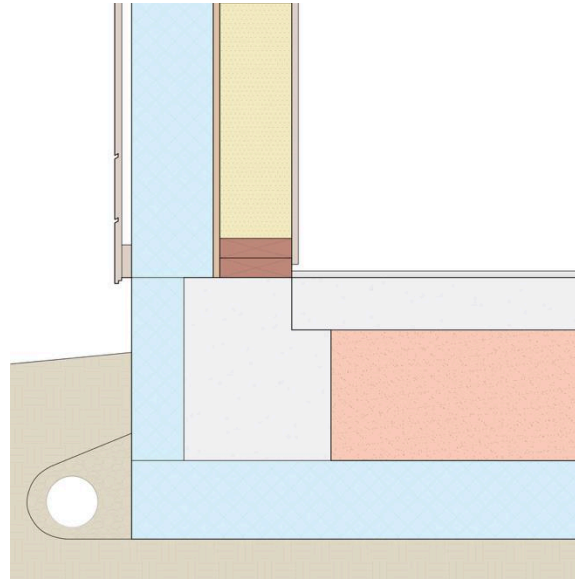
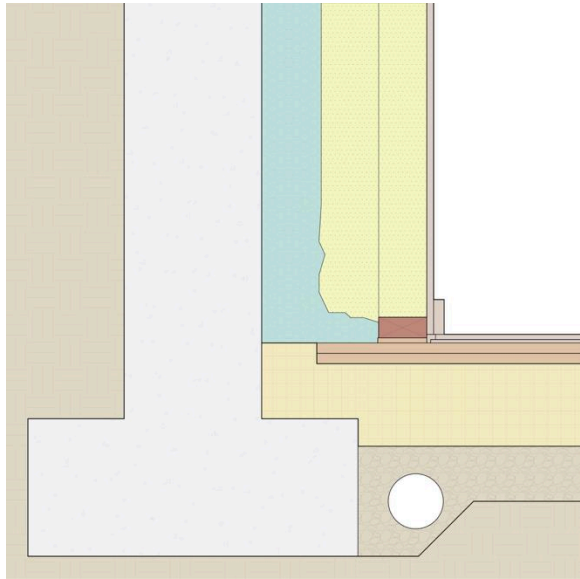
- Article/Paper
- Blog Post
- Calculator/Tool
- Case Study
- Graphic
- Modeling Protocol
- Podcast
- Presentation
- Tutorial
- Webinar
- Workbook

The screenshot shows the Phius Resource Library website. At the top, there is a navigation bar with links for 'Find a Professional', 'Partnerships', 'Klingenberg', 'Browse All Events', and 'PhiusCon'. On the right, there are buttons for 'Phius Alliance', 'JOIN', 'LOGIN', and 'DONATE'. Below the navigation bar, the Phius logo is displayed on the left, and a search bar with a 'SEARCH' button is on the right. The main heading 'Resource Library' is centered in a large, light blue font. Below the search bar, there is a section for 'Showing 1-10 of 538 results'. This section contains three resource cards: 1. 'ENERGY STAR Rebate Finder' (Calculator/Tool) with a sub-heading 'Find rebates for which you may be eligible.' and a date of 'September 26, 2022'. 2. 'Polsinelli Green Tax Incentive Compendium' (Calculator/Tool) with a sub-heading 'Find the federal and state tax incentives for which your project is eligible.' and a date of 'September 26, 2022'. 3. 'Inflation Reduction Act Savings Calculator' (Calculator/Tool) with a sub-heading 'Calculate how much money you can save on your project with the Rewiring America savings calculator.' and a date of 'September 26, 2022'. To the right of the third card is a small table with columns for 'Year', 'Energy Use', 'Savings', and 'Payback'. Below the resource cards, there is a 'CEU CREDITS' section with radio buttons for values: '<2', '2-5', '5-8', '8-12', and '>12'. On the left side of the screenshot, there is a sidebar with 'TOPIC' and 'RESOURCE TYPE' filters, which are partially obscured by the other panels.





# Online Details Library



# New Cloud-Based Energy Modeling Tool

similar to WUFI Passive – but faster and more integrated/connected

The screenshot displays the METr software interface. On the left, a 3D model of a multi-story building is shown with orientation labels: S, S-E, E, N-E, N, N-W, and W. The main window is divided into several panels:

- Project Panel:** Shows 'Case 1/1: Residential - P', 'Localization / Climate', 'PH cases', 'Building', 'Simulated zones', and 'Visualized'.
- Materials List:** A table with columns 'Nr' and 'Name'.

Nr	Name
1	Polysocyanurate Board
2	Concrete
3	Panel wall - R-1.25 / in
4	Above Grade Tower Wall (see su
5	XPS Core (heat cond.: 0,03 W/m
6	Concrete Brick
7	Concrete
8	Door - R-1 / in
9	CMU
10	Gypsum Board (1.4 per inch)
- Basic parameters:** Shows 'Thermal conductivity, dry, 10 C/50 F' and 'Color'.
- Status Panel:** Shows 'PH Calculation: Passive, 11/10/2023 2:09:50 PM, duration 9.1 sec.'
- Results Table:**

PH case: 1	Value	Chart
Heating demand	15.48 kWh/m <sup>2</sup> a	Bar chart (0-30)
Cooling demand	11.28 kWh/m <sup>2</sup> a	Bar chart (0-30)
Heating load	12.21 W/m <sup>2</sup>	Bar chart (0-60)
Cooling load	5.23 W/m <sup>2</sup>	Bar chart (0-20)
Source energy	3288 kWh/Person a	Bar chart (0-10000)
Site energy	66.6 kWh/m <sup>2</sup> a	Bar chart (0-10000)

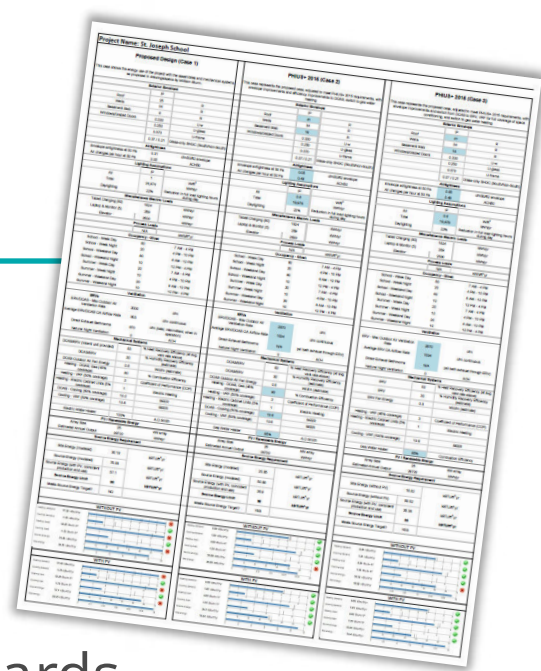


# Feasibility Study

**Turnaround:** 10-15 business days

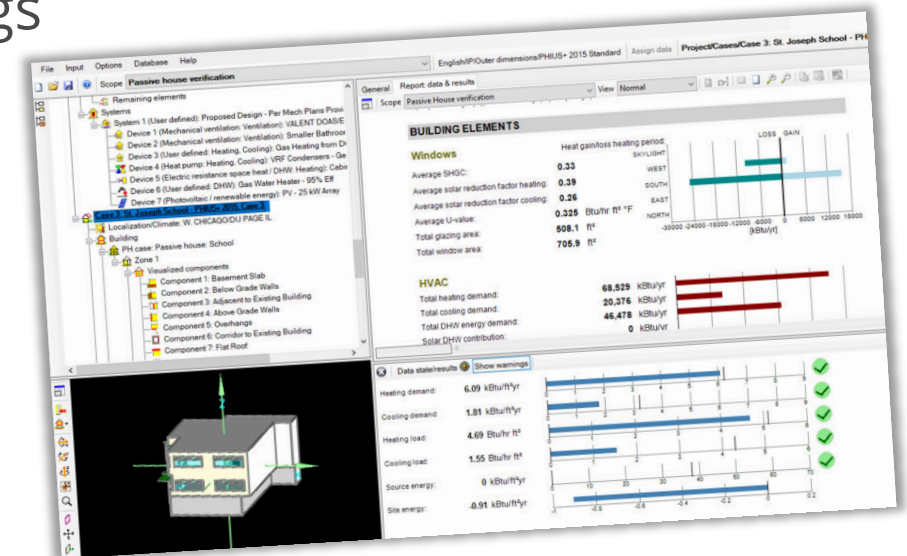
## Includes:

- WUFI® Passive energy model
- WUFI® Passive report estimating preliminary annual energy use
- Target building-envelope performance values to meet Phius standards
- Energy use comparison vs. code (optional)
- 1 hour follow-up call with the team to review findings



**Table 1.2.4.2.0 Feasibility Study Fees**

ICFA (sf)	Single-Family	Multifamily	Non-Residential
<10,000	\$1,500	\$2,000	\$2,500
10,001 - 50,000	n/a	\$3,000	\$3,500
50,001 - 100,000		\$3,500	\$4,000
Each additional 50,000		+ \$500	+ \$500



# Phius Alliance

**Become a member**  
**At [www.phius.org](http://www.phius.org)**

**Benefits Include:**

- Discounted rates on:
  - Exclusive webinars
  - Exclusive staff office hours
  - Annual conference
- Monthly 'Office Hours'
- Climate data library
- Details library



# *Phius Project Case Studies*

# FIRST IN THE UNITED STATES Smith House – 2003, Urbana IL



*RMI BASALT INNOVATION CENTER –  
Basalt, CO (Climate Zone 7)*



# RMI BASALT INNOVATION CENTER



**Location:** Basalt, CO

**Climate:** Zone: 7A

**Roof:** R-67

**Walls:** R-50 (SIP)

**Slab:** R-20 (whole slab)

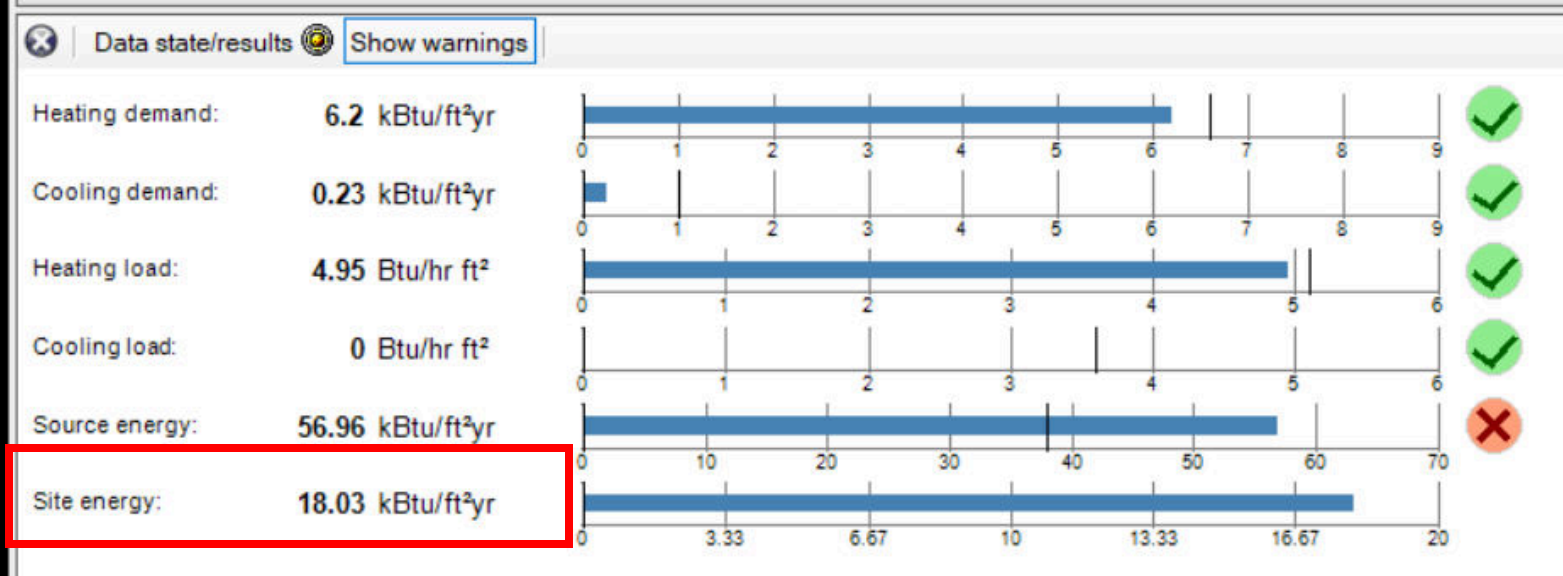
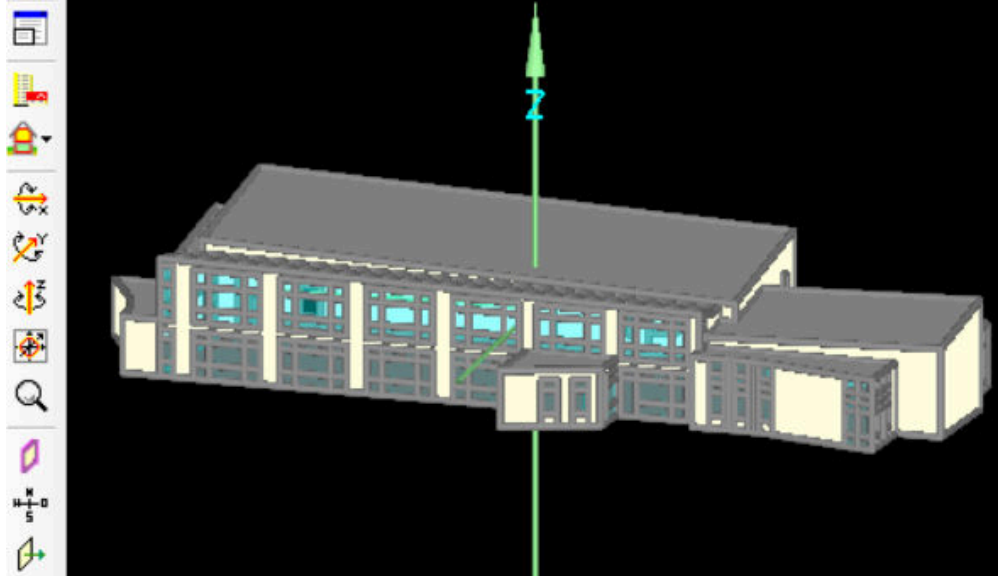
**Windows:** R- 5.8 (U-0.18) average

**Air-tightness:** 0.04 CFM50/ft<sup>2</sup> envelope area

**Renewable Energy:** 83 kW PV Array on-site

**Certification Level:** PHIUS+ Source Zero





**16**

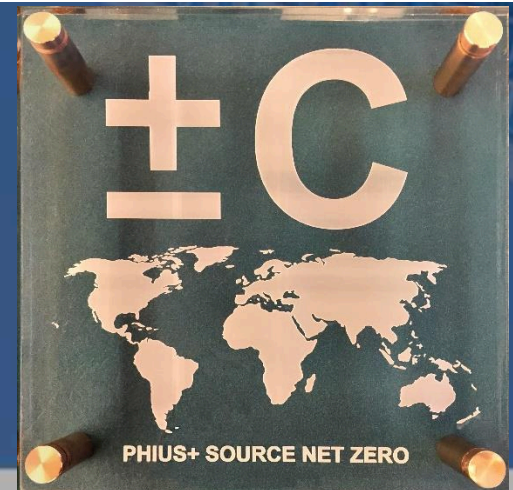
The building's energy use intensity (kBtu/sf/year)

**74%**

more efficient than the average office in the same climate

**100Y**

design life, opposed to the average 30-year



**WHY**

The Innovation Center is the highest-performing building in the coldest climate zone in the U.S., producing more clean energy than it uses on an annual basis plus enough to power six electric vehicles. It is one of only 200 net-zero commercial buildings in the U.S. as of 2016, and provides a leading example of buildings that can solve the climate crisis.

# PRAIRIE RECREATION & ACTIVITY CENTER



**Location:** Plainfield, IL

**Roof:** R-60

**Walls:** R-40

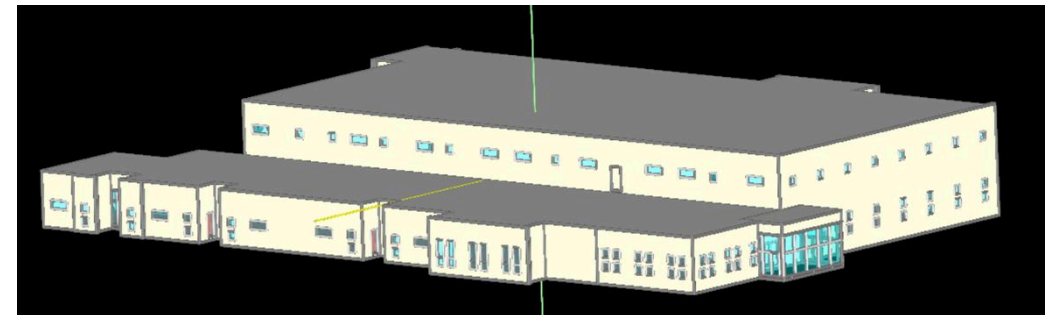
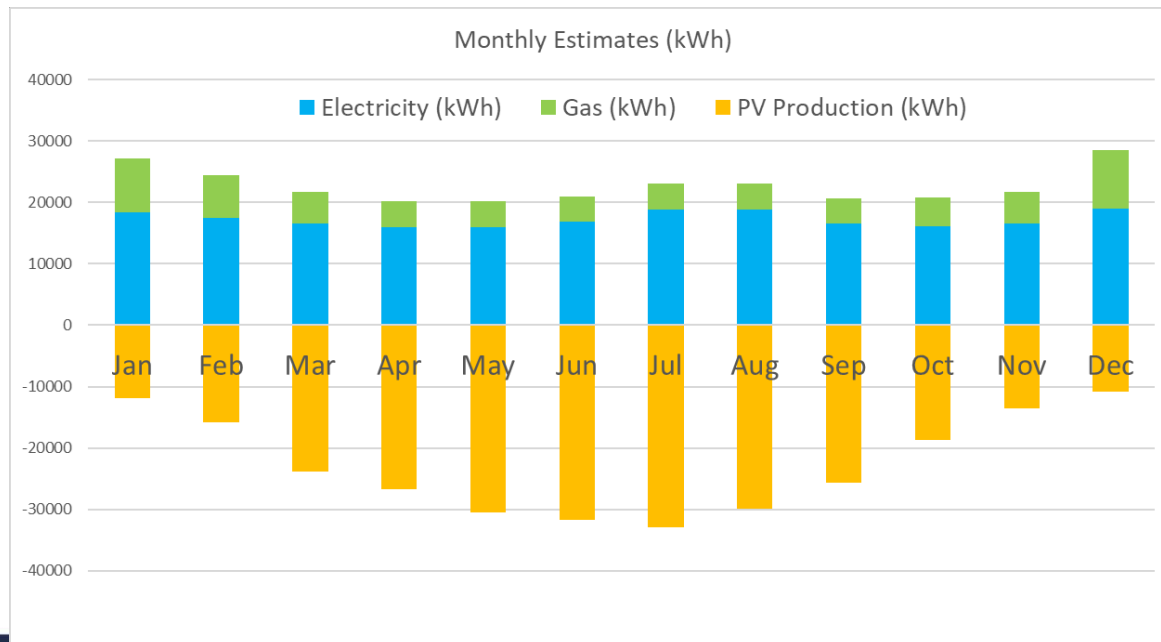
**Slab:** 4' perimeter (R-20)

**Windows:** R-6 (U-0.16)

**Air-tightness:** 0.045 CFM50/ft<sup>2</sup> envelope area

**Renewable Energy:** 215 kW PV Array on-site

**Certification Level:** PHIUS+ Source Zero





Capital Flat 2, Philadelphia



# ONION FLATS: THE BATTERY IN PHILADELPHIA

© Phius 2025



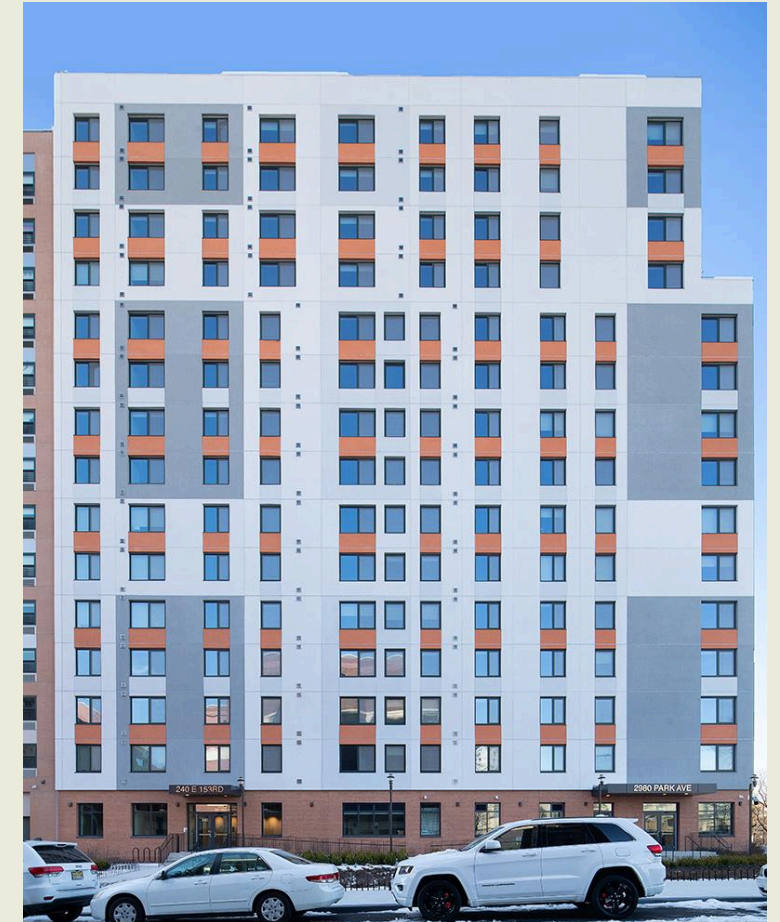
# HOOK & LADDER

MINNEAPOLIS, MN

PHOTO: STARTRIBUNE.COM



~~~~~ **PARK AVENUE GREEN | South Bronx, NYC**  
**154 Units | 153,000 ft<sup>2</sup>**



# PAX FUTURA

## Seattle, WA

PHOTO: SLOAN RICHIE

### 45 UNITS





**18 UNIT - MARKET RATE - PORTLAND, OR**



**24 UNIT- AFFORDABLE – BROOKLYN, NY** @phius

# AFFORDABLE/MARKET RATE, 274 UNITS KANSAS CITY, MO





# CHOM Village Center | 47 Units, Affordable Brewer, ME



# 425 Grand Concourse - BRONX, NY | 289 Units | 300,000 SF



# Fahy Commons

MULTIPURPOSE BUILDING

Allentown, PA  
20,000 SF



Certifications:  
Phius CORE 2021  
LEED Platinum  
LBC CORE



*Now what?*

**Next steps and furthering  
your education**



# Assembling a Team



## Required

- Phius Certified **Consultant**

**AND**

- Phius Certified **Rater** *(single family & small MF)*
- **OR**
- Phius Certified **Verifier** *(non-res. & large MF)*

## Adding to Success

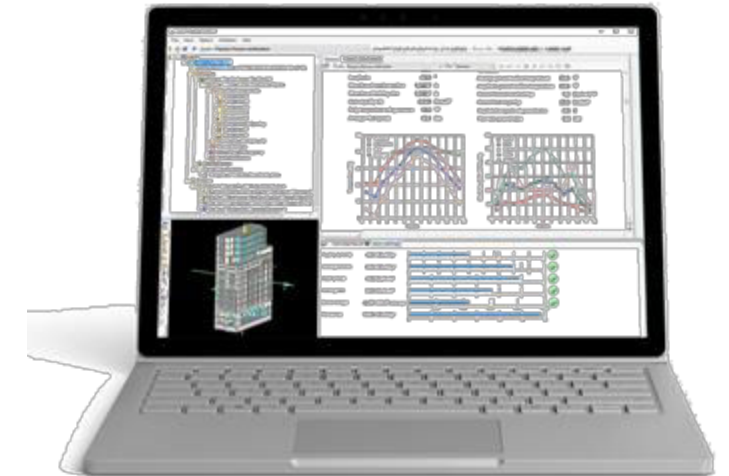
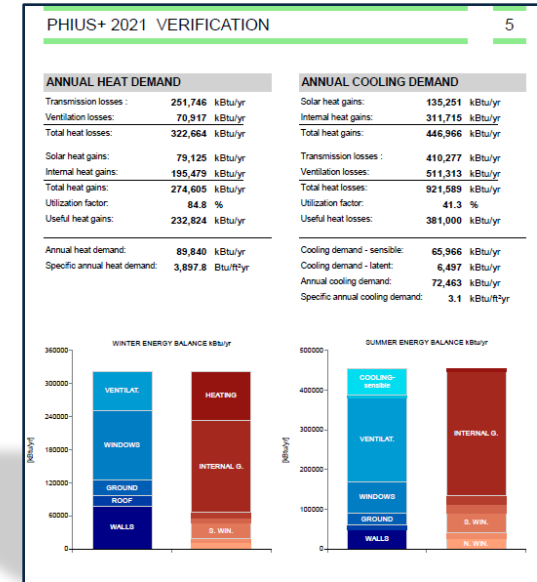
- Phius Certified **Builder**
- Phius Certified **Trades Professional**





phius  
certified  
consultant

- Engaged from the initial stages
- Completes energy modeling
- Ensures compliance is maintained during the entire design process
- Communicates directly with Phius



# Prerequisites

- **Basic application process**
- **Recommended:**
  - Architecture / engineering / building science background
  - Experience with CAD software



# Training

## ~ 50 hours of self-guided content

- Building Science
- Passive Building
- Passive Building Physics
- Phius Standards
- Phius Certification & more

## 24 hours of instructor-led sessions

- Design Exercises
- Practical Application of Principles and Theory
- WUFI Passive



# 2-part Certification Exam

## Online Exam

- ‘Traditional’ exam
- Aligns with self-guided content
- Completed on the training site
- Can be completed any day, any time within 12-month registration window

## Design Exam

- Aligns with design exercises and applied theory from instructor-led session
- Opens at end of instructor session and is due 30 days later





# Certified Professional Continuing Education

*Three Paths – Must Fulfill Every 3 Years*



Path 1: Work on a Certified Project



Path 2: Continue your Education and Earn CEUs



Path 3: Take and Pass the Re-Certification Exam

# Supplemental Training

<https://www.phius.org/trainings>

## ***WUFI Passive***

- *Single Family*
- *Multifamily Advanced*

## ***THERM***

- *Intro Hands-On Workshop*

## ***Prescriptive Path***

- *In-Depth Workshop*



Register at: [phius.org/trainings](https://www.phius.org/trainings)



# Phius Foundations Training



## 101-Level Introduction to:

Phius

The Business Case

Passive Building

Phius Case Studies

Building Science

Passive Policy

Phius Certification

Beyond the Building

+ Exam =

Phius Certified *Associate*

# Thanks! Questions?



**Lisa White | [Lwhite@phius.org](mailto:Lwhite@phius.org)**  
*Co-Executive Director, Phius*