Intro to the Passive House Standard for the PA Residential Construction Industry

www.phrc.psu.edu

PennState College of Engineering | PENNSYLVANIA HOUSING RESEARCH CENTER

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Pennsylvania Housing Research Center

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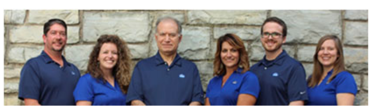
- **We conduct applied research, foster the development and commercialization of innovative technologies, and transfer appropriate technologies to the housing community.**
- **The PHRC is housed within the Department of Civil & Environmental Engineering at Penn State. For more information about the PHRC (publications, webinars, conferences), check out our website, phrc.psu.edu.**



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Description

The Passive House design standard is a voluntary above code program for both new construction and retrofits that focuses on significantly reducing a home's energy usage. Primary design principles involved in this standard are continuous insulation, strict air tightness limits, reduction of thermal bridging, and a focus on thermal comfort via balanced ventilation and heat recovery, resulting in homes that can use up to 90% less energy than a conventional home.

This webinar will provide an introduction of this standard for Pennsylvania's residential construction industry, including an overview of the international Passive House standard (PHI) and the Passive House Institute of the US (PHIUS) standard, the design principles behind each of them, and details on Pennsylvania case studies built to these standards. It will also include an overview of the certification process for the homes, as well as Passive House designers, builders, raters, and verifiers, to inform the residential construction industry of the logistics of building to the Passive House standard.

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Learning Objectives

1. Gain insight into the energy reduction and comfort principles and requirements of each Passive House standard
2. Review the general design and building science details of each standard for significant building energy reductions and increased occupancy comfort and safety
3. Review Pennsylvania case study homes built to these standards and which have the thermal comfort and indoor air quality provisions set out by the standard
4. Understand the PHIUS certification process for homes, as well as designers, builders, raters, and verifiers, to know how to enter the Passive House industry

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Code Change: 50+ Speaking Engagements!

Webinar Outline

- Overview of **Passive Buildings**
  - Introduction to Passive Buildings
  - History of Passive Buildings
  - General Characteristics of Passive Homes
  - Benefits of Passive Homes
  - Costs of Passive Homes
- 15 minute introductions to the:
  - **PHI - International Passive House Institute** Standard
  - **PHIUS - Passive House Institute of the US** Standard

https://www.pittsburghmagazine.com/Pittsburgh-Magazine/January-2016/Anything-But-Passive-These-Houses-Can-Save-You-Money/

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Webinar Outline

- 15 minute introductions to the:
  - **PHI - International Passive House Institute** Standard
  - **PHIUS - Passive House Institute of the US** Standard

1. **Landscape/Basics**
2. **Tools of Certification**
3. **Certification Details**
4. **Start to Finish Expectations**
5. **Pennsylvania Case Study**
6. **Next Steps/Training Resources**

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https://www.pittsburghmagazine.com/Pittsburgh-Magazine/January-2016/Anything-But-Passive-These-Houses-Can-Save-You-Money/

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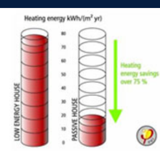
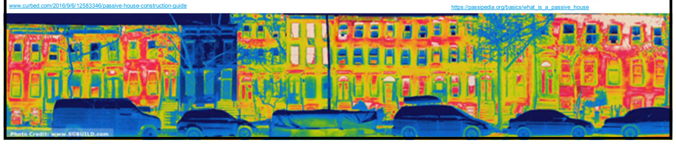
Brief Introduction to Passive Buildings

- **Passive Buildings**
  - Superinsulated
  - Ultra low energy usage
  - "Maximize Gains, Minimize Losses"
- **NOT Passive Solar Design**
  - "Mass and Glass"



www.curbed.com/2016/9/6/12583346/passive-house-construction-guide

https://passipedia.org/basics/what_is_a_passive_house



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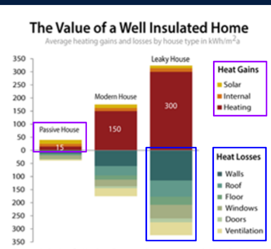

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http://shrinkthatfootprint.com/house-insulation-value

Brief Introduction to Passive Buildings

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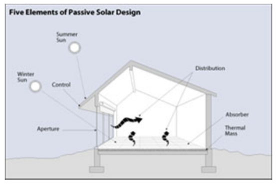
www.finehomebuilding.com/2016/09/14/passive-solar-design-actually-save-energy



https://sustainability.williams.edu/green-building-basics/passive-solar-design

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History of Passive Buildings

Pioneers - North America

- Saskatchewan Conservation House (1977)
- Illinois Lo-Cal House (1975)
- Massachusetts Leger House (1978)

Formalized Standard - Germany

- Darmstadt-Kranichstein (1991)
  - Passive House Institute (PHI)

United States Examples

- Smith House (2002)
- Biohaus (2006)
  - Passive House Institute of the US (PHIUS)

Saskatchewan Conservation House (1977)

https://thetyee.ca/News/2011/01/25/Passivhaus/

Darmstadt-Kranichstein (1991)

https://passipedia.org/examples/residential_buildings/multi-family_buildings/central_europe/the_world_s_first_passive_house_darmstadt-kranichstein_germany

Smith House (2002)

https://www.phius.org/about/mission-history

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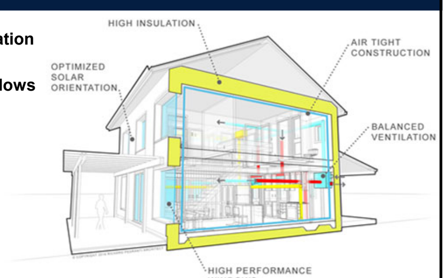
Characteristics of a Passive House

1. Optimized Solar Orientation
2. High Insulation
3. High Performance Windows
4. Airtight Construction
5. Balanced Ventilation



https://richardpedranti.com/passivehouse/

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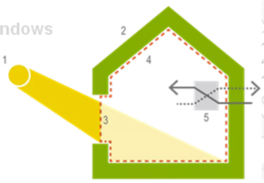
Optimized Solar Orientation

1. **Optimized Solar Orientation**
2. High Insulation
3. High Performance Windows
4. Airtight Construction
5. Balanced Ventilation



http://mizaarchitects.com/passive-house/

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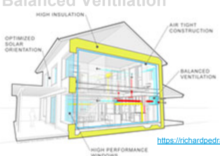
High Insulation: High R-Values + Continuous

1. Optimized Solar Orientation
2. **High Insulation**
3. High Performance Windows
4. Airtight Construction
5. Balanced Ventilation



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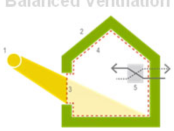
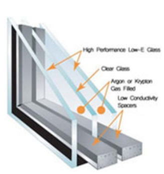
https://richardpedranti.com/passivehouse/

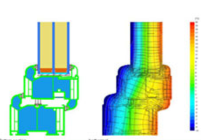
High Performance Windows

1. Optimized Solar Orientation
2. High Insulation
3. **High Performance Windows**
4. Airtight Construction
5. Balanced Ventilation





http://passivehousepa.blogspot.com/2012/11/passive-house-windows-low-u-valuesu.html



https://www.bpcgreenbuilders.com/personal-journey-building-passive-house-part-7/

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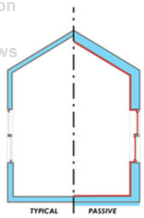
http://mizaarchitects.com/passive-house/

Airtight Construction

1. Optimized Solar Orientation
2. High Insulation
3. High Performance Windows
4. **Airtight Construction**
5. Balanced Ventilation



https://passivehouseaccelerator.com/articles/what-is-a-passive-house-1

https://www.phius.org/NAPHC2015/pedranti-PH-CASE-STUDY-reduced.pdf

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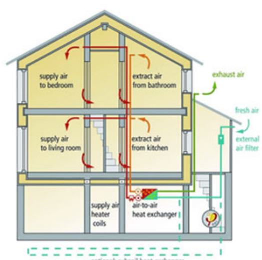
Balanced Ventilation: Continuous Fresh Air

1. Optimized solar orientation
2. High Insulation
3. High Performance Windows
4. Airtight Construction
5. **Balanced Ventilation**



http://passivehouse.com.au/page/ventilation---heat-energy-recovery

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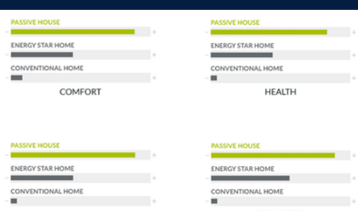
Benefits of a Passive House

1. **Comfort**
2. **Health**
3. **Efficiency**
4. **Durability**



https://hammerandhand.com/high-performance-building-101/

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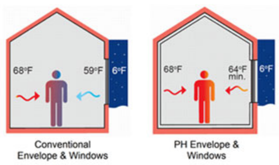

http://designcoalition.org/community/Passive%20House/Intro%20to%20PH%20June'15.pdf

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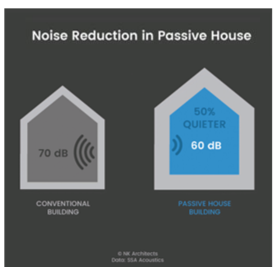

https://www.nkarch.com/blog/got-a-noisy-site-passive-house-brings-peace-and-quiet

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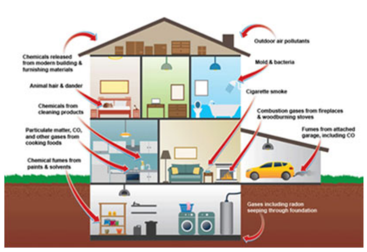

https://www.epa.gov/expobox/exposure-assessment-tools-media-air

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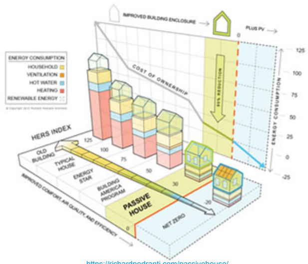

https://richardpedranti.com/passivehouse/

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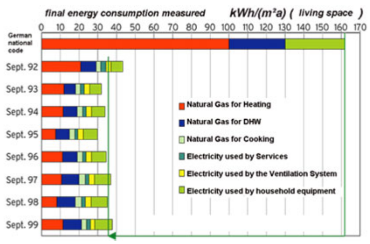

https://passipedia.org/examples/residential_buildings/multi-family_buildings/central_europe/the_world_s_first_passive_house_darmstadt-kranichstein_germany

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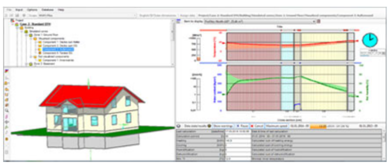

https://wufi.de/en/

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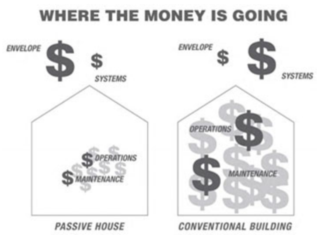
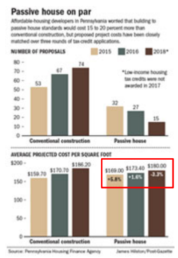
Costs for Passive Homes





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www.phfa.org/forms/multifamily_application_guidelines/submission/01_post_award_req/2015_passive_house_slide_presentationa.pdf

www.post-gazette.com/business/development/2018/12/31/pa-affordable-housing-tax-credits-pennsylvania-housing-finance-agency-passive-house-design/stories/201812190012

Webinar Outline

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- 15 minute introductions to the:
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https://www.pittsburghmagazine.com/Pittsburgh-Magazine/January-2016/Anything-But-Passive-These-Houses-Can-Save-You-Money/

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What's Needed for Both Standards

- **Trained Professionals**
  - Homes as systems
  - Building science focused
  - Know the standard
- **Integrated Design Team**
- **Goal to Certify**

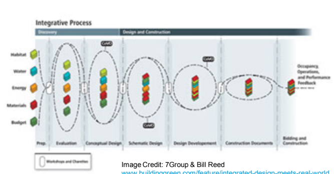

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Image Credit: 7Group & Bill Reed
www.buildinggreen.com/feature/integrated-design-meets-real-world

Introduction to the PHI Standard

- 15 minute introduction to the:
  - **PHI - International Passive House Institute** Standard

1. **Landscape/Basics**
2. **Tools of Certification**
3. **Certification Details**
4. **Start to Finish Expectations**
5. **Pennsylvania Case Study**
6. **Next Steps/Training Resources**

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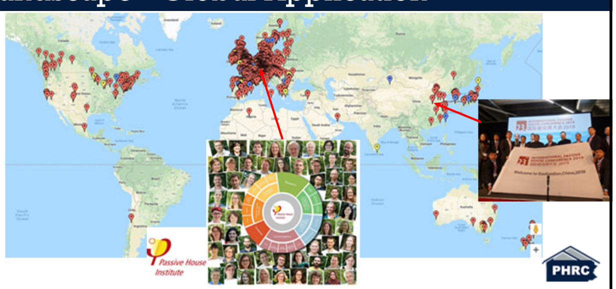
PHI Passive House Standard: Landscape - Global Application



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PHI Standard: Landscape - Global Community

PASSIVEHOUSE CANADA

maison passive québec

passivhaus MAINE

NYPH NEW YORK PASSIVE HOUSE

PHWPA

GPPHA

naphn North American Passive House Network

in support of professionals working with the International Passive House Standard

PASSIVE HOUSE

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PHI Standard: Basics...a comfort standard

- Pass/fail passive building standard
- Performance-based standard
- **Energy performance criteria**:
  a. Limits on heating and cooling/dehumidification
     - (**peak load OR annual demand**)
  b. Limits on overall **source energy use**
  c. **Airtightness**: 0.6 ACH50
- **Comfort performance criteria**:
  a. Thermal Comfort
  b. Occupant Satisfaction/Control
  c. Ventilation System

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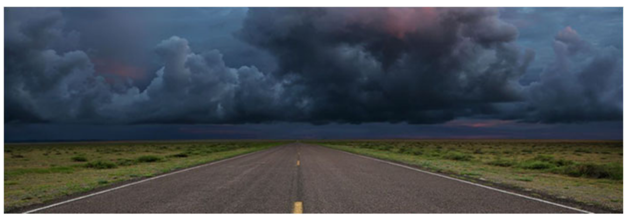
PHI Standard: Basics...future proofing



Future extreme weather - Future renewable grid - Future resilience

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PHI Standard(s): History

- **Passive House Standard**
  - Developed initially 1990's
  - Adapted as building uses and locations warrant
  - In 2014 reformulated to address future electric clean power grid & onsite renewables
- **EnerPHit Renovation Standard**
  - Developed in 2000s to deal with unique issues of retrofits - launched in 2011
- **PHI Low Energy Building Standard**
  - Developed in 2010s to deal with "near misses"

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PHI Standard: Tools of Certification

- **PHI Trained & Certified Professionals**
  - Designer/Consultant (CPHD/C)
  - Tradesperson (CPHT)
  - Energy Modeler
  - Certifier
- **Energy Model Software**
  - Passive House Planning Package (PHPP)

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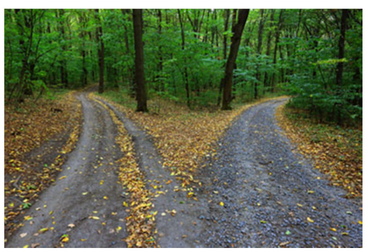
PHI Standard: Tools of Certification - Variants for future changes

Variants in PHPP
- Future Climate Data
- Usage pattern changes
- Component upgrades
- Future system updates



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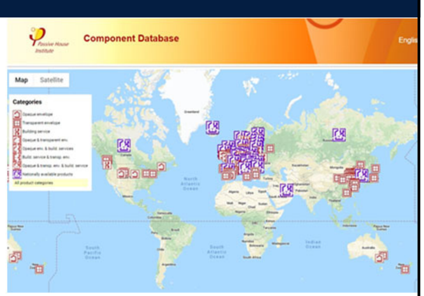
PHI Standard: Tools of Certification

Certified Component Performance



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PHI Standard: Tools of Certification - Community of Certifiers

- [Canadian Passive House Institute](#)
  - info@passivehouse.ca
- [CertiPHiers Cooperative](#)
  - info@certiphiers.com
- [Herz-Lang,](#)
  - ryan.conor@herz-lang.com
- [MEAD Ltd.](#)
  - enquiries@meadconsulting.co.uk
- [MIZU Passive House Consulting](#)
  - welcome@mizupassivehouse.com
- [Passive House Academy](#)
  - edel@passivehouseacademy.com
- [Passive House Institute](#)
  - building.certification@passiv.de
- [Peel Passive House Consulting](#)
  - info@peelpassivehouse.ca
- [RDH](#)
  - mpaulsen@rdh.com
- [Steven Winter Associates, Inc.](#)
  - larena@swinter.com
- [Stich Consulting & Design](#)
  - info@stichpassivedesign.com
- [ZEPHIR Passivhaus Italia](#)
  - f.nesi@zephir.ph

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PHI Standard: Tools of Certification

- https://passiv.de/downloads/Building_Certification_Guide

PASSIPEDIA The Passive House Resource https://passipedia.org/

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PHI: Certification Criteria

Criteria
for the Passive House,
EnerPHit and
PHI Low Energy Building Standard
(IP Version)

Structure of the criteria

Contents

Criteria for the Passive House, EnerPHit and PHI Low Energy Building Standard, version 9f (IP), revised 12.01.2016 2/27
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1. Passive House Standard Performance

- Added variables include:
  - dehumidification
  - use
  - mixed occupancy
  - renewables capabilities

Table 1 Passive House Criteria

			Criteria[1]			Alternative Criteria[2]
Heating						
Heating demand	[kBTU/(ft²yr)]	≤	4.75			-
Heating load[3]	[BTU/(hr.ft²)]	≤	-			3.17
Cooling						
Cooling + dehumidification demand	[kBTU/(ft²yr)]	≤	4.75 + dehumidification contribution[4]			variable limit value[5]
Cooling load[6]	[BTU/(hr.ft²)]	≤	-			3.17
Airtightness						
Pressurization test result n_{50}	[1/hr]	≤	0.6			
Renewable Primary Energy (PER)[7]			Classic	Plus	Premium	
PER demand[8]	[kBTU/(ft²yr)]	≤	19.02	14.26	9.51	±4.75 kBTU/(ft²yr) deviation from criteria...
Renewable energy generation[9] (with reference to projected building footprint)	[kBTU/(ft²yr)]	≥	-	19.02	38.04	...with compensation of the above deviation by different amount of generation

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2. EnerPHit Standard Performance

- **Component method** - using certified components

  OR
- **Energy Demand Method**

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

PLUS

- Airtightness relaxed to 1.0 ACH50
- General Requirements
- Typical Exemptions

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3. Low Energy Building Standard Performance

- For "near misses"

Table 4 PHI Low Energy Building criteria

			Criteria[1]	Alternative Criteria[2]
Heating				
Heating demand	[kBTU/(ft²yr)]	≤	9.51	
Cooling				
Cooling + dehumidification demand	[kBTU/(ft²yr)]	≤	Passive House requirement[3] + 4.75	
Airtightness				
Pressurization test result n_{50}	[1/hr]	≤	1.0	
Renewable Primary Energy (PER)[4]				
PER demand[5]	[kBTU/(ft²yr)]	≤	23.77	Exceeding the criteria up to +4.75 kBTU/(ft²yr) is permitted...
Renewable energy generation[6] (with reference to projected building footprint)	[kBTU/(ft²yr)]	≥	-	...with compensation of the above deviation by additional generation

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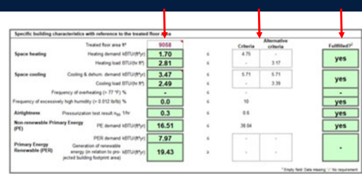
3. Criteria

- calculated values
- criteria values
- yes/no result

PLUS:

- supporting documentation: photos, reports, drawings, specifications



Specific building characteristics with reference to the treated floor area						
				Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area ft²	9058				
Space heating	Heating demand kBTU/(ft²yr)	1.70	≤	4.75	-	yes
	Heating load BTU/(hr ft²)	2.81	≤	-	3.17	
Space cooling	Cooling & dehum. demand kBTU/(ft²yr)	3.47	≤	5.71	5.71	yes
	Cooling load BTU/(hr ft²)	2.49	≤	-	3.39	
	Frequency of overheating (> 77 °F) %	-	≤	-		-
	Frequency of excessively high humidity (> 0.012 lb/lb) %	0.0	≤	10		yes
Airtightness	Pressurization test result n_{50} 1/hr	0.3	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kBTU/(ft²yr)	16.51	≤	38.04		yes
Primary Energy Renewable (PER)	PER demand kBTU/(ft²yr)	7.97	≤	-	-	-
	Generation of renewable energy (in relation to projected building footprint area) kBTU/(ft²yr)	19.43	≥	-	-	

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

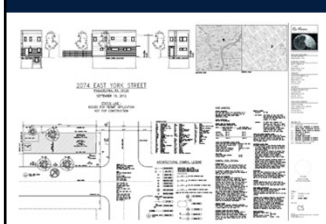
Not Required:

- Third party program validation
- BUT can harmonize with third party programs

PHI: Start to Finish - Major Phases

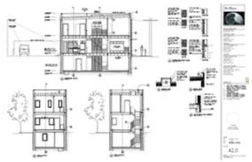
1. **select a certifier and professionals**
   a. select certified consultants / get training
2. **design**
   a. check assumptions with certifier
   b. select assemblies, components, systems
   c. certifier design check with calculations and selections
   d. run variants
3. **construction**
   a. submit documentation
      i. installation photos, specifications, final details, calculations, and "as-built" plans
      ii. third party testing of airtightness and ventilation system
4. **designer & certifier confirmation of accuracy**
5. **issuance of certification**

Case Study: Philadelphia Passive House



1,600 SF, single family home
Re:Vision Architects

Case Study: Philadelphia Passive House



Enclosure:
Slab: 3" XPS insulation, R15 (continuous)
Walls: 11" think double stud, R36 with mineral wool batt insulation
Roof: 13" I-Joist structure with mineral wool, deck and Polyiso above, R75
Windows: Triple Glazed, PVC frames, tilt-turn, R9 center of glass
Airtightness: 0.51 ACH50

Systems:
Heating & Cooling: Split heat pump system providing cooling and heating
Hot Water: Electric Hybrid Heater
Ventilation System: Zehnder ComfoAir 350, counterflow heat exchange with distributed supply and exhaust outlets

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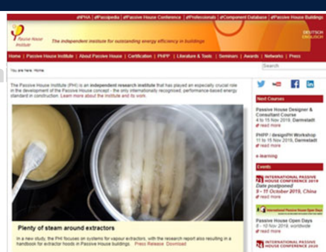
Next Steps

1. **Resources**
2. Training Opportun



- **www.passivehouse.com**
- www.naphnetwork.org
- www.passivehousewpa.com
- www.greenbuildingunited.org

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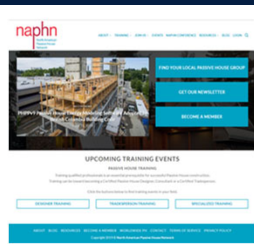
PHRC

Next Steps

1. Resources
2. **Training Opportunities**



- **www.naphnetwork.org**
- www.passivehousewpa.com
- www.greenbuildingunited.org

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PHRC

Introduction to the PHIUS Standard

- 15 minute introduction to the:
  - **PHIUS - Passive House Institute of the US** Standard

1. **Landscape/Basics**
2. **Tools of Certification**
3. **Certification Details**
4. **Start to Finish Expectations**
5. **Pennsylvania Case Study**
6. **Next Steps/Training Resources**

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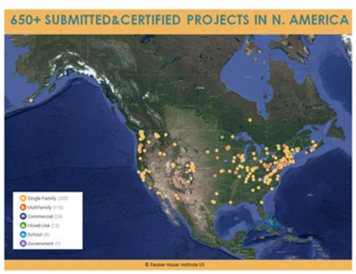
https://www.pittsburghmagazine.com/Pittsburgh-Magazine/January-2016/Anything-But-Passive-These-Houses-Can-Save-You-Money/

PHRC

PHIUS Standard: Landscape

- **650+ submitted and certified projects in North America**
  - 205 fully certified projects
- **International applicability**
  - Projects in Japan, China, and S. Korea
  - PHIUS+ 2018 aligned with ASHRAE global climate zones



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PHIUS Standard: Basics

PHIUS
Passive House Institute US

- Performance-based passive building standard
- Includes prescriptive quality assurance requirements
- Pass/fail passive building standard
- Three pillars:
  a. Limits on heating/cooling loads (peak & annual)
  b. Limits on net source energy demand
  c. Airtightness & other prescriptive quality assurance requirements

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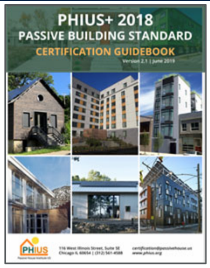
https://www.phius.org/projects/1086

Heidelberg, PA - Heidelberg Passive House

PHIUS Standard: Basics

- **PHIUS+ 2018**
  - Fully enforced as of April 1, 2019
  - Currently on Version 2.1 | June 2019
  - Builds on groundwork laid with **PHIUS+ 2015** standard
    - Developed with the Building Science Corporation under a Department of Energy Building America Program grant in 2014
    - PHIUS+ 2015 standard marked the distinction between PHI and PHIUS standards
  - PHIUS plans to provide standard updates every three years (**2021, 2024**, etc.)



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

PHIUS Standard: Basics

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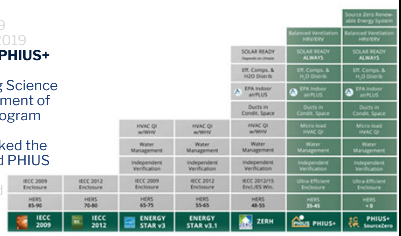

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www.phius.org/phius-certification-for-buildings-products/project-certification/overview

PHIUS Standard: Basics

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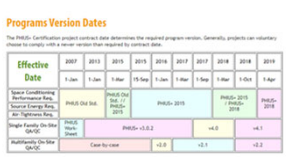

Programs Version Dates

The PHIUS+ Certification project contract date determines the required program version. Generally, projects can voluntary choose to comply with a newer version than required by contract date.

Effective Date	2007	2013	2015	2015	2016	2017	2017	2018	2018	2019
	1-Jan	1-Jan	1-Mar	15-Sep	1-Jan	1-Mar	1-Sep	1-Mar	1-Oct	1-Apr
Space Conditioning Performance Req. / Source Energy Req. / Air-Tightness Req.	PHIUS Old Std.		PHIUS Old Std. // PHIUS+ 2015	PHIUS+ 2015				PHIUS+ 2015 / PHIUS+ 2018		PHIUS+ 2018
Single Family On-Site QA/QC	PHIUS Work-Sheet	PHIUS+ v3.0.2					v4.0		v4.1	
Multifamily On-Site QA/QC	Case-by-case				v2.0	v2.1			v2.2	

https://www.phius.org/phius-certification-for-buildings-products/project-certification/programs-version-dates

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PHIUS Standard: Tools of Certification

- **Trained Professionals**
  - Certified Passive House:
    - Consultant
    - Builder
    - Rater
    - Verifier
  - PHIUS organization
- Software
  - WUFI Passive

Scranton, PA - Scranton Passive House

Richard Pedranti, architect and Pete Vargo, PHIUS+ energy rater performing initial blower door test

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https://www.phius.org/NAPHC2015/pedranti-PH-CASE-STUDY-reduced.pdf

PHIUS Standard: Tools of Certification

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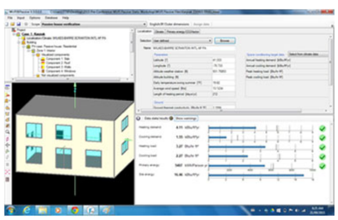

https://greeninghomes.com/introducing-the-phius-2015-rating-system-by-steven-gray/

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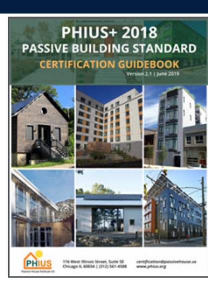
PHIUS+ 2018: Components

- **Performance Requirements**
- **Prescriptive Requirements**
- **Design Recommendations**

PHIUS Passive House Institute US

- Single Family Detached homes
- Attached homes will follow the Multifamily Guidelines



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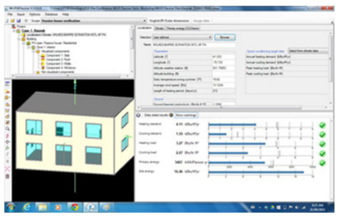
www.phius.org/PHIUS+2018/PHIUS+%20Certification%20Guidebook%20v2.1.pdf

PHIUS+ 2018: Performance Requirements

1. **Limits on heating/cooling loads (peak AND annual)**
2. **Limits on net source energy demand**
3. Airtightness Requirements



https://greeninghomes.com/introducing-the-phius-2015-rating-system-by-steven-gray/

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PHIUS+ 2018: Performance Requirements

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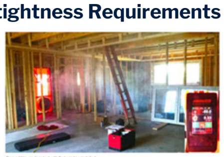

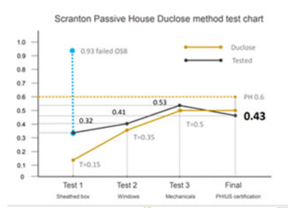

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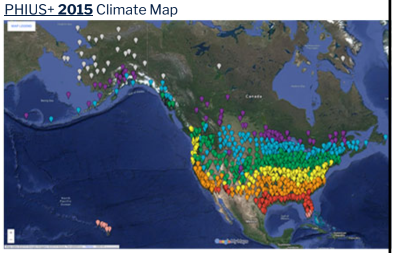
Image Credits: Richard Pedranti | www.richardpedranti.com/projects/scranton-passive-house/ | www.phius.org/NAPHC2015/pedranti-PH-CASE-STUDY-reduced.pdf

PHIUS+ 2018: Space Conditioning Requirements

Peak and annual heating and cooling usage limits based on:

- **Climate**
- **Location**
- **Building size**
  (new for PHIUS+ 2018)
- **Occupant density**
  (new for PHIUS+ 2018)

PHIUS+ **2015** Climate Map



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PHIUS+ 2018: Specific Location Performance Targets

At start of design: Estimated Targets

Lancaster, PA (CZ5) | Erie, PA (CZ5)

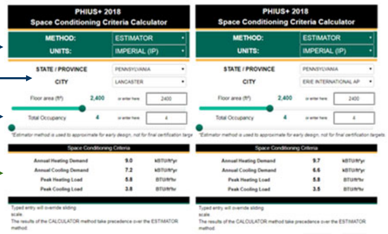
Estimator Method

Location

1. Floor Area
2. Total Occupancy

Output:

Estimated Space Conditioning Criteria



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PHIUS+ 2018: Estimator vs. Calculator

In design: Calculated Targets

Lancaster, PA - ESTIMATOR | Lancaster, PA - CALCULATOR

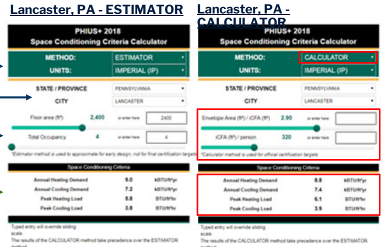
Calculator Method

Location

1. Envelope area per interior Conditioned Floor Area (iCFA)
2. iCFA / Person

Output:

Official Certification Targets for Space Conditioning Criteria



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PHIUS+ 2018: Net Source Energy (SE) Demand Limits

- **Climate-Independent Performance Requirement**
- **Three certification tiers**
  - PHIUS Core
    - Net SE Limit = 5,500 kWh/yr/person
    - Only allows on-site renewables
  - PHIUS 2018+
    - Net SE Limit = 3,840 kWh/yr/person
    - Allows on-site & off-site renewables
  - PHIUS+ Source Zero
    - Source energy used = Renewable energy generated
- **Updated criteria as of June 2019**

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

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3. Airtightness Requirements

- **Climate-Independent Performance Requirement**
- **<u>0.06 CFM/ft2 envelope @ 50Pa</u> for residential buildings**
  - Measures air leakage of envelope vs. air volume loss (ACH50)
- **Verified with a final blower door test**

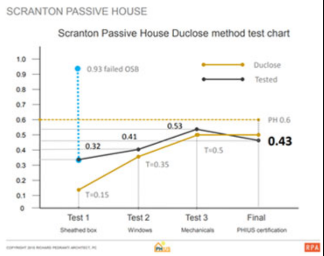

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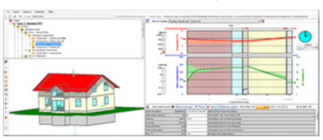
Image Credits: Richard Pedranti | www.richardpedranti.com/projects/scranton-passive-house/ | www.phius.org/NAPHC2015/pedranti-PH-CASE-STUDY-reduced.pdf

PHIUS+ 2018: Prescriptive Requirements

1. **Moisture Design Criteria**
   a. Climate-Appropriate Wall & Roof Assemblies
   b. Thermal Bridge Mold Risk Assessment
   c. Window Comfort & Condensation Risk Assessment
2. **QA/QC for Designer: Prescriptive Design Elements**
   a. Envelope, Heating & Cooling, Water Management, etc.
   b. Whole House Ventilation
   c. Third Party Standard Requirements
3. **QA/QC for Rater/Verifier: Field Inspections**



https://wufi.de/en/

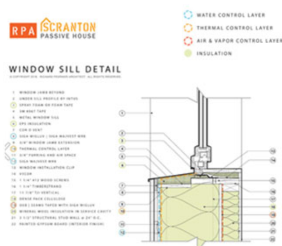


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Image Credit: Richard Pedranti | www.richardpedranti.com/projects/scranton-passive-house/

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From the PHIUS+ 2018 Certification Guidebook

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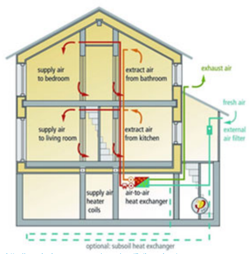

http://passivehouse.com.au/page/ventilation---heat-energy-recovery

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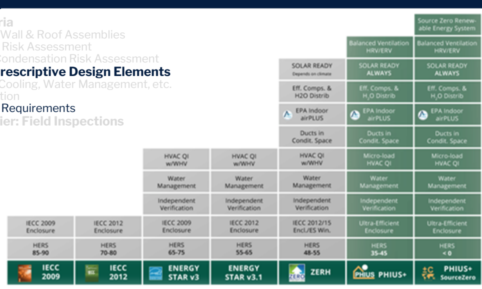

www.phius.org/phius-certification-for-buildings-products/project-certification/overview

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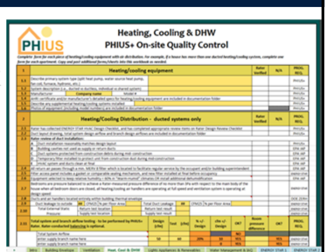

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PHIUS+ 2018: Design Recommendations

Sample R-Value Guidelines

Sample R-Value Guidelines**		R-Value Ranges		
Example Cities	Zone	Wall	Ceiling	Slab
Miami, FL; Honolulu, HI	1	19 - 27	44 - 60	2ft R-8 vertical perim
Jacksonville, FL; Phoenix, AZ	2	19 - 27	30 - 70	uninsulated
Charleston, SC; Sacramento, CA	3	15 - 31	30 - 60	uninsulated or 2ft R-8 vertical perim
San Francisco, CA	Marine 3	19 - 23	30 - 38	4ft R 8-20 vertical perim
Baltimore, MD; Amarillo, TX	4	31 - 51	49 - 80	2-4ft R 8-20 vertical perim
Salem, OR; Seattle, WA	Marine 4	31 - 43	60 - 70	4ft R-20 vertical perim or whole-slab R-20
Providence, RI; Flagstaff, AZ	5	31 - 43	60 - 70	4ft R-20 vertical perim or whole-slab R-20
Burlington, VT; Billings, MT	6	39 - 51	70 - 90	whole-slab R20-28
Duluth, MN; Edmonton, AB	7	49 - 65	80 - 90	whole-slab R28-40
Fairbanks, AK	8	89	120	whole-slab R-40

** NOTE:

Generated from PHIUS+ 2015 studies
Pertains mainly to single-family buildings
Actual R-values will vary by project

https://www.phius.org/what-is-passive-building/passive-house-faqs

Example Window Specs

Climate-by-Climate Recommendations for Window Performance

ASHRAE/IECC/DOE North American Climate Zone	Overall installed window U-value Btu/h.ft2.F	Center-of-glass U-value Btu/h.ft2.F	SHGC - South	SHGC - North, East, West
8	≤0.11	≤0.10	≥0.50	Any
7	≤0.12	≤0.11	≥0.50	Any
6	≤0.13	≤0.12	≥0.50	Any
5	≤0.14	≤0.13	≥0.50	Any
4	≤0.15	≤0.14	≥0.50	≤0.40
Marine North	≤0.16	≤0.15	≥0.50	≤0.40
Marine South	≤0.22	≤0.20	≤0.50	≤0.30
3	≤0.18	≤0.16	≤0.50	≤0.30
2 West	≤0.18	≤0.16	≤0.30	≤0.30
2 East	≤0.20	≤0.18	≤0.30	≤0.30

In the criteria table and on the data label, the climate zone labels differ slightly from the IECC map as follows:

- 2 East = 2A
- 2 West = 2B
- Marine North = 4C
- Marine South = 3C

https://www.phius.org/documents/2017-01-06_Program-Overview_PHIUS-Verified-Window-Performance-Data-Program.pdf

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PHIUS+ 2018: Start to Finish

1. **Assemble Your Team**
1. Design & Pre-Certify
   a. Energy model matches plans & specifications
1. Build, Verify, & Certify
   a. Final building matches plans & specifications

In Pennsylvania, there are currently …

- 64 Certified Passive House Consultants
- 28 Certified Passive House Builders
- 9 Certified Passive House Raters
- 10 Certified Passive House Verifiers

phius.org/find-a-professional

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PHIUS+ 2018: Start to Finish

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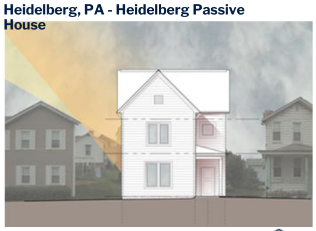
www.phfa.org/forms/multifamily_application_guidelines/submission01_post_award_req/2015_passive_house_slide_presentationa.pdf

Heidelberg, PA - Heidelberg Passive House



https://www.bizjournals.com/pittsburgh/blog/energy/2012/04/first-passive-house-breaking-ground-in.html

PHRC

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PHIUS+ 2018: Start to Finish

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Heidelberg, PA - Heidelberg Passive House

www.phfa.org/forms/multifamily_application_guidelines/submission/01_post_award_req/2015_passive_house_slide_presentationa.pdf

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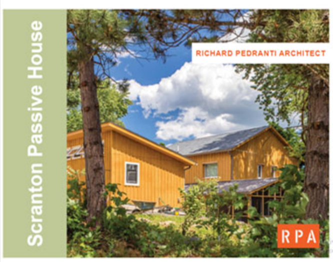
Case Study: Scranton Passive House

RPA SCRANTON PASSIVE HOUSE



SCRANTON PASSIVE HOUSE DATA

PROJECT INFORMATION	
Location	Scranton, PA
Size	2,153 sqft
Climate Zone	5/6 Cold
HERS	28
Construction	Complete 2015
Cost	$165/sqft
Modeling Tool	PHPP/REMRATE
Monitoring	RPA PHIOT

PASSIVE HOUSE ENERGY CRITERIA	
Annual Heat Demand	4.52 KBTU/(FT2YR)
Heat Load	2.75 BTU/(FT2HR)
Primary Energy	31.5 KBTU/(FT2YR)
Air Tightness	0.47 ACH @ 50 Pa
Treated Floor Area	1,750 sqft

CONSTRUCTION SPECIFICATIONS		
Floor	R=76	Slab on Grade
Walls	R=61	2x4 Wall + TJI
Roof	R=85	Raised Heel Energy Truss
Windows	R=7	Intus Eforte

MECHANICAL SYSTEMS	
Ventilation	Renewaire ERV
Heating & Cooling	Mitsubushi ASHP
Domestic Hot Water	GE HWHP

RPA PASSIVE HOUSE MORPHOLOGY	
Envelope Area to TFA	3
Surface Area to Volume	32
Envelope Area to Glazing	14%
South Glazing	47%
Enclosure R Value	36.2

RICHARD PEDRANTI ARCHITECT WWW.RICHARDPEDRANTI.COM 129 SAWMILL AVENUE, MILFORD, PA 18337 (570) 296 - 0466

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Scranton Passive House: Orientation

RPA SCRANTON PASSIVE HOUSE

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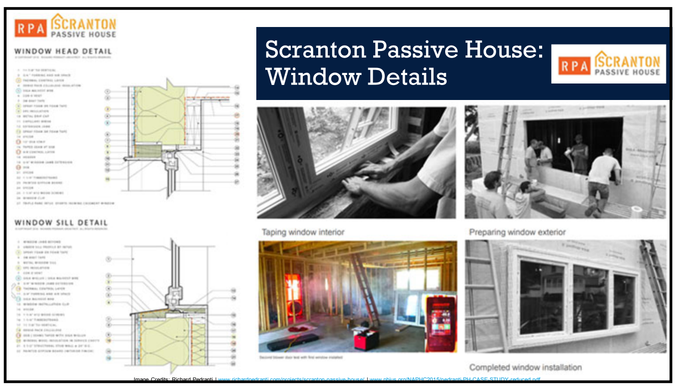
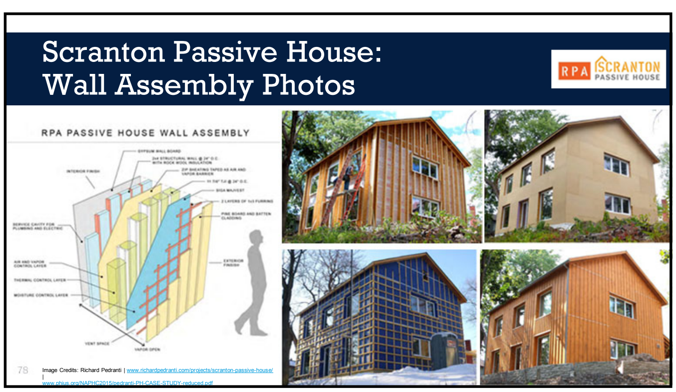
Scranton Passive House:
Envelope Airtightness Strategies
RPA SCRANTON PASSIVE HOUSE
OSB sheathing over 2x4 structural frame with entry door opening
Setting raised heel roof trusses
Sheathed and ready for blower door test #1
Richard Pedranti, architect and Pete Vargo, PHIUS+ energy rater performing initial blower door test
"We have leaky OSB"
Pete Vargo
PHIUS + rater Pete Vargo - "I was right, we have leaky OSB"
Richard Pedranti, architect and Pete Vargo, PHIUS+ energy rater performing initial blower door test
Image Credits: Richard Pedranti | www.richardpedranti.com/projects/scranton-passive-house/ | www.phius.org/NAPHC2015/pedranti-PH-CASE-STUDY-reduced.pdf


RPA SCRANTON PASSIVE HOUSE
WINDOW HEAD DETAIL
WINDOW SILL DETAIL
Scranton Passive House:
Window Details
RPA SCRANTON PASSIVE HOUSE
Taping window interior
Preparing window exterior
Completed window installation


Scranton Passive House:
Wall Assembly Photos
RPA SCRANTON PASSIVE HOUSE
RPA PASSIVE HOUSE WALL ASSEMBLY

Scranton Case Study: Resources

RPA SCRANTON PASSIVE HOUSE

Scranton Passive House eBook & Website

www.richardpedranti.com/projects/scranton-passive-house/

2015 North American Passive House Conference Presentation

www.phius.org/NAPHC2015/pedranti-PH-CASE-STUDY-reduced.pdf

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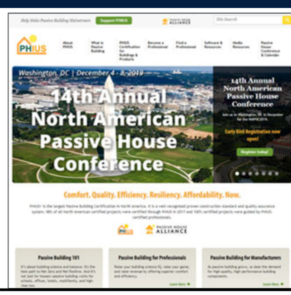
Next Steps

1. **Resources**
2. Training Opportunities

- **www.phius.org**
- www.phius.org/alliance (PHAUS)
- www.passivehousewpa.com
- www.greenbuildingunited.org



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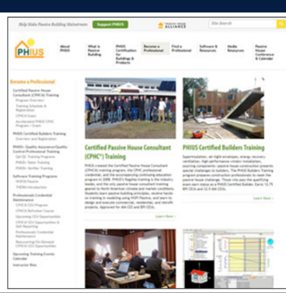
Next Steps

1. Resources
2. **Training Opportunities**

- **www.phius.org/become-a-professional**



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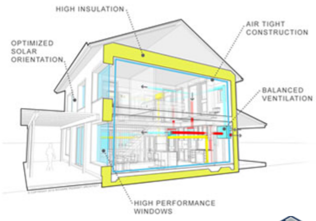
Conclusions

- Passive buildings have key characteristics to significantly reduce building energy loads
  - Optimized solar orientation
  - High Insulation
  - High Performance Windows
  - Airtight Construction
  - Balanced Ventilation
- Passive buildings are attainable, practical & affordable in Pennsylvania
- There are Pennsylvania resources for both the PHI and PHIUS passive building standards
- Work with the professionals, tools, and resources available to you



https://richardpedranti.com/passivehouse/

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Questions?

www.phrc.psu.edu

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