

Pennsylvania Housing Research Center

- The Pennsylvania Housing Research Center serves the home building industry and the residents of Pennsylvania by improving the quality and affordability of housing.
- 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.



Description





Learning Objectives

- Discuss the overall intent of the PA Alternative Residential Energy Provisions as an energy code compliance path, including flexibility and simplicity.
- Evaluate the available energy enhancement options that can be used as entrance requirements for this compliance path, including upgrades to building enclosure elements, higher efficiency equipment, and renewable energy generation.
- Identify available trade-offs that are provided due to the inclusion of an energy enhancement option, such as alternative building enclosure parameters, and their effect on building performance.
- 4. Identify the impact of electing to use this compliance path on the permit and inspection process.



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PA Uniform Construction Code Changes

- On May 1, 2018, the PA Uniform Construction Code (PA UCC) Review and Advisory Council (RAC) submitted their report to the Department of Labor and Industry adopting the majority of code provisions contained in the 2015 International Code Council (ICC) Model Codes.
- These new code provisions are effective as of October 1, 2018.





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Download Link

- PHRC Website
 - www.phrc.psu.edu
- Direct Link
 - <u>https://www.phrc.psu.edu/assets/docs/Publications/2018_Pen</u> nsylvania_Alternative_Energy_Provisions.pdf









Ener	Energy Enhancement Options										
		Energy	Enhancemen	t Options							
	Ontion	Description		Minimum efficiency by climate zone			I				
	option	beschpion		South (4)	Central (5)	North (6)	1				
	1	Ductless heat pumps		8.5 HSPF	8.5 HSPF	8.5 HSPF					
	2	All air ducts located inside the thermal envelop	e	Compliant	Compliant	Compliant					
	3	Solar photovoltaic system installed	1.4 kW	1.7 kW	3.4 kW						
	4	Geothermal or water source heat pump installe	Compliant	Compliant	Compliant						
	5	Improved efficiency air source heat pump insta	8.7 HSPF	9.0 HSPF	10.0 HSPF	1					
	6	Improved efficiency furnace installed		90 AFUE	90 AFUE	90 AFUE	í – – – – – – – – – – – – – – – – – – –				
	7	Exterior continuous insulation		R20+10	R20+10						
	8	Improved airtightness		3.0 ACH50	3.0 ACH50	3.0 ACH50	1				
	9	Improved efficiency windows		U-factor = 0.25	U-factor = 0.23	U-factor = 0.19					
		Package: Improved efficiency windows and	Windows	U-factor = 0.27	U-factor = 0.25	U-factor = 0.25	1				
		higher attic R-value with raised heel truss*	Attic	R-value = 60	R-value = 60	R-value = 60	1				
		Destance becaused officiency units down and	Windows	U-factor = 0.27	U-factor = 0.25	U-factor = 0.23					
	11	heat pump water heater	Heat Pump Water Heater	Compliant	Compliant	Compliant					
16	No	tes: a. Full height of uncompressed insulation sha	ill extend over t	he top plate at the e	aves.		PHRC				

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Energy Enhancement Options

7. Exterior continuous insulation









Energy Enhancement Options

10. Package: Improved efficiency windows & higher attic R-value with raised heel truss

		AMI		South (4)	Central (5)	North (6)
	A CONTRACTOR	005. MIT - PRESERVATION DOUBLE HUNG DRU-PRIC - MELLER - MITLE ALLO PEUR HINK, - MELLER - MITLE ALLO PEUR HINK, - MELLER - MITLE ALLO	Windows	U-factor = 0.27	U-factor = 0.25	U-factor = 0.25
	ENERGY PE	AFORMANCE RATINGS	Attic	R-value = 60	R-value = 60	R-value = 60
	ADDITIONAL I		Notes: a. Fu	ll height of uncompressed ir	sulation shall extend over	the top plate at the eaves.
3			leaa BO	ge Source: TOP - http://peoriasidin TTOM – 2018 PA Alternative Energy	g.com/tag/best-replacement-winde Provisions	ws-in-dlinois/ PHRC











2015 IECC Section R402.2.2

Ceilings without attic spaces

Where Section R402.1.2 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30.
This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet or 20 percent of the total insulated ceiling area, whichever is less.



2015 IECC Section R402.2.4

Access hatches and doors

Source: In

 Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces.







2015 IECC Section R402.2.10

 Slab-on-grade floors - The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall





2015 IECC Section R402.3.4

Opaque door exemption

One side-hinged opaque door assembly up to 24 square feet in area is exempted from the U-factor requirement in Section R402.1.4.

Energy Tradeoffs



2015 IECC Table R402.1.2

Climate Zone	Fenestration U- Factor	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, #}	CEILING R- VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R- VALUE	FLOOR R- VALUE	BAWSEMENT WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE [®] WALL <i>R</i> -VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5 ^h	8/13	19	5/13'	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13 + 5 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13 + 5 ^h	13/17	304	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h or 18 + 6.5 ^h	15/20	304	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	19/21	384	15/19	10, 4 ft	15/19
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Energy Tradeoffs

5. <u>CZ4 Attic Insulation</u>: R-38 insulation (instead of R-49)

Climate Zone	Fenestration ^b U-factor	Skylights U-factor	Glazed Fenestration SHGC	Ceiling R-value	Wood Frame Wall R-value	Mass Wall R-value ^c	Floor R-value	Basement ^d Wall R-value	Slab [*] R-value and depth	Crawlspace ^d Wall R-value
South (4)	0.35	0.55	0.4	38	20 ^h or 13+5 ^g	8/13	19	10/13	10, 2 ft	10/13
Central (5)	0.32	0.55	NR	49	20 ^h or 13+5 ^g	13/17	30 ^f	10/13	10, 2 ft	10/13
North (6)	0.32	0.55	NR	49	23, 20+5, 18+6.5, or 13+10	15/20	30 ^f	10/13	10, 4 ft	15/19

2015 IECC Table R402.1.2

Climate Zone	Fenestration U- Factor	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, #}	CEILING R- VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R- VALUE	FLOOR R- VALUE	BAWSEMENT ⁴ WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5 ^h	8/13	19	5/13'	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13 + 5 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13 + 5 ^h	13/17	304	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h or 18 + 6.5 ^h	15/20	304	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	19/21	384	15/19	10, 4 ft	15/19
		Sour	rce: International Oc	ode Council (ICC). ;	(2014). 2015 intern	ational Residential	Code, Country Clui	b Hill, III.		PHI



Energy Tradeoffs

6. Basement Walls: R-10 insulation option (instead of R-15)

Climate Zone	Fenestration ^b U-factor	Skylights U-factor	Glazed Fenestration SHGC	Ceiling R-value	Wood Frame Wall R-value	Mass Wall R-value ^c	Floor R-value	Basement ^d Wall R-value	Slab [*] R-value and depth	Crawlspace ^d Wall R-value
South (4)	0.35	0.55	0.4	38	20 ^h or 13+5 ^g	8/13	19	10/13	10, 2 ft	10/13
Central (5)	0.32	0.55	NR	49	20 ^h or 13+5 ^g	13/17	30 ^f	10/13	10, 2 ft	10/13
North (6)	0.32	0.55	NR	49	23, 20+5, 18+6.5, or 13+10	15/20	30 ^f	10/13	10, 4 ft	15/19

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2015 IECC Table R402.1.2 2015 IECTable N1102.1.2

Climate Zone	Fenestration U- Factor	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, #}	CEILING R- VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R- VALUE	FLOOR R- VALUE	BAWSEMENT WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE [®] WALL <i>R</i> -VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5 ^h	8/13	19	5/13'	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13 + 5 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13 + 5 ^h	13/17	304	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h or 18 + 6.5 ^h	15/20	304	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	19/21	384	15/19	10, 4 ft	15/19
		Sour	rce: International O	ode Council (ICC). ;	2014). 2015 Interni	ational Residential	Code, Country Clu	ib Hill, III.		PHF

2015 IECC Table R402.1.2 Amendment

- Topic: Climate zone 6 wood frame wall R-value
- Code Section Summary: Additional option added using combination of cavity and continuous exterior insulation
- **PA Amendment:** R18+6.5 is now an option along with R20+5 and R13+10

Source: In







Exterior Insulation: Considerations

- Hygrothermal loading - Double vapor retarder / barrier
- Wall bracing
- Cladding attachment
- Water-resistive barrier placement - Flashing
- Window & door installation

Drying Potential

- Assuming an assembly will get wet, will it be able to dry?
 - Through proper source control, occupant behavior, and assembly design, all building assemblies *must be designed so that they can dry* to the *interior, exterior, or both.*



Vapor Retarders

- Slows diffusion of water vapor through into the building cavity
 - In heating climates, purpose of vapor retarder is to prevent water vapor from entering a wall cavity from the interior and condensing on the interior side of the exterior sheathing (sheathing will be below dew point)

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· Former requirement: on "warm side in winter"

2015 IRC Section R702.7 Vapor Retarders

- Class I or II vapor retarders are required on the interior side of framed walls in Zones 5, 6, 7, 8, and Marine 4
- Exceptions:
 - Basement walls
 - Below grade portion of any wall
 - Construction where moisture or its freezing will not damage materials





Climate Zone	Class III Vapor Retarders Permitted For:
4	Vented cladding over wood structural panels Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 2.5 over 2 x 4 wall Continuous insulation with R-value ≥ 3.75 over 2 x 6 wall
5	Vented cladding over wood structural panels Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 5 over 2 x 4 wall Continuous insulation with R-value ≥ 5 over 2 x 6 wall
6	Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 7.5 over 2 x 4 wall Continuous insulation with R-value ≥ 1.1.25 over 2 x 6 wall

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Energy Tradeoffs										
7. <u>C</u>	<u>Z6 Wa</u>	<u>ills</u> : (-Onl	y Wall	nsul	atio	n Opt	ion	
Climate Zone	Fenestration ^b U-factor	Skylights U-factor	Glazed Fenestration SHGC	Ceiling R-value	Wood Frame Wall R-value	Mass Wall R-value ^c	Floor R-value	Basement ^d Wall R-value	Slab [*] R-value and depth	Crawlspace ^d Wall R-value
South (4)	0.35	0.55	0.4	38	20 ^h or 13+5 ^g	8/13	19	10/13	10, 2 ft	10/13
South (4) Central (5)	0.35	0.55	0.4 NR	38 49	20 ^h or 13+5 ^g 20 ^h or 13+5 ^g	8/13	19 30 ^r	10/13	10, 2 ft 10, 2 ft	10/13













