Christopher Hine, March 11, 2025

Navigating the Ever-Changing Energy Code Landscape, the 2021 IRC/IECC Edition

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1

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- The Pennsylvania Housing Research Center (PHRC) provides and facilitates education, training, innovation, research, and dissemination to the residential construction industry for the purpose of improving the quality and affordability of housing.
- Educational programs and publications by the PHRC address a wide range of topics relevant to the home building industry and are designed to reach a diverse audience: builders, code officials, remodelers, architects, developers, engineers, planners, landscape architects, local government officials, educators, etc. to provide professional development and continuing education.

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2

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2

Description

One of the more challenging portions of the Uniform Construction Code (UCC) for residential builders is navigating the evolution of energy code provisions. This session will provide an overview of the energy-related code provisions in the UCC with an emphasis on the recent changes associated with the 2021 IRC / IECC adoption. Learn about some of the ongoing challenges faced by builders and contractors, including new climate zone maps, continuous insulation requirements, increased slab insulation, energy code compliance paths, and the PA Alternative Residential Energy Provisions.

3

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3

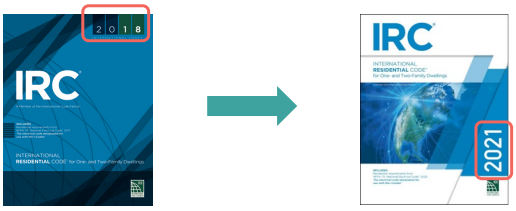
Learning Objectives

- Discuss the building science and heat flow principles that drive the performance of building as it relates to energy.
- Understand current code provisions that dictate minimum energy efficiency features and components in residential construction.
- Review some major impacts that come with the introduction of the 2021 IRC/IECC energy provisions.
- Examine various compliance pathways for energy code compliance in the Uniform Construction Code in Pennsylvania.

4

4

New "Base" Code



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PA UCC Energy Code Summary

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When Is It Changing?

- Anticipated effective date for PA UCC code changes:

July 13, 2025

7

7

Setting the Stage

- Let's start from the beginning.

8

8

General (N1101)

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9

N1101.1 Scope

- This chapter regulates the energy efficiency for the design and construction of buildings regulated by this code.
- **Note:** The text of Sections N1101.2 through N1113 parallels the text of the 2021 edition of the International Energy Conservation Code—Residential Provisions (IECC-R). The section numbers appearing in parenthesis after each section number are the section numbers of the corresponding text in the IECC-R. If a section does not have a section number in parenthesis after it, then there is no corresponding text in the IECC-R.

10

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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10

N1101.4 (R102.1.1) Above Code Programs

- The code official or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. Buildings approved in writing by such an energy-efficiency program shall be considered to be in compliance with this code. The requirements identified in Table N1105.2 *(requirements for total building performance)*, as applicable, shall be met and the building thermal envelope is greater than or equal to levels of efficiency and solar heat gain coefficients (SHGC) in Tables 402.1.1 and 402.1.3 of the 2009 International Energy Conservation Code.

11

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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11

Table N1105.2 (R405.2) Requirements for Total Building Performance

SECTION*	TITLE
General	
~~N1101.13.2~~	~~Additional energy efficiency~~
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.3	Eave baffle
N1102.2.4.1	Access hatches and doors
N1102.2.10.1	Crawl space wall insulation installation
N1102.4.1.1	Installation
N1102.4.1.2	Testing
N1102.5	Maximum fenestration U-factor and SHGC

Mechanical	Technical code changes from previous of the I-Codes are shown in blue text
N1103.1	Controls
N1103.3, including N1103.3.1, except Sections N1103.3.2, N1103.3.3 and N1103.3.6	Ducts
N1103.4	Mechanical system piping insulation
N1103.5.1	Heated water circulation and temperature maintenance systems
N1103.5.3	Drain water heat recovery units
N1103.6	Mechanical ventilation
N1103.7	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt system controls
N1103.10	Energy consumption of pools and spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls

a. Reference to a code section includes all the relative subsections except as indicated in the table.

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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12

12

N1101.9 (R302.1) Interior Design Conditions

- The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

13

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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13

N1101.13 (R401.2) Application

- Residential buildings shall comply with Section:
  - N1101.13.5 (Additional Energy Efficiency) and:
  - N1101.13.1 (Prescriptive Compliance Path),
  - N1101.13.2 (Total Building Performance Option),
  - N1101.13.3 (Energy Rating Index Option) or
  - ~~N1101.13.4 (Tropical Climate Region Option),~~
  - Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Section N1109.

14

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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14

N1101.13.5 Additional Energy Efficiency

- **This section was not adopted during the RAC process.**
  - RAC Report: Section N1101.13.5 (R401.2.5) Additional energy efficiency, was not adopted as part of the current Pennsylvania adoption of the 2021 IRC/IECC
  - Along with all references

15

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15

N1108.1 Scope

- Section N1108.1 - **Scope.** This section establishes additional efficiency package options to achieve additional energy efficiency. ~~in accordance with Section N1101.13.5.~~
  - This modified language removes the compliance reference to N1101.13.5.

16

16

N1108.2 Additional Efficiency Package Options

- **Section N1108.2 - Additional efficiency package options, is adopted as follows:**
  - **N1108.2 (R408.2) Additional efficiency package options:** Additional efficiency package options ~~for compliance with Section N1101.13.5~~ are set forth in Sections N1108.2.1 (R408.2.1) through N1108.2.5 (R408.2.5).
  - This modified language leaves the provisions in the code but are no longer mandatory. They can now be a guide for increased energy efficiency.

17

17

N1101.13 (R401.2) Application

- Residential buildings shall comply with Section:
  - ~~N1101.13.5 (Additional Energy Efficiency) and~~:
  - N1101.13.1 (Prescriptive Compliance Path),
    - R-value Alternative
    - Total UA Alternative
  - N1101.13.2 (Total Building Performance Option),
  - N1101.13.3 (Energy Rating Index Option) or
  - ~~N1101.13.4 (Tropical Climate Region Option).~~
  - Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Section N1109.

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

18

18

Climate Zones N1107 (R301.1)

19

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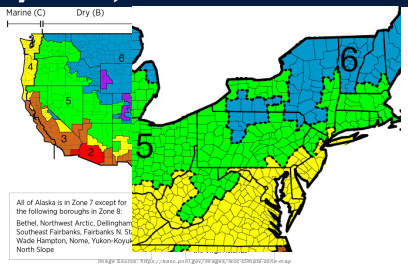
19

2018 Climate Zone Map (3 Climate Zones in Pennsylvania)



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20

2021 Climate Zone Map (2 Climate Zones in Pennsylvania)

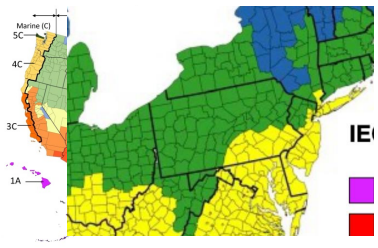

Image Source: https://basc.pnnl.gov/images/ecc-climate-zone-map

21

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21

Prescriptive Compliance Option N1102, N1103 & N1104)

22

22

N1101.13.1 Prescriptive Compliance Option

- The Prescriptive Compliance Option requires compliance with Sections N1101 through N1104.
  - N1101 – General – Already covered
  - N1102 – Building Thermal Envelope
  - N1103 – Systems
  - N1104 – Electrical Power and Lighting Systems

23

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

23

Building Thermal Envelope (N1102)

24

24

N1102.1 (R402.1) General:

- The building thermal envelope shall comply with the requirements of Sections N1102.1.1 through N1102.1.5.
  - N1102.1.1 – Vapor Retarder
  - N1102.1.2 – Insulation and Fenestration Criteria
  - N1102.1.3 – R-Value Alternative
  - N1102.1.4 – R-Value Computation
  - N1102.1.5 – Total UA Alternative

25

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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25

N1102.1 (R402.1) General:

- The building thermal envelope shall comply with the requirements of Sections N1102.1.1 through N1102.1.5.
  - **Exceptions:**
    - 1. The following low-energy buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this section shall be exempt from the building thermal envelope provisions of Section N1102.
      - 1.1. Those with a peak design rate of energy usage less than 3.4 Btu/h × ft2 (10.7 W/m2) or 1.0 watt/ft2 of floor area for space-conditioning purposes.
      - 1.2. Those that do not contain conditioned space.
    - 2. Log homes designed in accordance with ICC 400.

26

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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26

N1102.1.1 (R402.1.1) Vapor Retarder:

- Wall assemblies in the building thermal envelope shall comply with the vapor retarder requirements of Section R702.7.

- 2021 PA UCC Residential Code Update: Part 1
  - Vapor Retarder discussion @ 38:19
  - @PHRCPennState
    - https://youtu.be/zcQEZuAiAhA?si=JpaprufLr44odNcM

27

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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27

N1102.1.2 (R402.1.2) Insulation and Fenestration Criteria:

- The building thermal envelope shall meet the requirements of Table N1102.1.2 *(Maximum Assembly U-Factors and Fenestration Requirements)* based on the climate zone specified in Section N1101.7. Assemblies shall have a U-factor equal to or less than that specified in Table N1102.1.2. Fenestration shall have a U-factor and glazed fenestration SHGC equal to or less than that specified in Table N1102.1.2.

28

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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28

Table N1102.1.2 Maximum Assembly U-Factors and Fenestration Requirements

TABLE R1102.1.2 (R402.1.2)
MAXIMUM ASSEMBLY *U*-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC[d,e]	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR[b]	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.25	0.030	0.060	0.098	0.047	0.091	0.136
4 except Marine	0.30	0.55	0.40	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	NR	0.026	0.051	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.026	0.045	0.057	0.028	0.050	0.055

29

Source: https://www.pa.gov/content/dam/copapwp-pagov/en/dli/documents/ucc/documents/2021%20icc%20code%20adoption%20final%20report.pdf

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29

N1102.1.3 (R402.1.3) R-value Alternative

- Assemblies with R-value of insulation materials equal to or greater than that specified in Table N1102.1.3 *(Insulation Minimum R-Value and Fenestration Requirements by Component)* shall be an alternative to the U-factor in Table N1102.1.2.

30

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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30

Table N1102.1.3 Insulation Minimum R-Value and Fenestration Requirements by Component

TABLE N1102.1.3 (R402.1.3)
INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING R-FACTOR	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] 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	0.32	0.55	0.25	38	20 or 13 + 5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	20 or 13 + 5[h]	8/13	19	10/13	10, 2ft	10/13
5 and Marine 4	0.30	0.55	NR	49	23 or 13 + 7.5[h] or 20 + 3.8[h]	13/17	30[g]	15/19	10, 4ft or 15, 3ft	15/19
6	0.30	0.55	NR	49	20 + 5[h] or 13 + 10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20 + 5[h] or 13 + 10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

Source: https://www.pa.gov/content/dam/copapwp-pagov/en/dli/documents/ucc/documents/2021%20icc%20code%20adoption%20final%20report.pdf

31

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31

R-Value, U-Factor Conversion

- Thermal resistance (R-Value)
  - Higher R-Value = better insulating value
- Thermal transmittance (U-Factor)
- U-Factor = 1 / (R-Value); U-.30 = R-3.33 or R-20 = U-.05
  - R-Value = Insulation
  - U-Factor = Fenestration
  - Lower U-Factor = better insulating value

32

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32

N1102.1.4 (R402.1.4) R-value Computation.

- Cavity insulation alone shall be used to determine compliance with the cavity insulation R-value requirements in Table N1102.1.3. Where cavity insulation is installed in multiple layers, the R-values of the cavity insulation layers shall be summed to determine compliance with the cavity insulation R-value requirements. The manufacturer's settled R-value shall be used for blown-in insulation. Continuous insulation (ci) alone shall be used to determine compliance with the continuous insulation R-value requirements in Table N1102.1.3. Where continuous insulation is installed in multiple layers, the R-values of the continuous insulation layers shall be summed to determine compliance with the continuous insulation R-value requirements. Cavity insulation R-values shall not be used to determine compliance with the continuous insulation R-value requirements in Table N1102.1.3. Computed R-values shall not include an R-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table N1102.1.3, the manufacturer's labeled R-value for insulated siding shall be reduced by R-0.6.

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

33

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33

N1102.1.5 (R402.1.5) Total UA Alternative

- Where the total building thermal envelope UA, the sum of U-factor times assembly area, is less than or equal to the total UA resulting from multiplying the U-factors in Table N1102.1.2 by the same assembly area as in the proposed building, the building shall be considered to be incompliance with Table N1102.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements of Table N1102.1.2 and the maximum fenestration U-factors of Section N1102.5 shall be met.

34

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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34

N1102.5 (R402.5) Maximum Fenestration U-Factor and SHGC

- The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section N1102.1.5 or N1105 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section N1105 in Climate Zones 0 through 3 shall be 0.40.
  - Exception: The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

35

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

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35

Total UA Alternative Calculator

- **The total UA Alternative is a calculation, not a simulation**
  - REScheck: https://www.energycodes.gov/rescheck

Generated by RES*check*-*Web* Software

Compliance Certificate

Project A Sample Project

Verify energy code, location, construction type, and conditioned floor area

Energy Code:	2018 IECC
Location:	Eugene, Oregon
Construction Type:	Single-family
Project Type:	New Construction
Orientation:	Bldg. faces 180 deg. from North
Conditioned Floor Area:	3,000 ft2
Glazing Area	2%
Climate Zone:	4 (4546 HDD)
Permit Date:	
Permit Number:	

Construction Site: 123 Main St., Dogtown, WA 99352

Owner/Agent: R. Franklin, 321 W. Tenth, Dogtown, WA 99532, 509.888.7777

Designer/Contractor: Anne Hatchet, Acme Home Designers, 555 Paire Ridge, Dogtown, WA 99532, 509.888.999

Compliance: Passes using UA trade-off

Compliance: **17.8% Better Than Code** Maximum UA: **545** Your UA: **448**

The % Better or Worse Than Code Index reflects how close to compliance the house is based on code trade-off rules. It DOES NOT provide an estimate of energy use or cost relative to a minimum-code home.

Building Energy Codes Program

https://www.energycodes.gov/sites/default/files/2022-07/NECC2022_Bootcamp_REScheck-Basics.pdf

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36

Total Building Performance Option (N1105)

37

37

N1101.13.2 (R401.2.2) Total Building Performance Option

- The Total Building Performance Compliance Path requires compliance with Section N1105.
  - N1105 (R405) – Total Building Performance

38

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

38

N1105.1 (R405.1) Scope

This section establishes criteria for compliance using total building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water-heating energy only.

39

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Il.

39

N1105.2 (R405.2) Performance-based Compliance.

Compliance based on total building performance requires that a proposed design meets all of the following:

1. The requirements of the sections indicated within Table N1105.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 International Energy Conservation Code.

40

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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40

Table N1105.2 (R405.2) Requirements for Total Building Performance

SECTION[a]	TITLE
General	
~~N1101.13.2~~	~~Additional energy efficiency~~
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.3	Eave baffle
N1102.2.4.1	Access hatches and doors
N1102.2.10.1	Crawl space wall insulation installation
N1102.4.1.1	Installation
N1102.4.1.2	Testing
N1102.5	Maximum fenestration *U*-factor and SHGC

Mechanical	
N1103.1	Controls
N1103.3, including N1103.3.1, except Sections N1103.3.2, N1103.3.3 and N1103.3.6	Ducts
N1103.4	Mechanical system piping insulation
N1103.5.1	Heated water circulation and temperature maintenance systems
N1103.5.3	Drain water heat recovery units
N1103.6	Mechanical ventilation
N1103.7	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt system controls
N1103.10	Energy consumption of pools and spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls

Technical code changes from previous of the I-Codes are shown in blue text

a. Reference to a code section includes all the relative subsections except as indicated in the table.

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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41

41

N1105.2 (R405.2) Performance-based Compliance. (cont.)

Compliance based on total building performance requires that a proposed design meets all of the following:

1. The requirements of the sections indicated within Table N1105.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 International Energy Conservation Code.

42

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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42

N1105.2 (R405.2) Performance-based Compliance.

TABLE 402.1.1INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5/8	19	5/13[f]	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13/17	30[g]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5[h]	15/19	30[g]	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38[g]	15/19	10, 4 ft	10/13

43

Source: International Code Council (ICC), (2008), 2009 International Energy Conservation Code, Country Club Hill, Ill.

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43

N1105.2 (R405.2) Performance-based Compliance. (cont.)

Compliance based on total building performance requires that a proposed design meets all of the following:

3. An annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.
   - Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

44

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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44

N1105.3.2 (R405.3.2) Compliance Report

Compliance software tools shall generate a report that documents that the proposed design complies with Section N1105.2. A compliance report on the proposed design shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based on the confirmed condition of the building shall be submitted to the code official before a certificate of occupancy is issued.

- Compliance reports shall include information in accordance with Sections N1105.3.2.1 and N1105.3.2.2.

45

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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45

Example Reports

- Ekotrope
  - Total Building Performance
- REMRate

IECC 2021 Performance Compliance

Property
123 Fake Street
New Castle, PA 16101

Organization
Harmony Home Energy
Michael Arblaster

Inspection Status
Results are projected

PHRC EXAMPLE REPORT-REM-RATE_2021IECC.xml

Builder
PHRC Example

This report is based on a proposed design and does not confirm field enforcement of design elements.

Annual Energy Cost

Design	IECC 2021 Performance	As Designed
Heating	$1,068	$957
Cooling	$106	$103
Water Heating	$267	$267
Mechanical Ventilation	$32	$29
SubTotal - Used to determine compliance	**$1,473**	**$1,357**
Lights & Appliances w/out Ventilation	$950	$950
Onsite generation	$0	$0
Total	**$2,423**	**$2,307**

R405.2 Source Energy Exception: The proposed home uses 9.01 MBtu LESS source energy than the reference home.

Requirements

✔	R405.2	Performance-based compliance passes by 7.9%	The proposed house meets the IECC 2021 Performance reference energy bill requirement by $115.99 (9.01 MBtu).
✔	R405.2 Item 2 (IECC 2009)	Total UA alternative compliance passes by 11.1%.	The proposed home meets the UA requirement by 11.1%
✔	R405.2 Item 2 (IECC 2009)	Glazed Fenestration SHGC	
✔	R402.4.1.2	Air Leakage Testing	Air sealing is 1.63 ACH at 50 Pa and 0.14 CFM50 / ft² Shell Area. It must not exceed 5.00 ACH at 50 Pa or 0.28 CFM50 / ft² Shell Area.
✔	R403.3.1	Duct Insulation	All ducts are inside the thermal envelope or outside and insulated to at least R8.0.
✔	R403.3.5	Duct Testing	
⚠	R403.6	Mechanical Ventilation	Rated home must have at least one mechanical ventilation system, and it should be IRC M1505.4 compliant. Please refer to the 'Codes & Programs' tab.
✔	R404.1	Lighting Equipment	
⚠	Mandatory Checklist	Mandatory code requirements that are not checked by Ekotrope must be met.	2021 IECC Required Items must be checked as complete.
⚠	R403.6.2	Mechanical Ventilation Efficacy	Please specify whether the mechanical ventilation is an inline fan.
✔	R403.6.1	Mechanical Ventilation Energy Recovery	
✔	R402.5	Area-weighted average fenestration SHGC	Area-weighted average fenestration SHGC is 0.281. The maximum allowed value is [No Limit].
✔	R402.5	Area-weighted average fenestration U-Factor	
✔	R401.2.5 Option 2	Additional energy efficiency	R401.2.5: 2.2 - 95% Threshold Met.

Design exceeds the performance requirement for IECC 2021 Performance compliance by 7.9% but fails the mandatory requirements.

46

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Energy Rating Index Option (N1106)

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N1101.13.3 (R401.2.3) Energy Rating Index Option

- The Energy Rating Index (ERI) option requires compliance with Section N1106.
  - N1106 (R406) – Energy Rating Index Compliance Alternative

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

48

48

N1106.1 (R406.1) Scope

- This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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49

N1106.2 (R406.2) ERI Compliance

Compliance based on the Energy Rating Index (ERI) requires that the rated design meet all of the following:

1. The requirements of the sections indicated within Table N1106.2.
2. Maximum ERI of Table N1106.5.

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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50

Table N1106.2 (R406.2) Requirements for Energy Rating Index

SECTION[a]	TITLE
General	
~~N1101.13.2~~	~~Additional efficiency packages~~
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor retarder
N1102.2.3	Eave baffle
N1102.2.4.1	Access hatches and doors
N1102.2.10.1	Crawl space wall insulation installation
N1102.4.1.1	Installation
N1102.4.1.2	Testing

Mechanical	
N1103.1	Controls
N1103.3 except Sections N1103.3.2, N1103.3.3 and N1103.3.6	Ducts
N1103.4	Mechanical system piping insulation
N1103.5.1	Heated water circulation and temperature maintenance systems
N1103.5.3	Drain water heat recovery units
N1103.6	Mechanical ventilation
N1103.7	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt system controls
N1103.10	Energy consumption of pools and spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior lighting controls
N1105.3	Building thermal envelope

a. Reference to a code section includes all of the relative subsections except as indicated in the table.

Source: International Code Council (ICC), (2020), 2021 International Residential Code, Country Club Hill, Ill.

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51

~~N1106.3 (R406.3) Building Thermal Envelope~~ – Not Adopted per RAC Report

Building and portions thereof shall comply with Section N1106.3.1 or N1106.3.2.

52

52

~~N1106.3.1 (R406.3.1) On-Site Renewables Are Not Included~~ – Not Adopted per RAC Report

Where on-site renewable energy is not included for compliance using the ERI analysis of Section N1106.4, the proposed total building thermal envelope UA, which is sum of U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table N1102.1.2 multiplied by 1.15 in accordance with Equation 11-4. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

$$UA_{Proposed\ design} = 1.15 \times UA_{Prescriptive\ reference\ design} \quad \text{(Equation 11-4)}$$

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~~N1106.3.2 (R406.3.2) On-Site Renewables Are Included~~ – Not Adopted per RAC Report

Where on-site renewable energy is included for compliance using the ERI analysis of Section N1106.4, the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table N1102.1.2, or Table R402.1.4 of the 2018 International Energy Conservation Code.

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N1106.4 (R406.4) Energy Rating Index - 2021 Not Adopted per RAC Report Remains; 2018 Language

The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the ERI reference design has an Index value of 100 and a residential building that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1 percent change in the total energy use of the rated design relative to the total energy use of the ERI reference design. The ERI shall consider all energy used in the residential building.

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Table N1106.4 (R406.4) Maximum Energy Rating Index (modified table from 2015 review)

TABLE N1106.4 (R406.4)MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX[a]
1	57
2	57
3	57
4	62
5	61
6	61
7	58
8	58

a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of R406.2 and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.3.

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N1106.2 (R406.2) R406.2 Mandatory Requirements - 2018 Language (2015 IECC)

... The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009 International Energy Conservation Code .

- **Exception**: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

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N1105.2 (R405.2) Performance-based Compliance.

TABLE 402.1.1INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5/8	19	5/13[f]	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13/17	30[g]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5[h]	15/19	30[g]	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38[g]	15/19	10, 4 ft	10/13

Source: International Code Council (ICC), (2008), 2009 International Energy Conservation Code, Country Club Hill, Ill.

58

58

N1106.4.1 (R406.4.1) ERI Reference Design - 2021 Not Adopted per RAC Report Remains; 2018 Language

The ERI reference design shall be configured such that it meets the minimum requirements of the 2006 International Energy Conservation Code prescriptive requirements. The proposed residential building shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the ERI reference design.

59

59

Blower Door Testing in the 2021 IRC

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N1102.4.1.2 Testing (Performance)

- The building or dwelling unit shall be tested for air leakage. The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 m3/(s × m2)] of *dwelling unit enclosure area*. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed.

61

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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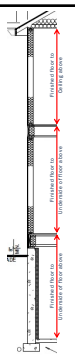
61

Dwelling Unit Enclosure Area - Defined

- **DWELLING UNIT ENCLOSURE AREA.** The sum of the area of ceiling, floors and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.



62

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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62

N1102.4.1.3 Leakage Rate (Prescriptive)

- **N1102.4.1.3 (R402.4.1.3) Leakage rate.**
- Where complying with Section N1101.13.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section N1102.4.1.2.

63

Source: International Code Council (ICC). (2020). 2021 International Residential Code, Country Club Hill, Ill.

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63

What Exactly Does That Mean?

- **Performance Path for any climate zone**
  1. Meeting overall building performance requirements
  2. Not exceeding 5ach50
  3. Not exceed .28cfm/sq ft
     1. Exception: Not exceeding .30 for attached or units under 1500 sq.ft.
- **Prescriptive Path**
  1. Not exceeding 3ach50 in CZ 3-8
     1. Exception: Not exceeding .30 for attached or units under 1500 sq.ft.
  2. Not exceeding 5ach50 in CZ 0-2
     1. Exception: Not exceeding .30 for attached or units under 1500 sq.ft.

64

64

2025 Pennsylvania Alternative Residential Energy Provisions

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Act 45 of 1999

- **Chapter 3 (Uniform Construction Code) - Section 301 (c):**
  - (c) Prescriptive methods for energy-related standards.–The department shall, within 180 days of the effective date of this section, by regulation promulgate prescriptive methods to implement the energy-related standards of the Uniform Construction Code which take into account the various climatic conditions through this Commonwealth. In deriving these standards the department shall seek to balance energy savings with initial construction costs.

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Uniform Construction Code Regulations

- **Chapter 403 – 403.21 (Uniform Construction Code) part (d) (1):**
  - (1) The prescriptive methods for detached residential buildings contained in the "International Energy Conservation Code of *2018*" compliance guide containing State maps, prescriptive energy packages and related software published by the United States Department of Energy, Building Standards and Guidelines Program (REScheckTM) or "Pennsylvania's Alternative Residential Energy Provisions."

67

67

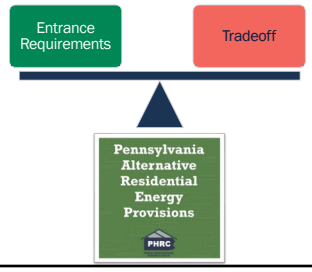
Mandate for the PA-Alt

- **The PHRC developed the PA-Alt for consideration by DLI to meet their legislative mandate. The PA-Alt was developed with the intent of being:**
  - Simpler to build to and easier to enforce;
  - more rational and flexible;
  - Focused on PA in terms of climatic and other considerations; and
  - equivalent to the provisions of the International Energy Conservation Code (IECC) as amended in the PA UCC.

68

68

PA Alternative Residential Energy Provisions

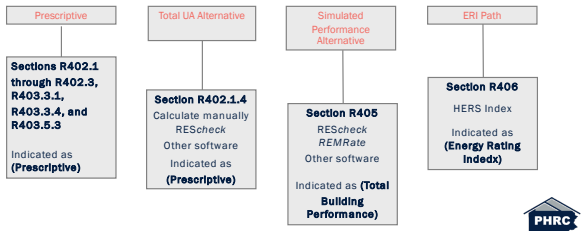


- **Choose one (1) Entrance Requirement**
  - "Energy Enhancement Options"
- **Receive ALL tradeoffs**
- **Energy modeling completed (BEopt) to ensure equivalent energy usage**

69

69

Summary: 2021 IECC Energy Compliance Options in Pennsylvania



70

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70

Questions?

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71

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71

PHRC YouTube Channel

- Link and QR Code to the PHRC YouTube Channel
- https://www.youtube.com/@PHRCPennState

72

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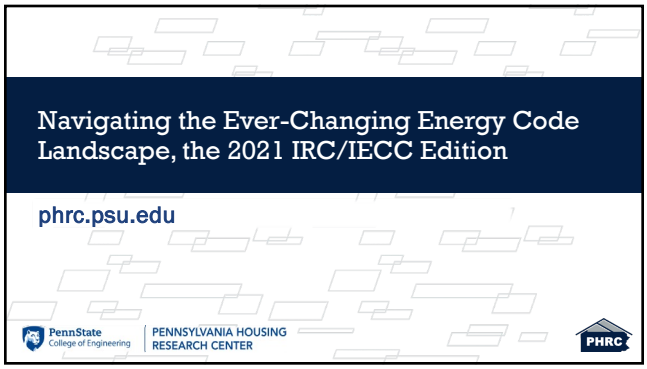
72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73