An Introduction to the 2021 IECC

December 3, 2024

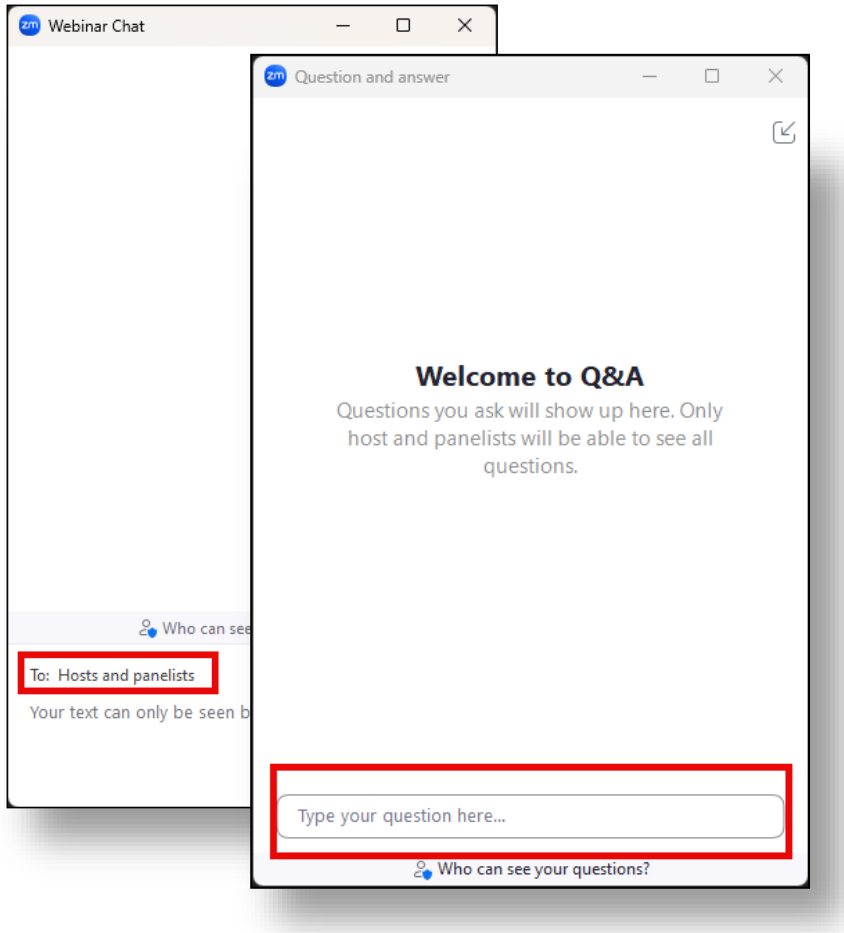
U.S. Department of ENERGY | Office of Energy Efficiency & Renewable Energy

Webinar Instructions

- PowerPoint and webinar recording will be available on the HUD Exchange
- Participants are in ‘listen only’ mode
- Submit content related questions in the Q&A
- For technical issues, request assistance through the chat box

Technical Issues? Questions?

- Chat
  - Submit any technical issues via the chat box
    - Send the message to the Host
    - Host will work directly with you to resolve those issues
- Q&A
  - Submit any content related questions via the Q&A box



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Energy Code Webinar Series

Implementing HUD's New Minimum Energy Standards for HOME and Housing Trust Fund Projects	November 19, 2024 2:00-3:30 PM EST
An Introduction to the 2021 IECC	December 3, 2024 2:00-3:30 pm EST
An Introduction to ASHRAE 90.1-2019	December 9, 2024 2:00-3:30 PM EST
Alternative Compliance Pathways	TBD

Register for the Energy Code Webinar Series at www.hudexchange.info/trainings

Today's Presenters

Andrew Poling

Program Analyst

Office of Environment and Energy

U.S. Department of Housing and Urban Development

Dana Bartolomei

Senior Manager, Community Development

ICF

Mike Turns

Senior Research Analyst

Pacific Northwest National Laboratory

Background

Scope and Purpose

The Energy Independence and Security Act of 2007 (EISA) requires HUD and USDA to jointly adopt the most recently published energy standards subject to a housing "affordability and availability" test. HUD and USDA currently require 2009 IECC and ASHRAE 90.1-2007.

The Final Determination, published in the Federal Register on April 26, 2024, brings HUD and USDA into compliance with EISA by adopting 2021 IECC and ASHRAE 90.1-2019 as minimum energy standards.

This notice impacts new construction only.

The updated energy code does not apply to FHA-insured or USDA mortgage financing for existing housing or manufactured housing.

Current Determination (2024)

- Final Determination: Adoption of Energy Efficiency Standards for New Construction of HUD- and USDA-Financed Housing:
  - Jointly published by HUD and USDA in April 2024
  - Applies to **new construction** for the HUD and USDA programs covered by the statute
  - Establishes **2021 IECC** as minimum standard for single-family and low-rise multifamily housing
  - Establishes **ASHRAE 90.1-2019** as minimum standard for mid- or high-rise multifamily housing (4+ stories)

Estimated Savings of the 2021 IECC

- The 2021 IECC is 34.3% more efficient than the 2009 IECC
- Cost savings across all units are estimated at $73 million per year or $1.48 billion over a 30-year period

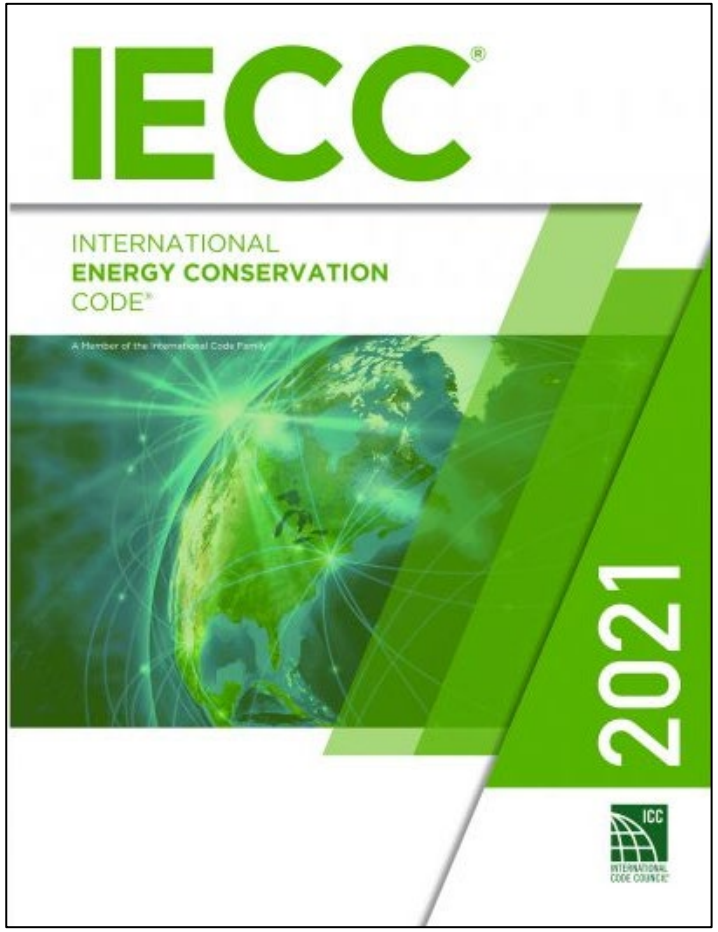
Compliance Dates by Program

Program	Event that Triggers Compliance	Final Determination (Current)
FHA-Insured Multifamily	Pre-application submitted to HUD	12 months after effective date or May 28, 2025
FHA-Insured Single Family USDA Single Family Direct, Guaranteed, and Self-Help Loans	Building permit application	18 months after effective date or November 28, 2025
HOME/Housing Trust Fund (HTF)	Participating Jurisdiction or HTF grantee funding commitment	180 days after effective day (6 months) or November 28, 2024*
Public Housing (Capital Fund, Project Based Vouchers)	HUD approvals of development proposals for new Capital Fund, mixed financed projects, and PBVs	12 months after effective date or May 28, 2025
Competitive Grants (Choice Neighborhoods, Section 202, Section 811)	NOFO publication	Next published NOFO after effective date
Rental Assistance Demonstration	Required by Federal Register Notice published on July 27, 2023	Already implemented and applicable to new construction
All programs, persistent poverty rural areas	-	24 months after effective date or May 28, 2026

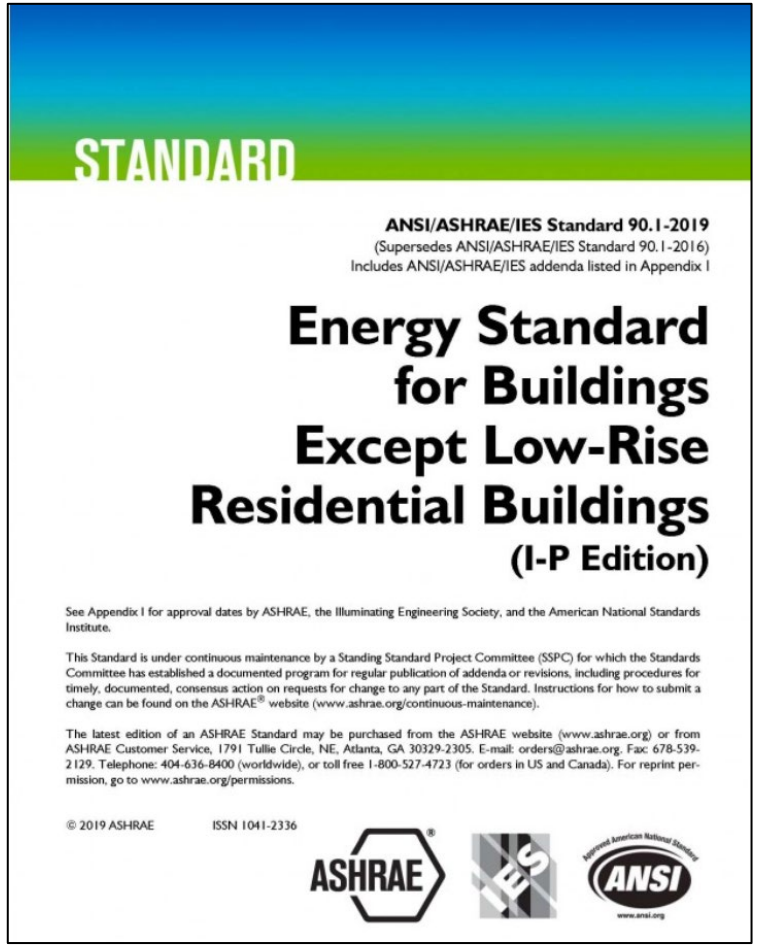
*If HOME/HTF funding layered with other HUD funds, the later program compliance date applies.

2021 International Energy Conservation Code (IECC)

Two Codes Specified in Statute

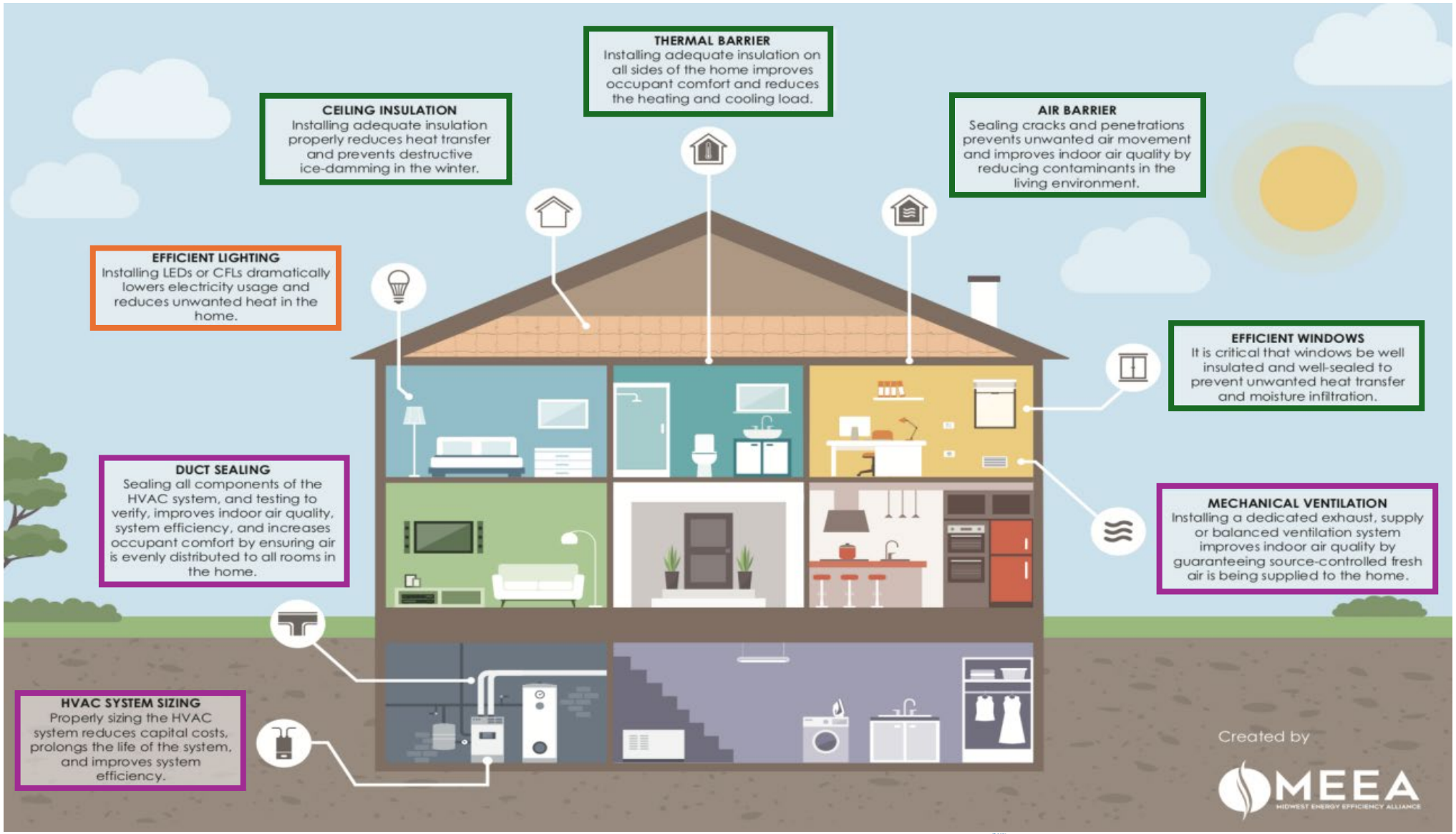


Single Family + Low-Rise Multifamily



Multifamily 4+ Stories

How the IECC Improves a Home



Anticipated Benefits

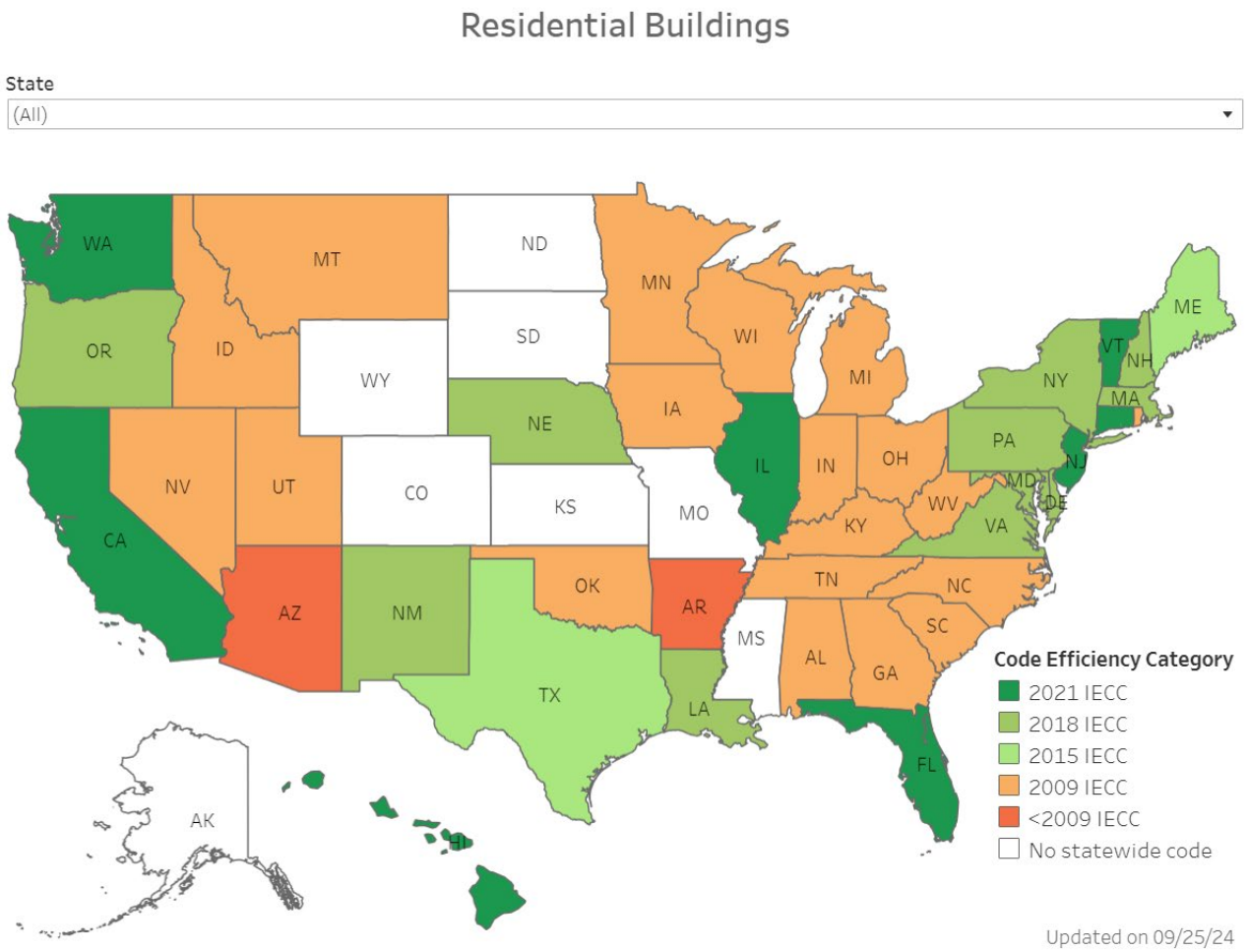
Initial and ongoing cost savings

Health Benefits

Enhanced Comfort

Resilience to extreme weather events

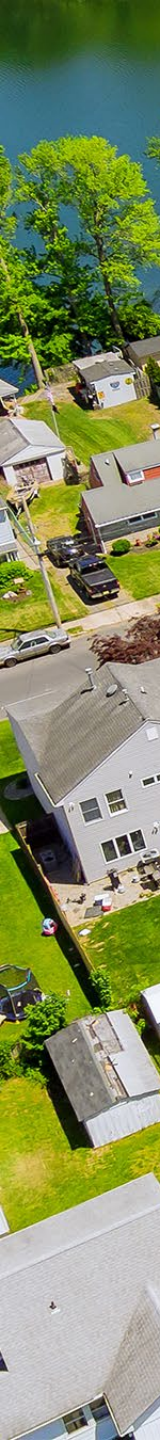
Differences in State Code Adoption and Requirements



- Codes are adopted at the state level
- States often adopt amendments to the IECC
- HUD and USDA-assisted new construction projects must build to the standards of the unamended 2021 IECC or its equivalent

Alternative Compliance Pathways

- Industry is already building to standards that meet or exceed the 2021 IECC or ASHRAE 90.1-2019
  - Low Income Housing Tax Credit (LIHTC) Qualified Allocation Plans often require or incentivize high-performance building standards
  - Tax credits available for building to ENERGY STAR program requirements or certifying to DOE's Zero Energy Ready Home Program
- HUD will publish a list of high-performance building standards that will be accepted as alternate compliance pathways
  - These may include ENERGY STAR Certified Homes, DOE's Zero Energy Ready Home Program, and other high performance building standards that set or incentivize 2021 IECC or ASHRAE 90.1-2019 as baseline standards
  - The 2024 IECC may also be accepted, contingent on DOE analysis showing increased efficiency over the 2021 IECC



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PNNL-SA-204978

An Introduction to the 2021 IECC:

Changes between the 2009 and 2021 IECC – Residential Provisions

Mike Turns
Senior Research Analyst

U.S. DEPARTMENT OF ENERGY BATTELLE

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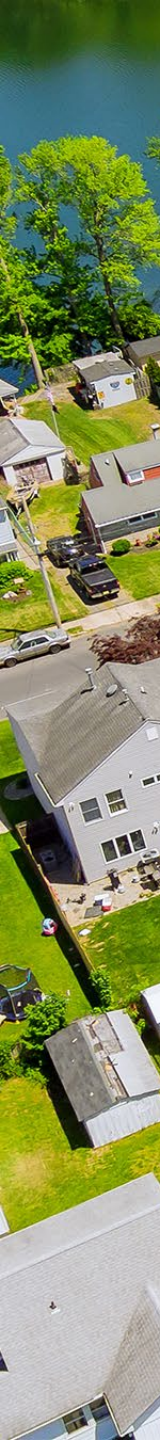

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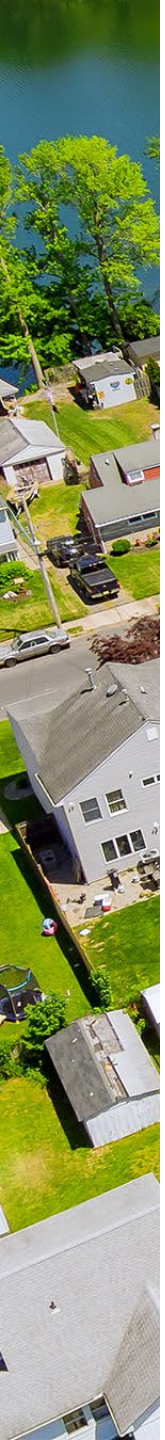
Agenda

- **DOE Building Energy Codes Program Introduction**
- **Energy Codes 101**
- **Climate Zone changes**
- **Compliance paths**
- **Chapter 4 – Residential Energy Efficiency changes**
  - **Building Thermal Envelope**
    - Prescriptive R-value/U-factors
    - Air barrier and insulation installation criteria
    - Air leakage testing and ACH50 limits
  - **Lighting**
    - Interior lighting
      - ✓ % high-efficacy
      - ✓ Controls
    - Exterior lighting controls
  - **Mechanical systems**
    - Building cavities used as ducts
    - Duct leakage testing options and limits
    - Hot water pipe insulation
    - Whole-house ventilation and testing
    - HRV/ERV for Climate Zones 7 and 8
  - **Additional Efficiency Packages**



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Building Energy Codes Program Introduction

Mission

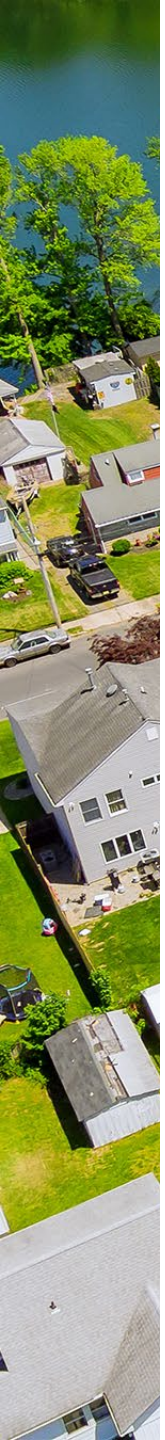
To support building **energy code development, adoption, implementation and enforcement processes** to achieve the maximum practicable, cost-effective improvements in energy efficiency and decarbonization while providing safe, healthy buildings for occupants.

Directive

The Building Energy Codes Program is directed to:

- **Participate in industry processes** to develop model building energy codes
- **Issue determinations** as to whether updated codes result in energy savings
- **Promulgate standards** for federal buildings
- **Provide technical assistance** to states to implement their energy codes

More Information: www.energycodes.gov



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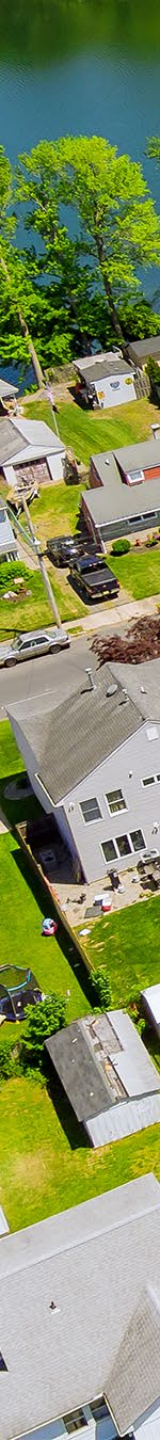
Energy Codes 101

Free to view at https://codes.iccsafe.org/

- Energy codes set requirements for minimum levels of efficiency
- The IECC is the most adopted model energy code in the US, typically by states
- The IECC is developed through a national, consensus-based process
- An updated version is published every three years
- State amendments are common
- The IECC is one of many model building codes (building, plumbing, mechanical, electrical, fire, etc.)



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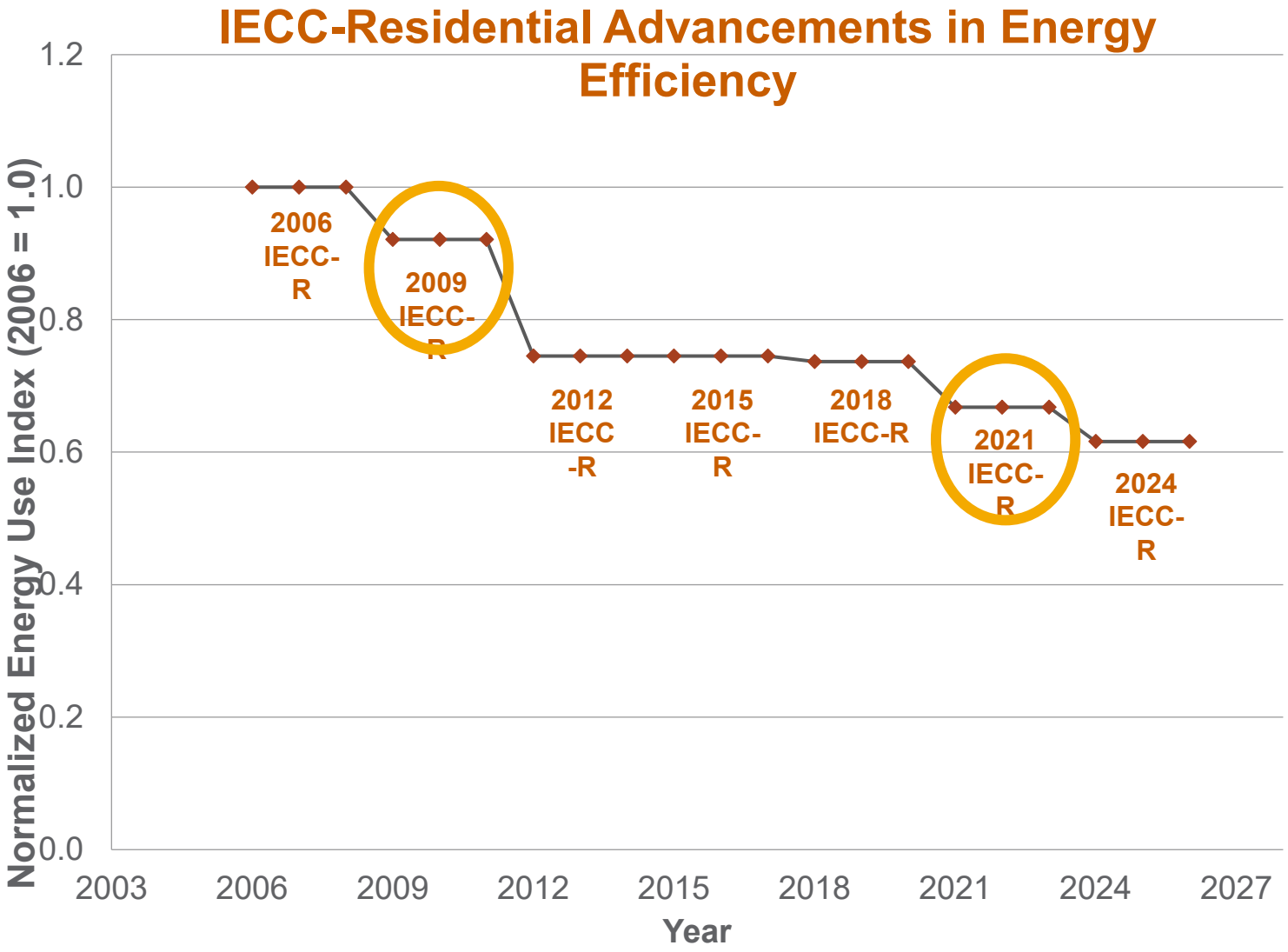

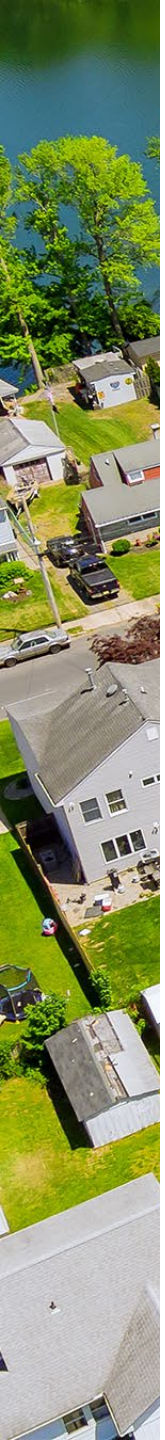

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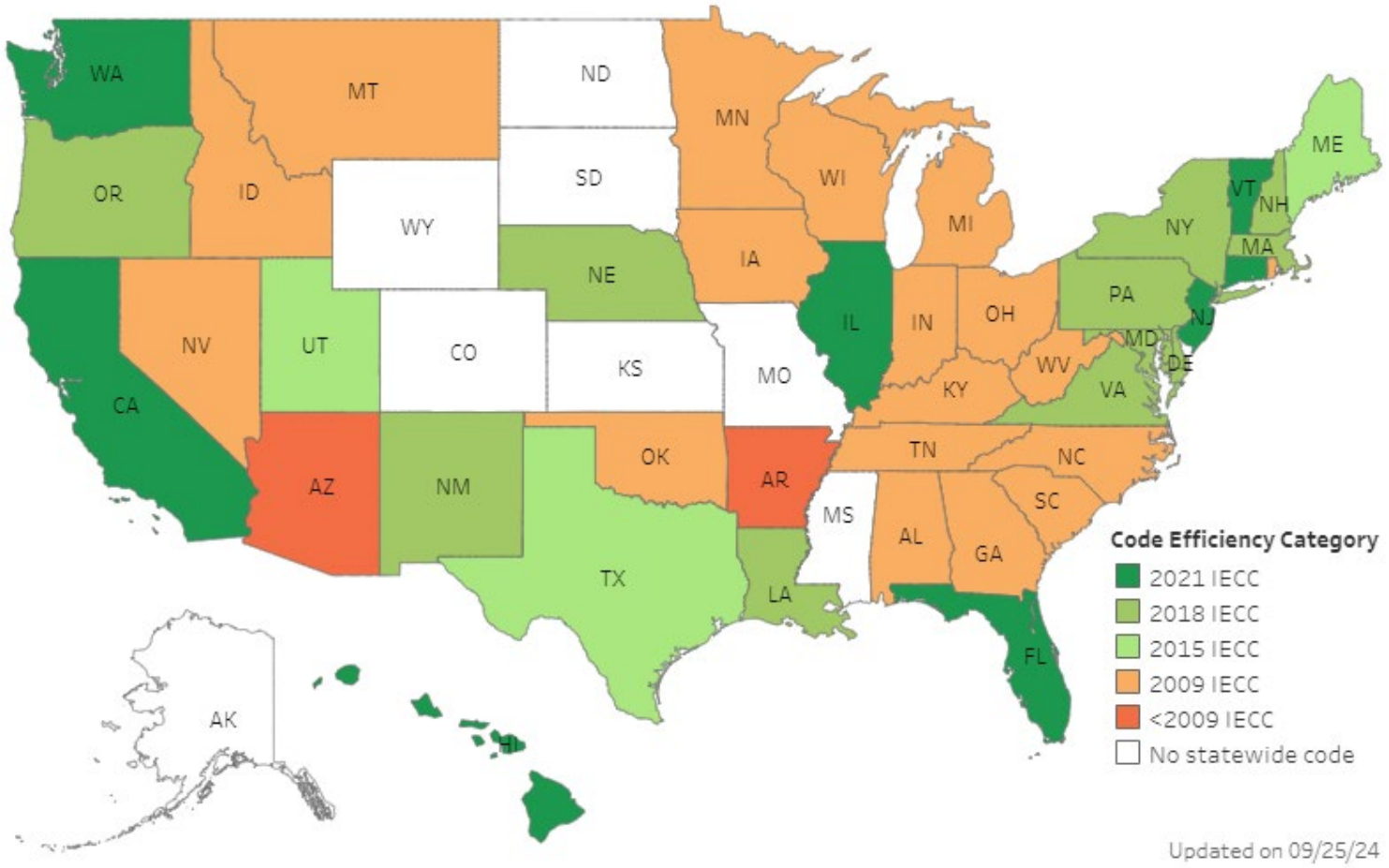
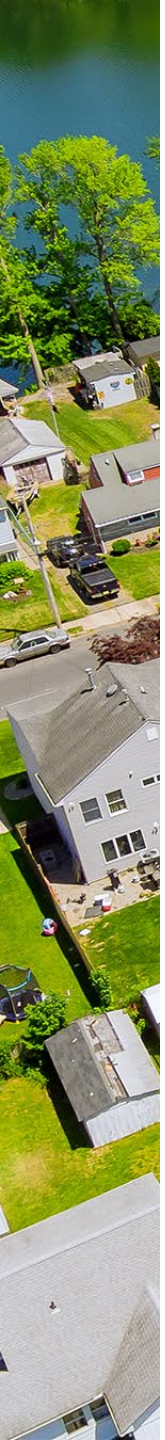
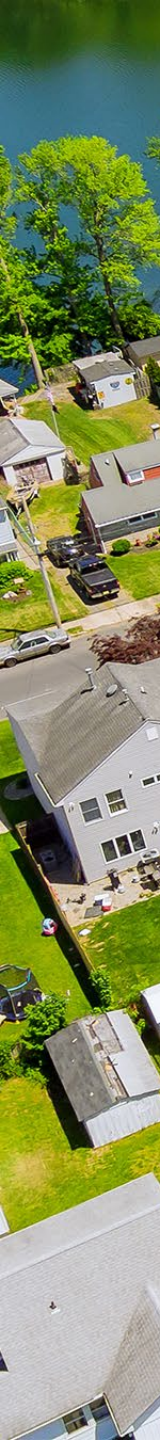
Residential Energy Code Efficiency Category by State





IECC Format Changes

2009 IECC	2021 IECC
Chapter 1 – Administrative	Chapter 1 [RE] – Administrative
Chapter 2 – Definitions	Chapter 2 [RE] – Definitions
Chapter 3 – General Requirements	Chapter 3 [RE] – General Requirements
Chapter 4 – Residential Provisions	Chapter 4 [RE] – Residential Energy Efficiency
Chapter 5 – Commercial Provisions	Chapter 5 [RE] – Existing Buildings
Chapter 6 – Referenced Standards	Chapter 6 [RE] – Referenced Standards
Index	Appendices
	Index
	+
	Equivalent chapters for commercial buildings [CE]



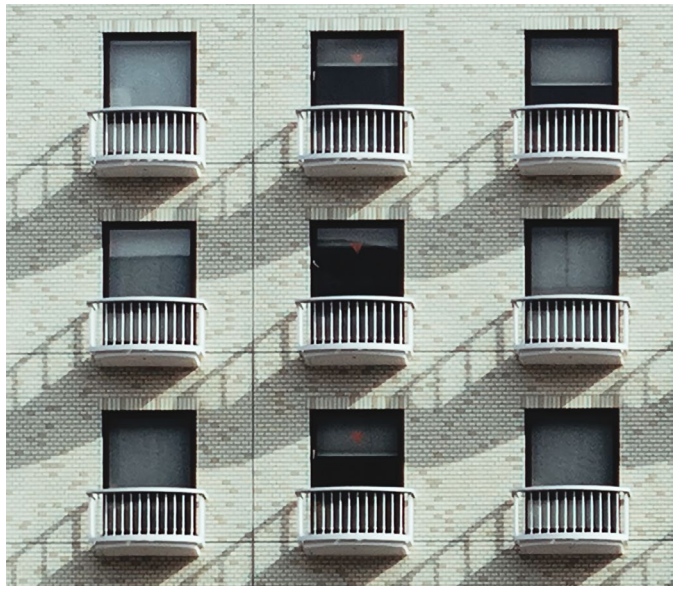
Definition of Residential

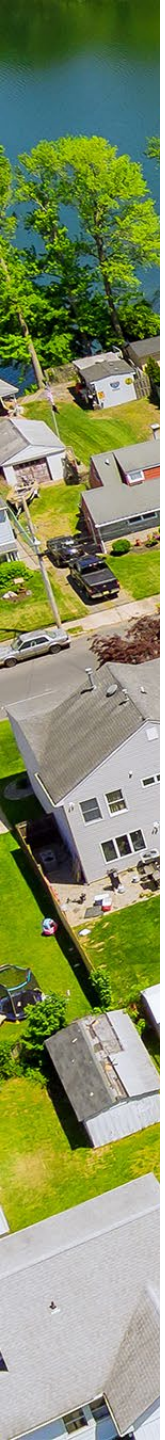
R202

This presentation covers the *residential* provisions of the IECC.

Definition (no change):

- One- and two-family dwellings and townhouses of any height
- Group R-2, R-3, and R-4 *three stories or less*





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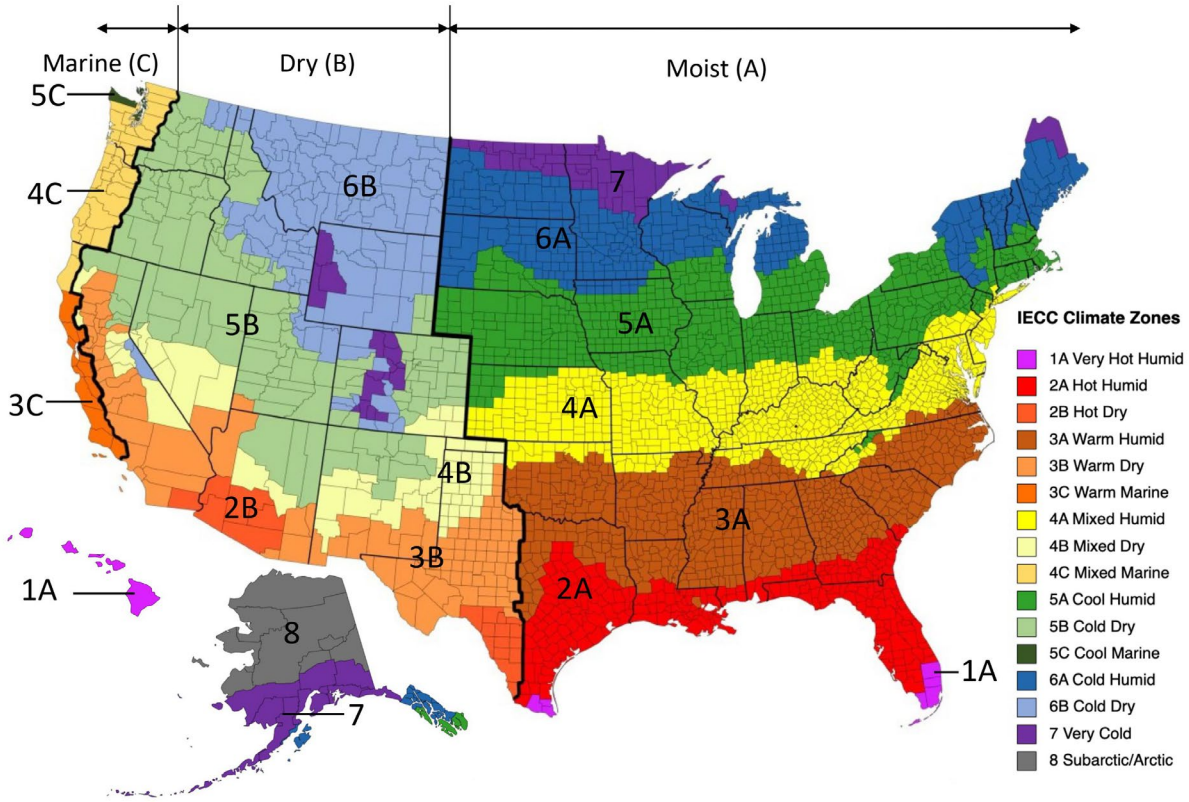
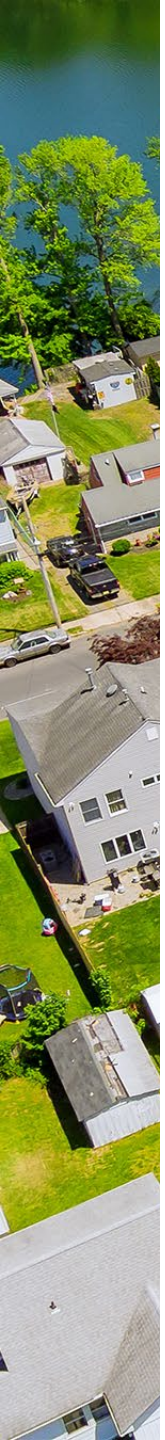
Climate Zones

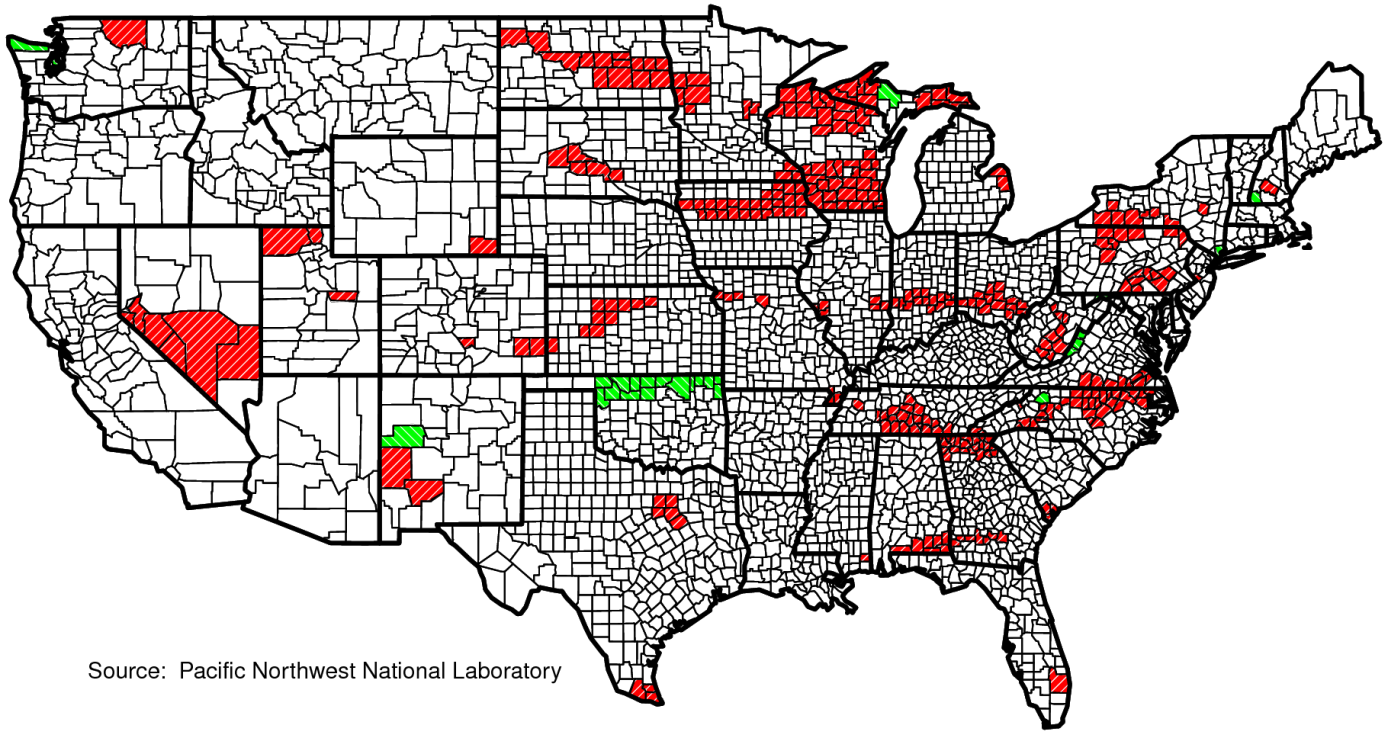
R301

- 8 Climate Zones
- Aligned with ASHRAE Climate Zones in the 2021 IECC
- 10% of counties changed
- Almost all to warmer zones





Changes in Climate Zones by County



Source: Pacific Northwest National Laboratory

Climate zones by state and county are found in IECC Table R303.1

Red: Counties moving to warmer zones
Green: Counties moving to colder zones

2021 IECC Residential Compliance: 4 Pathway Options

ADDITIONAL ENERGY EFFICIENCY
R401.2.5

+ one option below

PRESCRIPTIVE

- R-value (no tradeoffs)
- • U-factor (tradeoffs within individual components)
  • UA (tradeoffs between envelope components)

TOTAL BUILDING PERFORMANCE

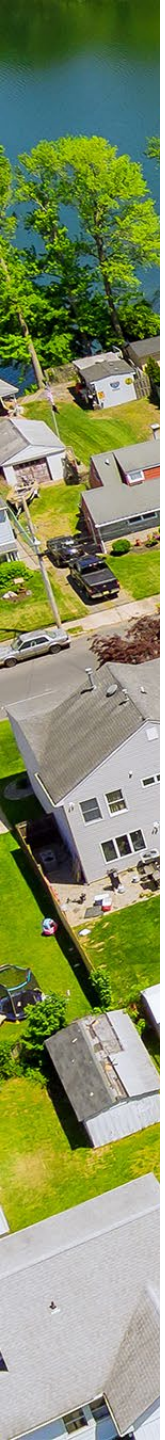
- Total Building Performance R405

ENERGY RATING INDEX (ERI)

- ERI Compliance Alternative R406

TROPICAL CLIMATE REGION

- R407



Permanent Certificate

R401.3

2021 IECC Energy Efficiency Certificate

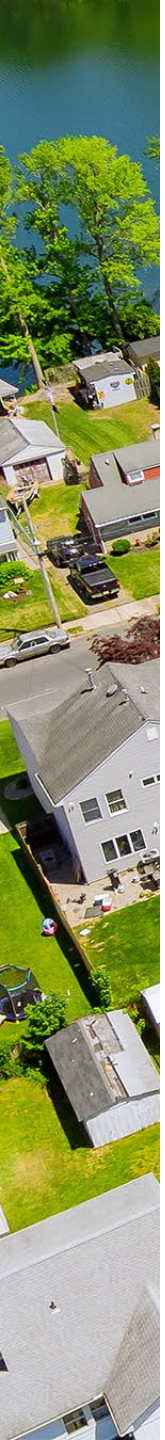
Insulation Rating	R-Value	
Above-Grade Wall	26.00	
Below-Grade Wall	15.00	
Floor	38.00	
Ceiling / Roof	60.00	
Ductwork (unconditioned spaces):	_____	
Glass & Door Rating	**U-Factor**	**SHGC**
Window	0.25	
Door	0.70	
Skylight	0.50	
Heating & Cooling Equipment	**Efficiency**	
Heating System:_____	_____	
Cooling System:_____	_____	
Water Heater:_____	_____	

Name: _____ Date:_____

Comments

A permanent certificate shall be completed by the builder or other approved party and posted near the furnace, in a utility room, or other approved location inside the building, including:

- Predominant insulation R-values
- Predominant window U-factor/ SHGC
- Duct testing results
- Envelope testing results
- Equipment types, efficiencies, and sizes
- PV capacity, inverter efficiency, panel tile and orientation (if applicable)
- ERI score (if applicable)
- Code edition



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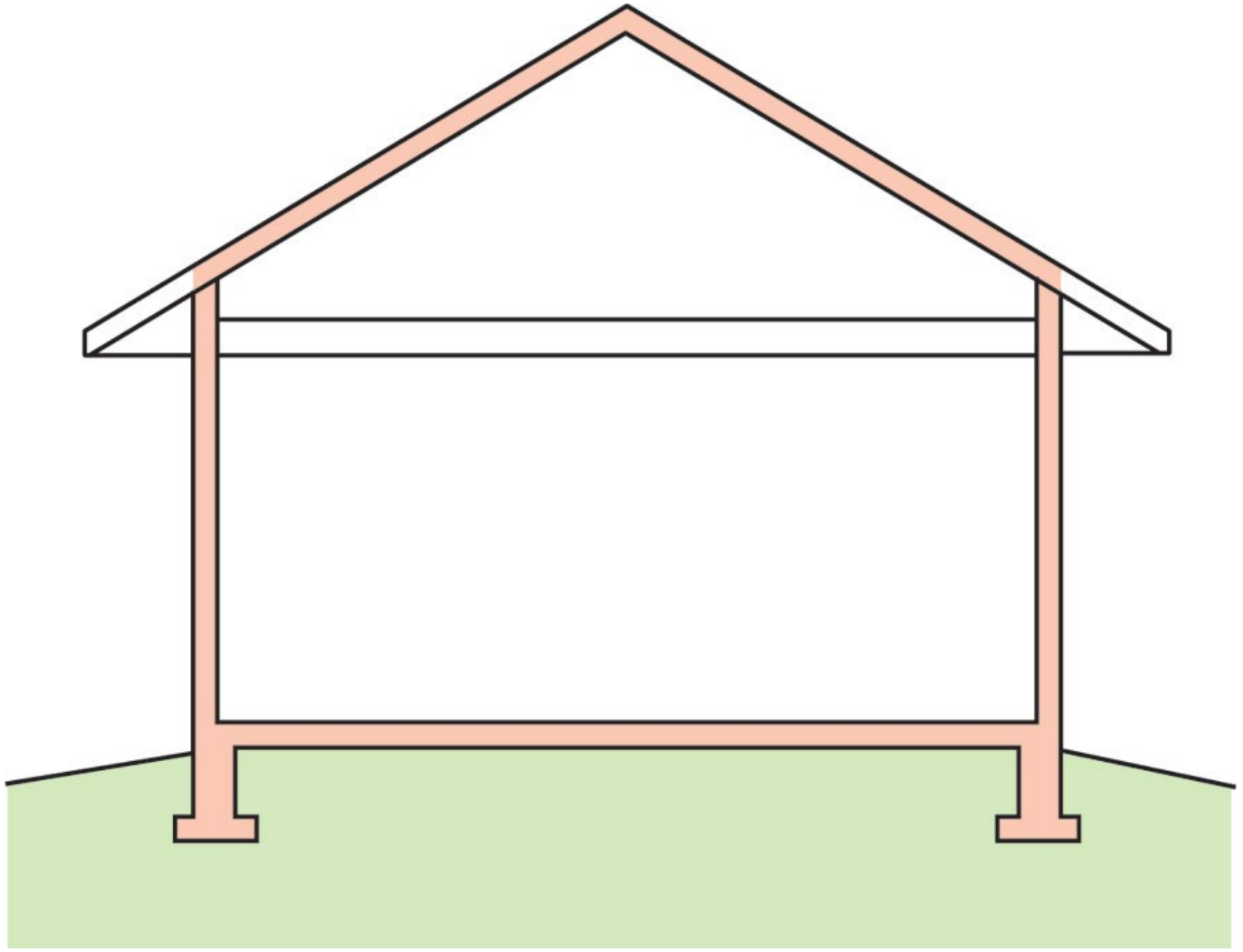
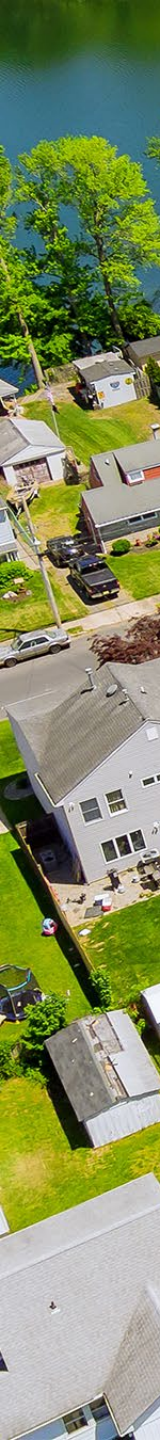
Insulation and Air Sealing

R402



Source: Building America Solution Center (www.basc.pnnl.gov)



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Window Performance

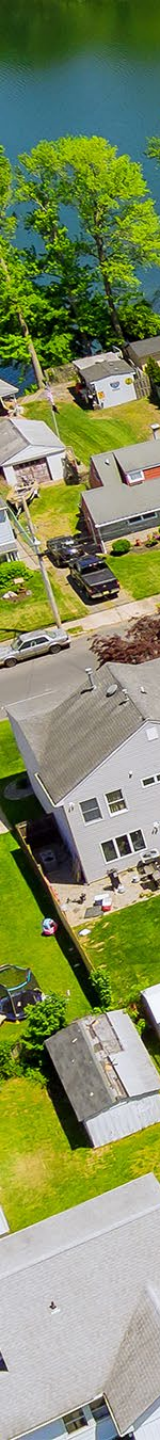
R402.1.2

Fenestration U-factor

Climate Zone	2009 IECC	2021 IECC
0	NA	**0.50**
1	1.2	**0.50**
2	0.65	**0.40**
3	0.50	**0.30**
4 except Marine	0.35	**0.30**
5 and Marine 4	0.35	**0.30**
6	0.35	**0.30**
7 and 8	0.35	**0.30**

U-factor = thermal transmittance

Lower values mean less heat transfer
(the lower, the better)



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Window Performance: IECC vs. ENERGY STAR 7.0

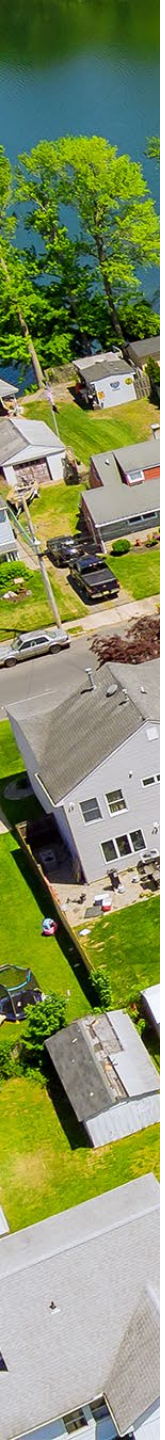
2021 IECC

Climate Zone	U-factor
7 and 8	0.30
6	0.30
5 and Marine 4	0.30
4 except Marine	0.30
3	0.30
2	0.40
1	0.50
0	0.50

ENERGY STAR® Certification Criteria for Residential Windows

Effective October 23, 2003

Climate Zone	U-Factor[1]	SHGC[2]
Northern	≤ 0.22	≥ 0.17
	= 0.23	≥ 0.35
	= 0.24	
	= 0.25	≥ 0.40
	= 0.26	
North-Central	≤ 0.25	≤ 0.40
South-Central	≤ 0.28	≤ 0.23
Southern	≤ 0.32	≤ 0.23



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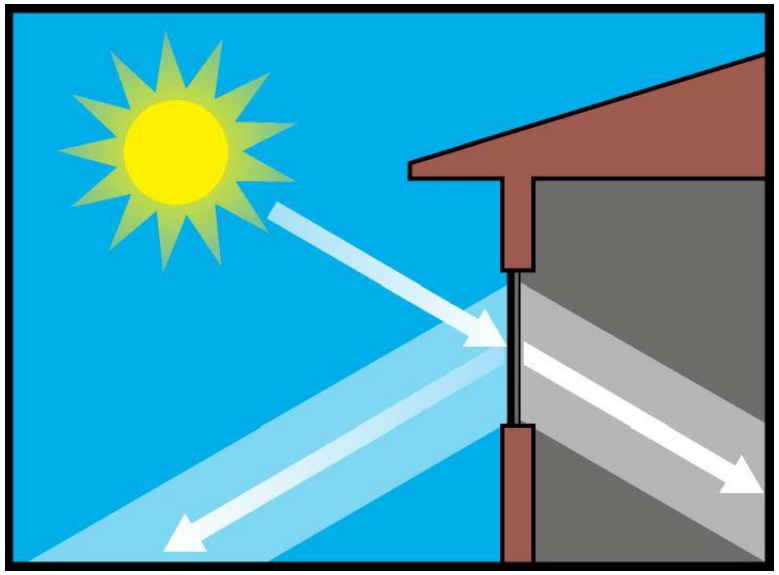
Window Performance

R402.1.2



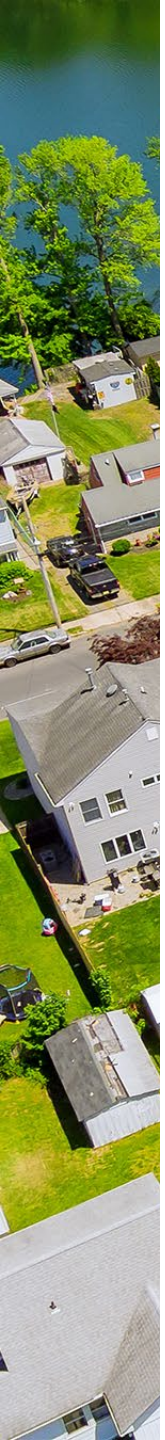
Fenestration SHGC

Climate Zone	2009 IECC	2021 IECC
0	NA	**0.25**
1	0.30	**0.25**
2	0.30	**0.25**
3	0.30	**0.25**
4 except Marine	NR	**0.40**
5 and Marine 4	NR	**0.40**
6	NR	NR
7 and 8	NR	NR

SHGC = solar heat gain coefficient

Always between 0 and 1

Closer to 0 means less radiant heat passing to the inside



Window Performance: IECC vs. ENERGY STAR 7.0 (Cont.)

2021 IECC

Climate Zone	SHGC
7 and 8	NR
6	NR
5 and Marine 4	0.40
4 except Marine	0.40
3	0.25
2	0.25
1	0.25
0	0.25

ENERGY STAR® Certification Criteria for Residential Windows

Effective October 23, 2003

Climate Zone	U-Factor[1]	SHGC[2]
Northern	≤ 0.22	≥ 0.17
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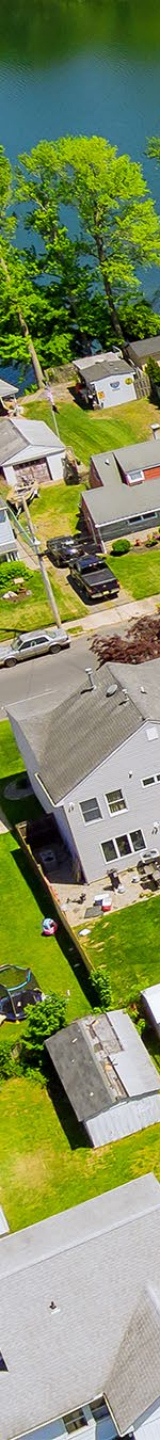

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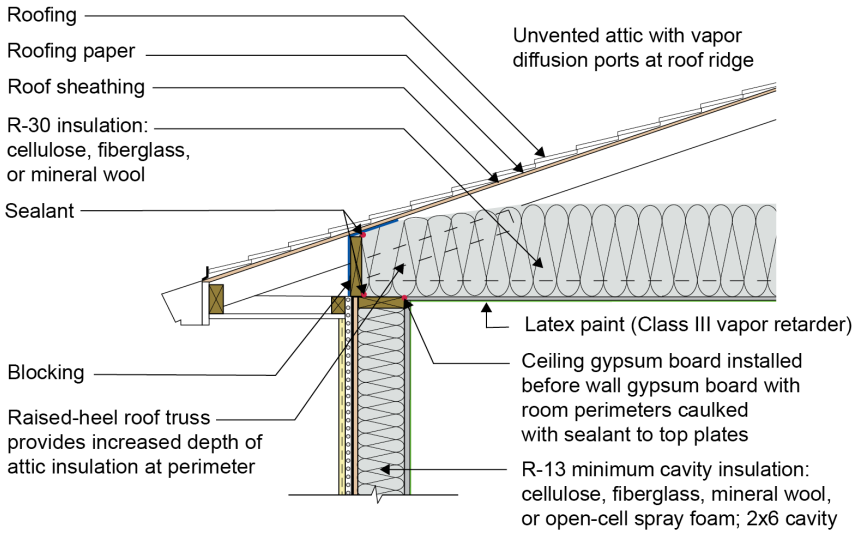
Ceiling Insulation

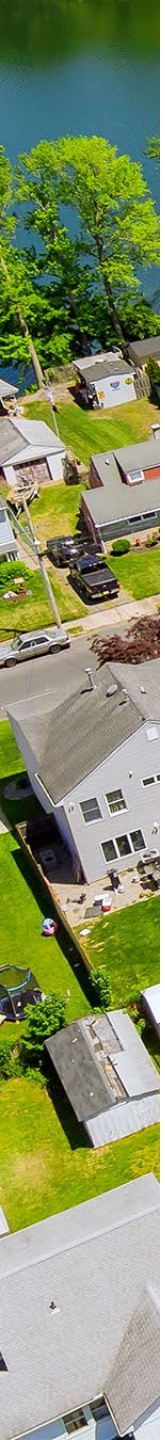
R402.1.2



Source: Building America Solution Center (www.basc.pnnl.gov)

Ceiling R-value

Climate Zone	2009 IECC	2021 IECC
0	NA	**30**
1	30	30
2	30	**49**
3	30	**49**
4 except Marine	38	**60**
5 and Marine 4	38	**60**
6	49	**60**
7 and 8	49	**60**



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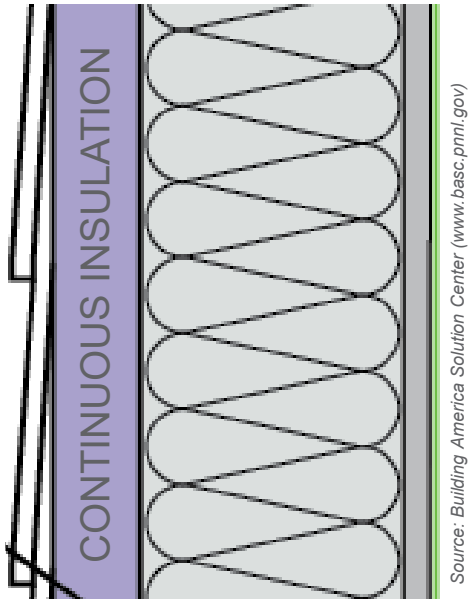
Wall Insulation

R402.1.2

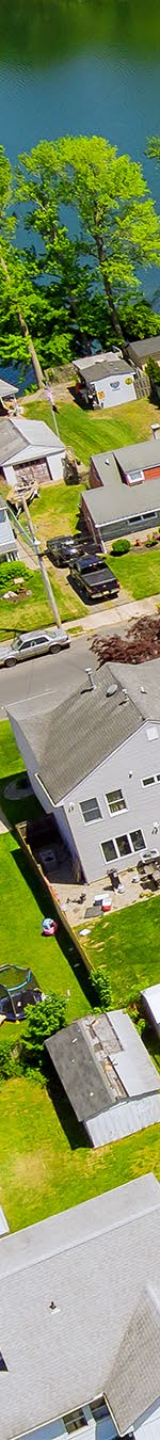


Source: Building America Solution Center (www.basc.pnnl.gov)

Wood Frame Wall R-value

Climate Zone	2009 IECC	2021 IECC
0	NA	**13 or 10ci**
1	13	13 **or 10ci**
2	13	13 **or 10ci**
3	13	**20 or 13&5ci or 15ci**
4 except Marine	13	**30 or 20&5ci or 13&10ci or 20ci**
5 and Marine 4	20 or 13+5	**Same as CZ 4**
6	20 or 13+5	**Same as CZ 4**
7 and 8	21	**Same as CZ 4**

*ci = continuous insulation, usually installed outboard of the framing / exterior sheathing.



Pacific Northwest NATIONAL LABORATORY

Mass Wall Insulation

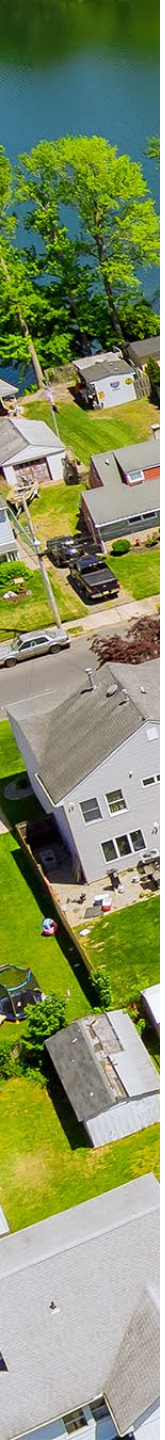
R402.1.2

Source: Building America Solution Center (www.basc.pnnl.gov)

Mass Wall R-value

Climate Zone	2009 IECC	2021 IECC
0	NA	**3/4**
1	3/4	3/4
2	4/6	4/6
3	5/8	**8/13**
4 except Marine	5/10	**8/13**
5 and Marine 4	13/17	13/17
6	15/19	15/**20**
7 and 8	19/21	19/21

- Above-grade walls of concrete, concrete masonry units, brick, solid timber/logs, adobe, etc.
- The second R-value applies when more than half of the insulation is on the interior



Pacific Northwest NATIONAL LABORATORY

Floor Insulation

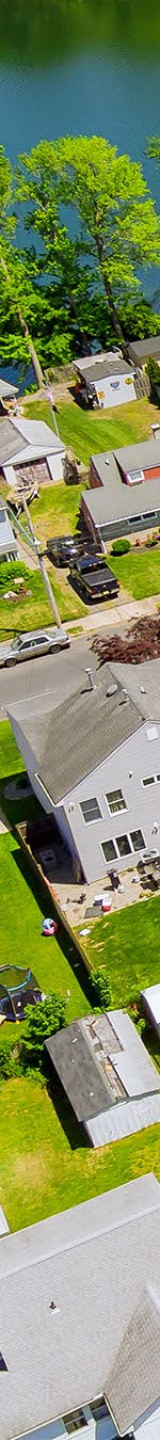
R402.1.2

Source: Building America Solution Center (www.basc.pnnl.gov)

Floor R-value

Climate Zone	2009 IECC	2021 IECC
0	NA	**13**
1	13	13
2	13	13
3	19	19
4 except Marine	19	19
5 and Marine 4	30[g]	30[g]
6	30[g]	30[g]
7 and 8	38[g]	38[g]

[g] Or insulation sufficient to fill the framing cavity, R-19 minimum



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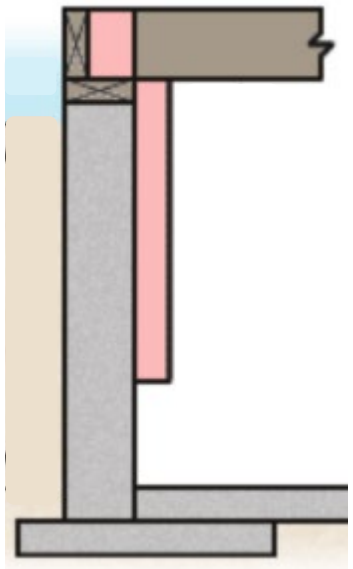
Basement Wall Insulation

R402.1.2

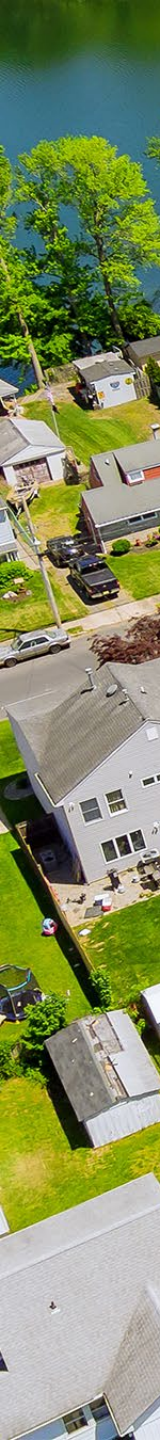


Source: REScheck

Basement Wall R-value

Climate Zone	2009 IECC[c]	2021 IECC
0	NA	0
1	0	0
2	0	0
3	5/13	5ci or 13
4 except Marine	10/13	10ci or 13
5 and Marine 4	10/13	**15ci or 19 or 13 & 5ci**
6	15/19	15ci or 19 or **13 & 5ci**
7 and 8	15/19	15ci or 19 or **13 & 5ci**

[c] The first R-value is for continuous insulation, the second for cavity



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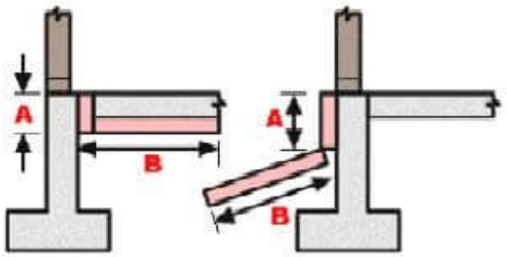
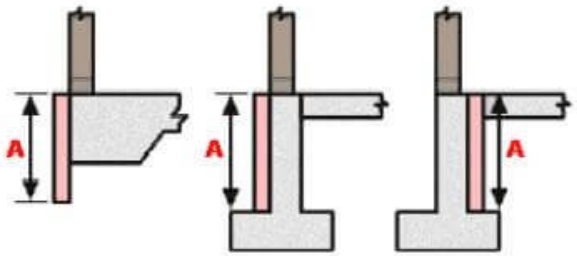
Slab Insulation and Depth

R402.1.2



Horizontal Insulation (A + B = Insulation Depth)



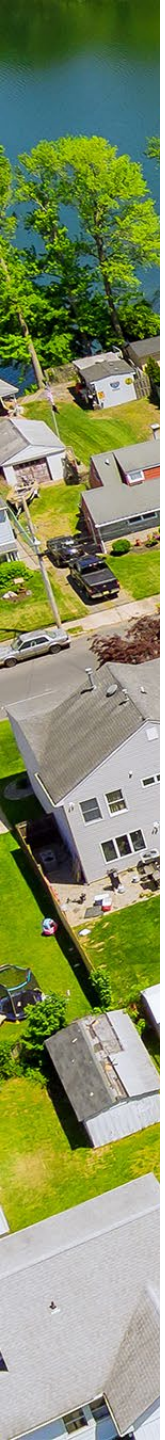
Vertical Insulation (A = Insulation Depth)

Source: REScheck

Slab R-value

Climate Zone	2009 IECC[d]	2021 IECC
0	NA	0
1	0	0
2	0	0
3	0	**10ci, 2 ft**
4 except Marine	10, 2 ft	10ci, **4 ft**
5 and Marine 4	10, 2 ft	10ci, **4 ft**
6	10, 4 ft	10ci, 4 ft
7 and 8	10, 4 ft	10ci, 4 ft

[d] Add R-5 for heated slabs



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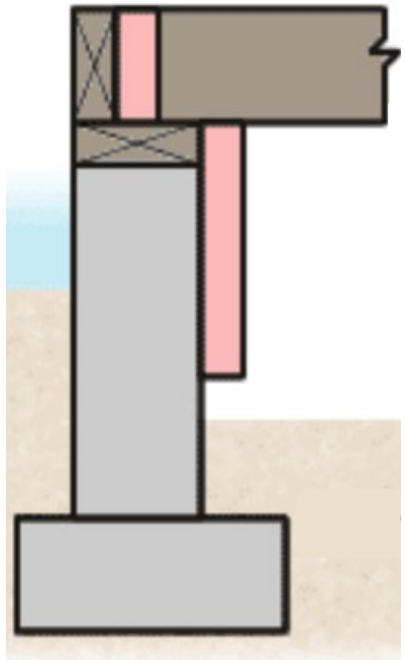
Crawl Space Wall Insulation

R402.1.2

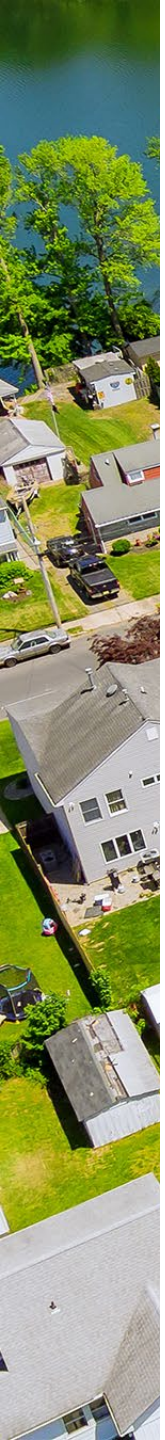


Source: REScheck

[Unvented] Crawl Space Wall R-value

Climate Zone	2009 IECC[c]	2021 IECC
0	NA	0
1	0	0
2	0	0
3	5/13	5ci or 13
4 except Marine	10/13	10ci or 13
5 and Marine 4	10/13	**15ci or 19 or 13 & 5ci**
6	10/13	**15ci or 19 or 13 & 5ci**
7 and 8	10/13	**15ci or 19 or 13 & 5ci**

[c] The first R-value is for continuous insulation, the second for cavity



Air Barrier and Insulation Installation Criteria

R402.4

2009 IECC

Air Barrier and Insulation Inspection Criteria

OR

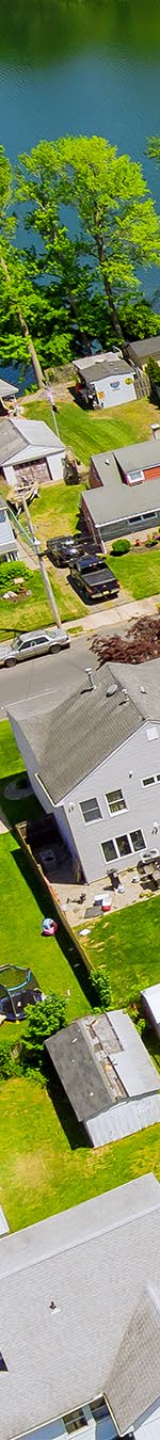
Envelope Air Leakage Test

2021 IECC

Air Barrier, Air Sealing and Insulation Installation

AND

Envelope Air Leakage Test



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Air Barrier and Insulation Installation Criteria

R402.4

2009 IECC

TABLE 402.4.2
AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

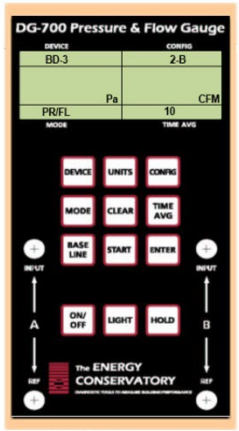
2021 IECC

TABLE R402.4.1.1
AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10. Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.

(continued)

Envelope Air Leakage (Blower Door) Testing



DG700 or equal
2-Channel Manometer (2CM)

T-Fittings

Tubing

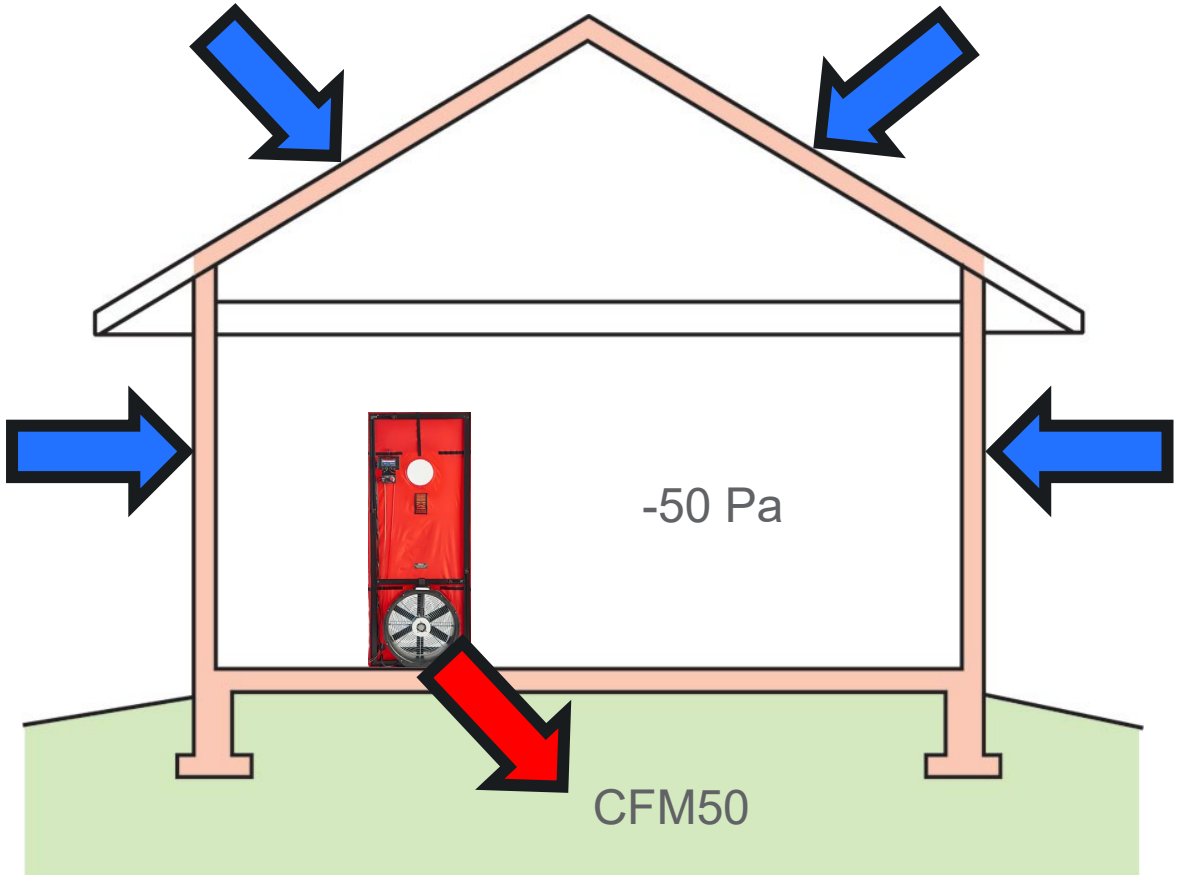
DG1000 or equal
Smart Manometer (SM)

Blower Door

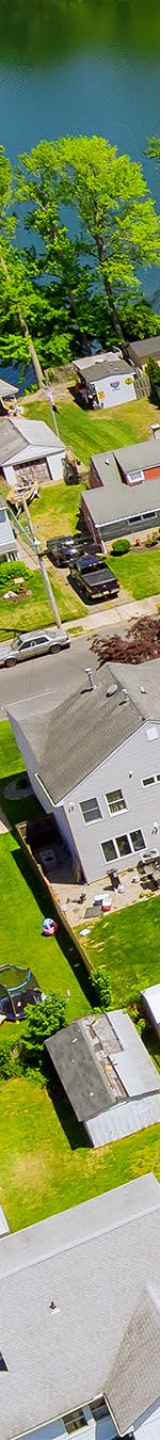
Pressure Mapping - Tools Needed

CALCS-PLUS

Source: Building America Solution Center (www.basc.pnnl.gov)



CFM50 = cubic feet per minute at 50 Pascals
ACH50 = air changes per hour at 50 Pascals
= CFM50 / conditioned volume x 60



Air Leakage Testing and Leakage Limits

R402.4

2009 IECC

Testing optional

Maximum leakage rate:

All Climate Zones: 7 ACH50

2021 IECC

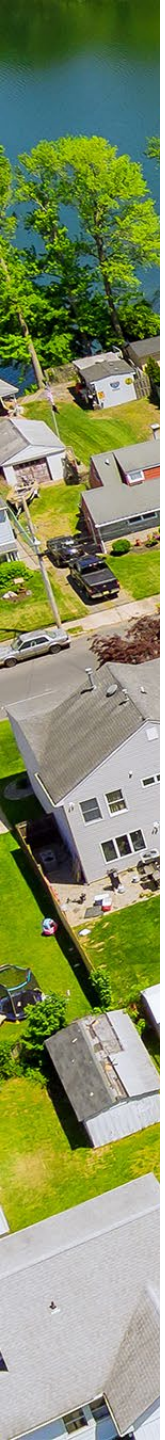
Testing mandatory

Maximum leakage rates:

Climate Zone 0-2: 5 ACH50

Climate Zone 3-8: 3 ACH50[1]

[1] Up to 5 ACH50 allowed for performance and ERI paths



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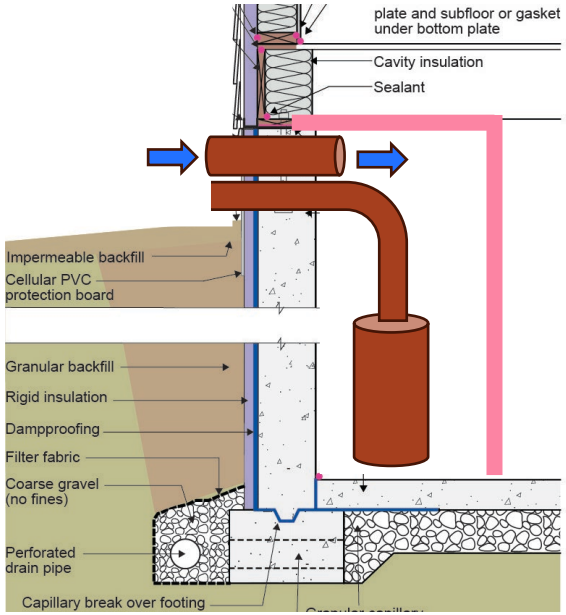
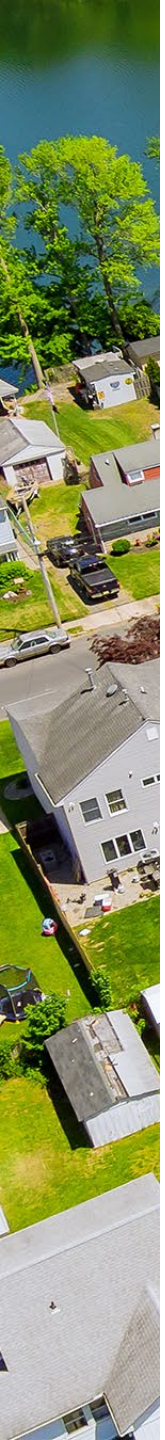
Rooms Containing Fuel-Burning Appliances R402.4



Source: Building America Solution Center (www.basc.pnnl.gov)

- Applies in Climate Zones 3-8
- Applies where ducts bring outside combustion air into the space
- Equipment must be located outside the thermal envelope or in an insulated/air sealed room that is isolated from the conditioned space
- Combustion air ducts passing through conditioned space insulated to R-8

Exception: Direct-vent appliances



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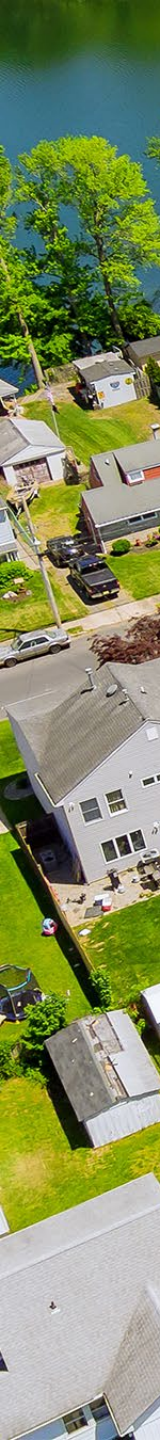
Electrical and Communication Outlet Boxes R402.4

- Electrical and communication boxes must have an air leakage rate ≤ 2 cfm @ 75 Pa per NEMA OS 4, *Requirements for Air-Sealed Boxes for Electrical and Communication Applications*
- Marked as “NEMA OS 4” or “OS 4”



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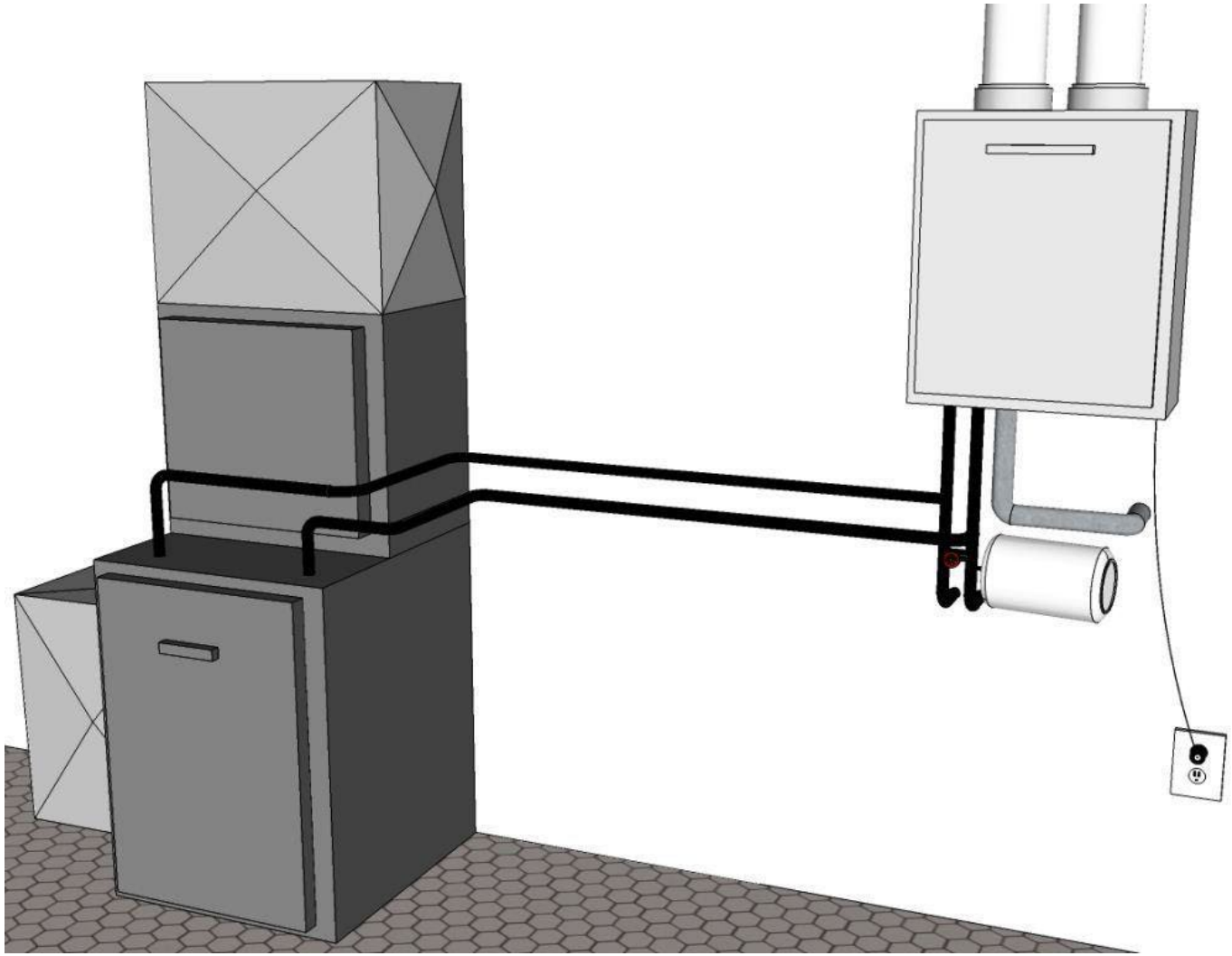
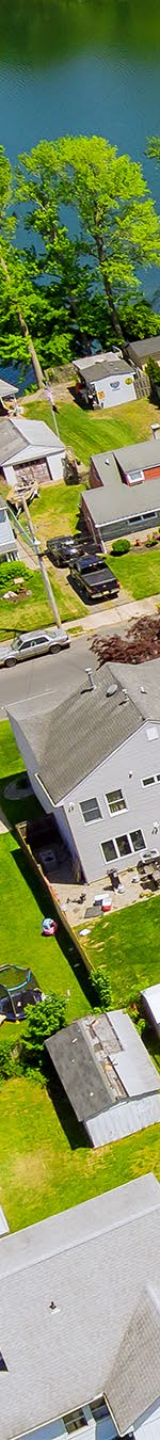
Heating, Ventilation, and Air Conditioning (HVAC)

Mechanical Systems R403





Duct Leakage Testing: Options and Limits

R403.3

2009 IECC

Post-construction test

Leakage to outdoors: 8 cfm/100 sf, or

Total leakage: 12 cfm/100 sf

Rough-in test

Total leakage w/air handler: 6 cfm/100 sf, or

Total leakage w/o air handler: 4 cfm/100 sf

Exception:

Air handler and all ducts are located within conditioned space

2021 IECC

Post-construction test

Leakage to outdoors: **NA**

Total leakage: 4 cfm/100 sf

Rough-in test

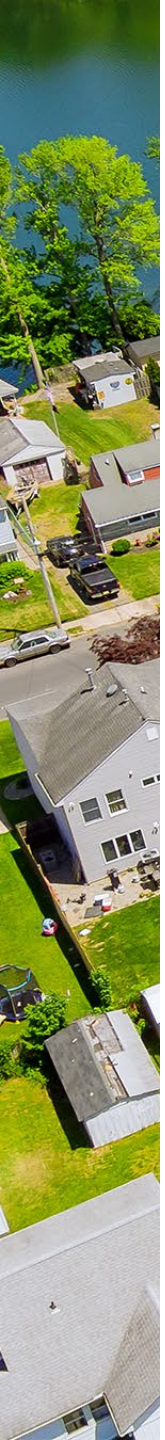
Total leakage w/air handler: 4 cfm/100 sf, or

Total leakage w/o air handler: 3 cfm/100 sf

Ducts within thermal envelope:

Must be tested

Maximum total leakage: 8 cfm/100 sf



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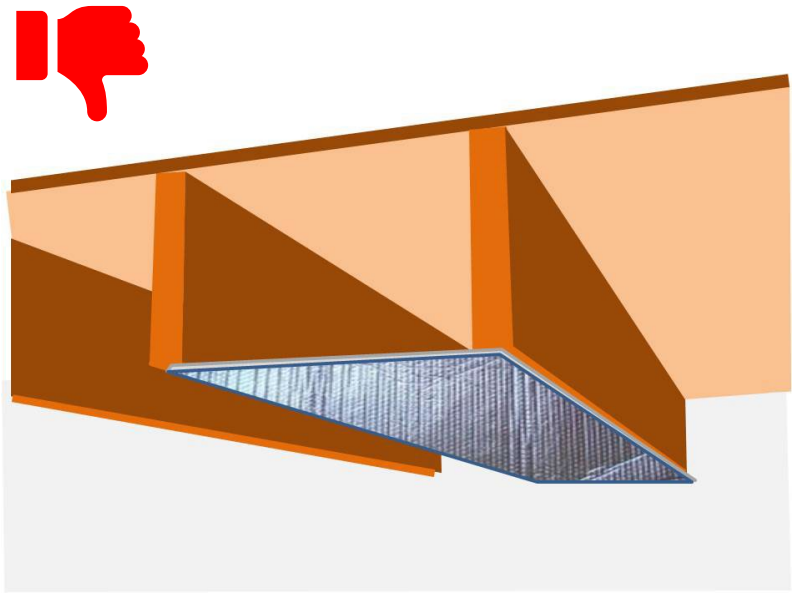
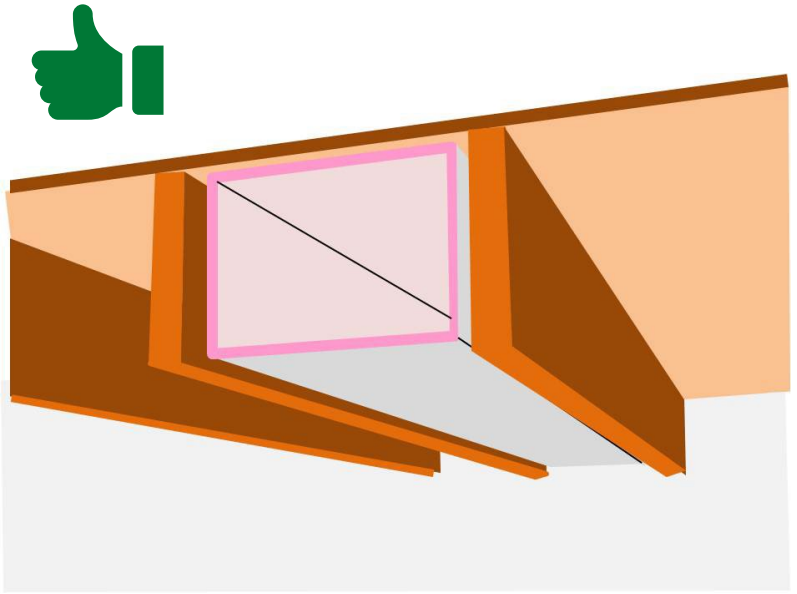
Building Cavities Used as Ducts

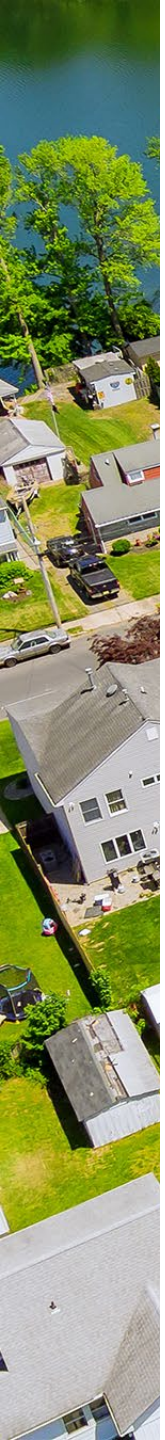
R403.3

- Building cavities shall not be used as ~~supply~~ ducts





Source: Building America Solution Center (www.basc.pnnl.gov)

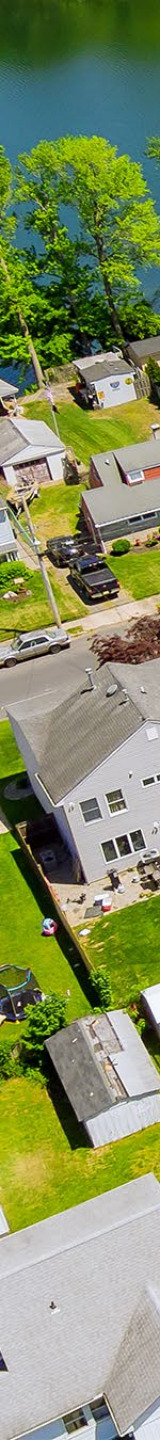


Hot Water Pipe Insulation

R403.4

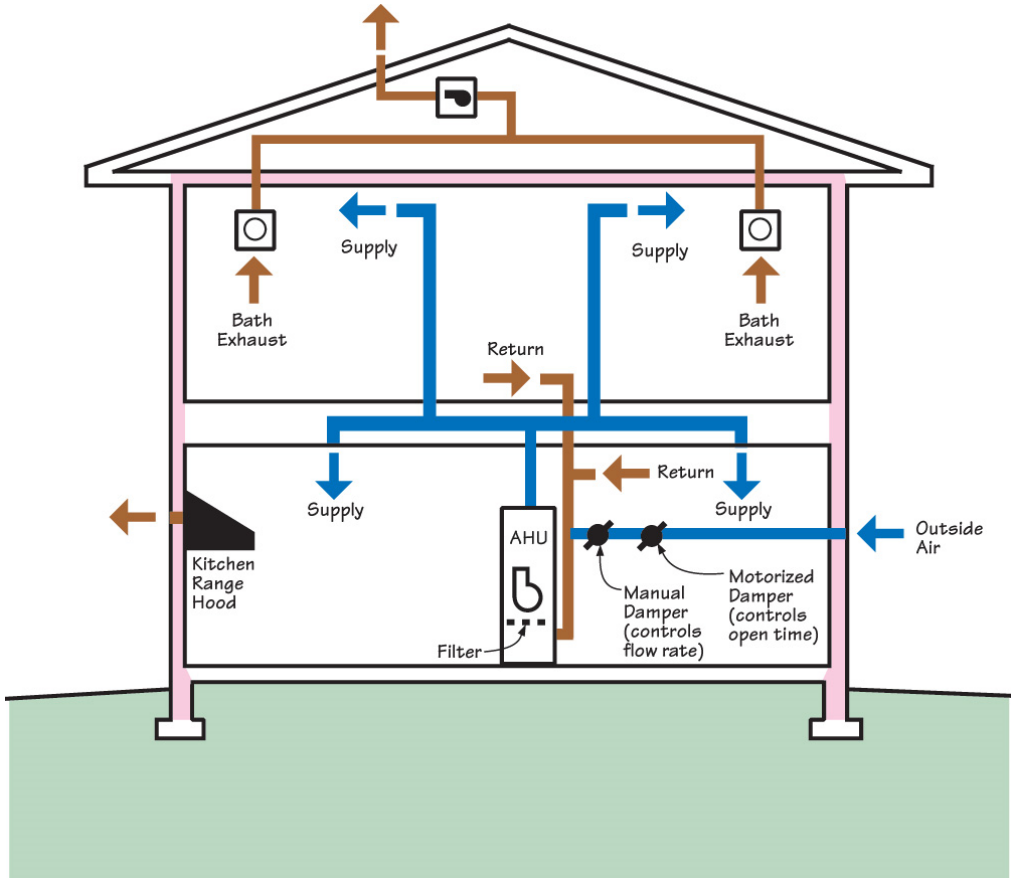
R-3 insulation required on the following:

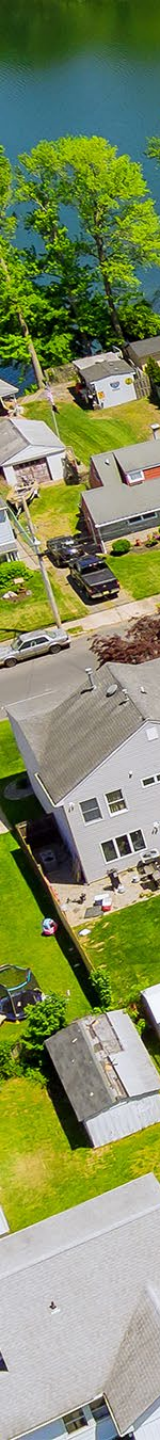
1. Piping ¾-inch and larger
2. Piping serving more than one dwelling unit
3. Piping located outside the conditioned space
4. Piping from the water heater to a distribution manifold
5. Piping located under a floor slab
6. Buried piping
7. Supply and return piping in circulation and recirculation systems other than cold water pipe return demand recirculation systems



Whole-House Mechanical Ventilation

- Minimum airflow rates set by the *International Residential Code*
- Strategies include:
  - Exhaust only
  - Supply only
  - Balanced
- Operates continuously or intermittently on a set schedule





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Whole-House Mechanical Ventilation (Cont.)

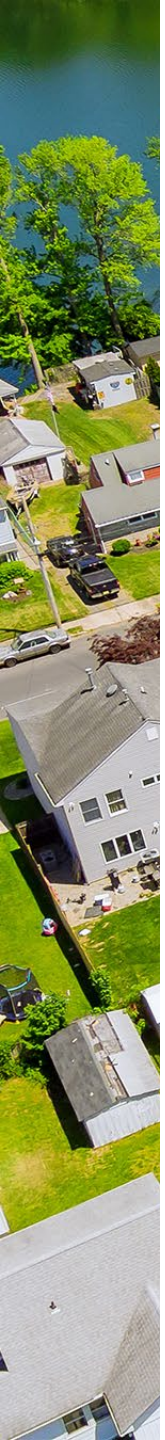
IRC M1505.4

Buildings shall have ventilation complying with the *International Residential Code* or *International Mechanical Code*, as applicable.

$$Ventilation\ rate\ (cfm) = 0.01\ x\ floor\ area + [7.5\ x\ (no.bedrooms + 1)]$$

or

	Number of Bedrooms				
	0-1	2-3	4-5	6-7	>7
Dwelling Unit Floor Area (sf)	**Airflow in CFM**				
< 1,500	30	45	60	75	90
1,501 – 3,000	45	60	75	90	105
3,001 – 4,500	60	75	90	105	120
4,501 – 6,000	75	90	105	120	135
6,001 – 7,500	90	105	120	135	150
>7,500	105	120	135	150	175



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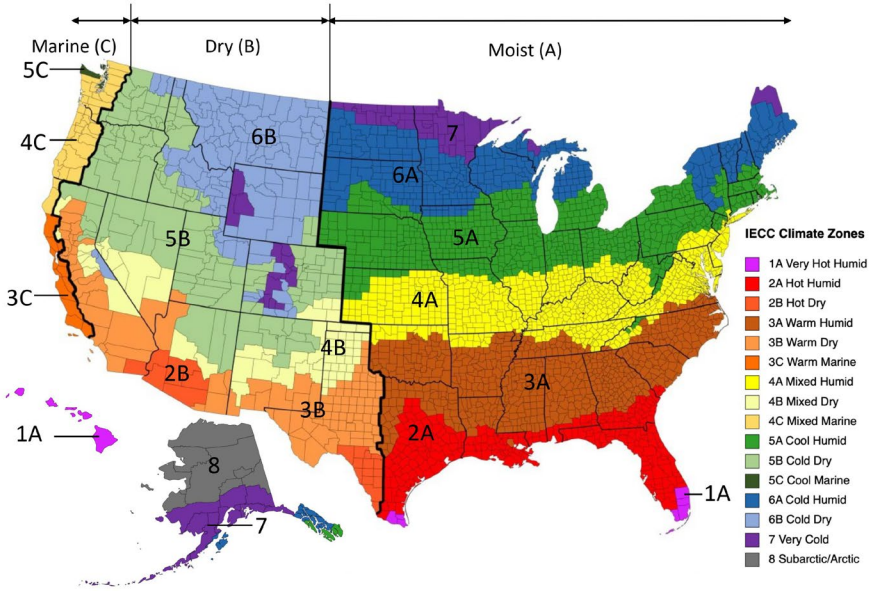
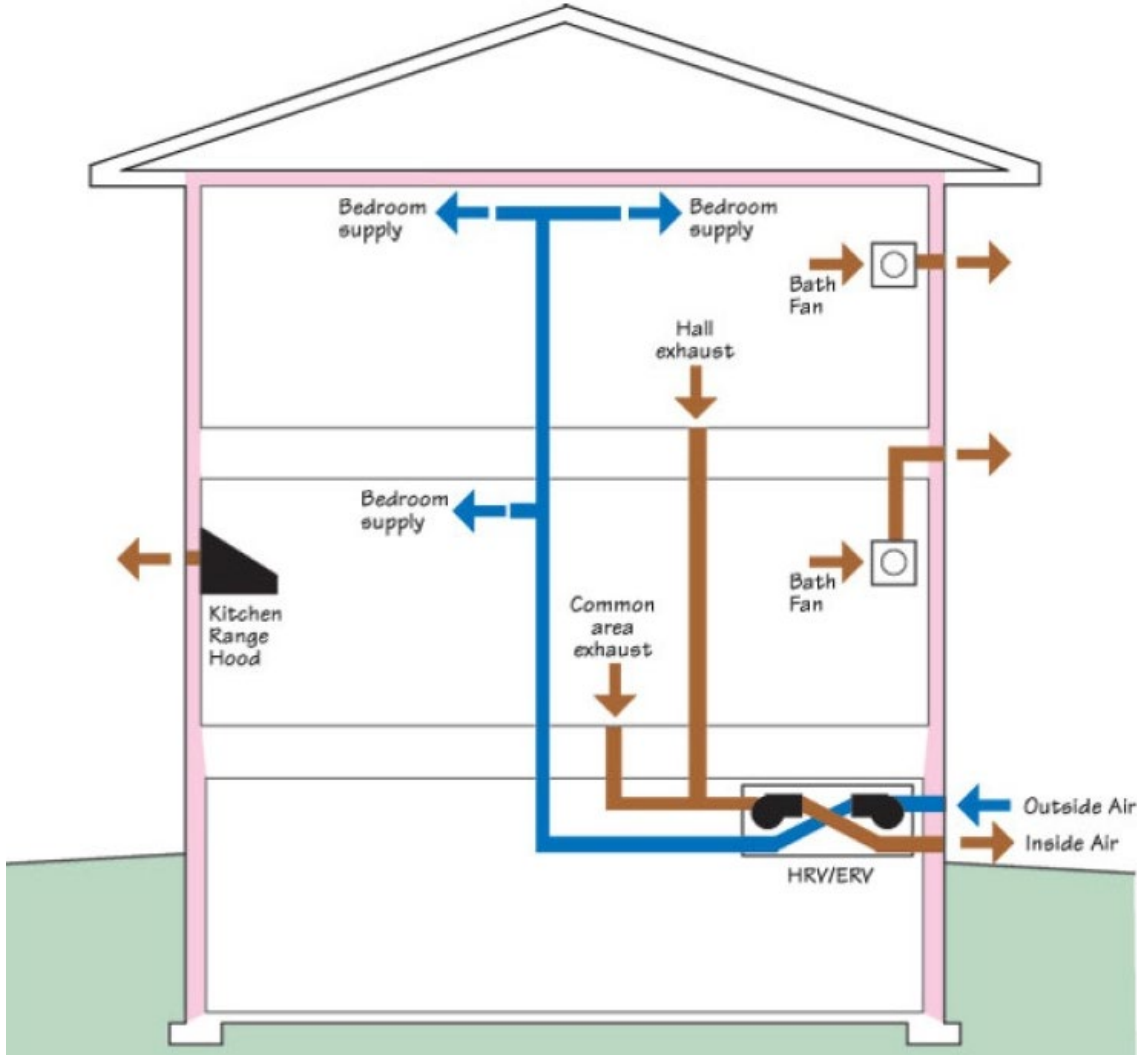
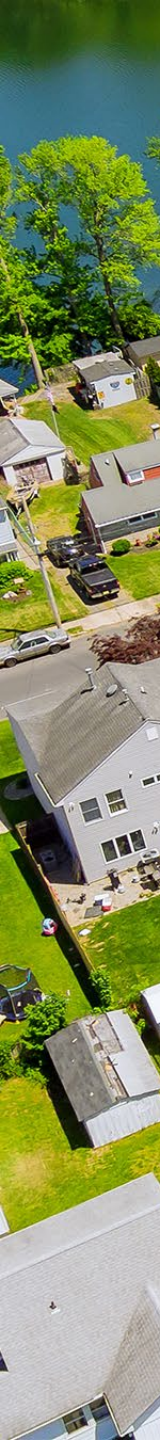
Heat Recovery and Energy Recovery Ventilation Requirements R403.6





Source: Building America Solution Center (www.basc.pnnl.gov)

- HRV / ERV required in Climate Zones 7 and 8 only
- Sensible heat recovery efficiency (SRE) ≥ 65% at 32°F



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Whole-House Dwelling Ventilation Efficacy

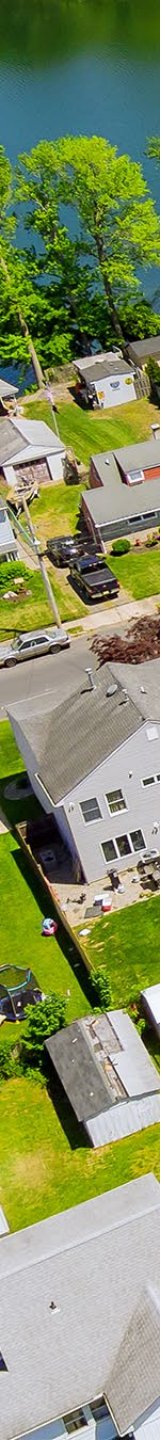
R403.6

Source: Building America Solution Center (www.basc.pnnl.gov)

Ventilation Fan Flow and Efficacy Req'ts

Fan Location	Airflow Rate Min (CFM)	Minimum Efficacy (CFM/Watt)
HRV, ERV	Any	1.2
In-line supply or exhaust fan	Any	3.8
Other exhaust fan	< 90	2.8
Other exhaust fan	≥ 90	3.5
Air handler integrated	Any	1.2

Fans must meet minimum efficacy requirements



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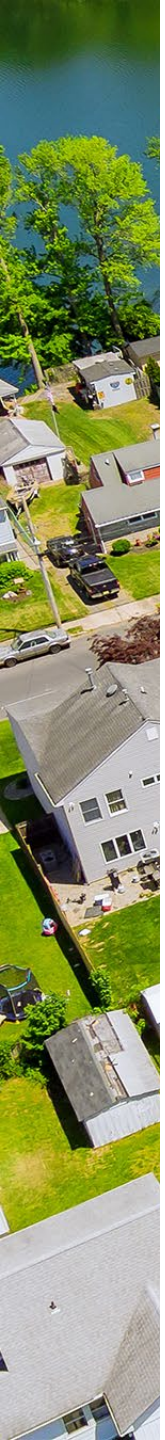
Whole-Dwelling Ventilation System Testing

R403.6

Source: Building America Solution Center (www.basc.pnnl.gov)

- Systems shall be **tested** and verified to provide the minimum required flow rates
- Testing can identify airflow restrictions in ductwork layouts, such as crimping and tight U-bends

Source: Building America Solution Center (www.basc.pnnl.gov)



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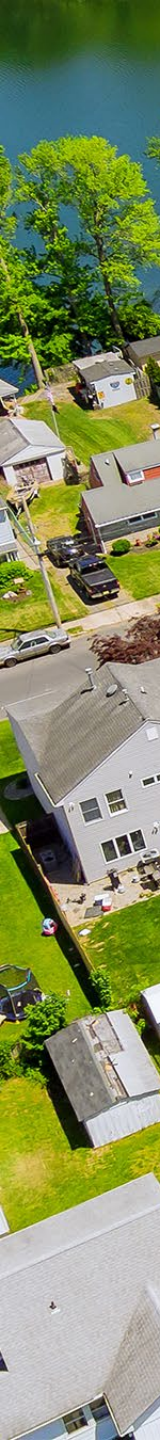
Lighting



Interior Lighting: High-efficacy Lighting

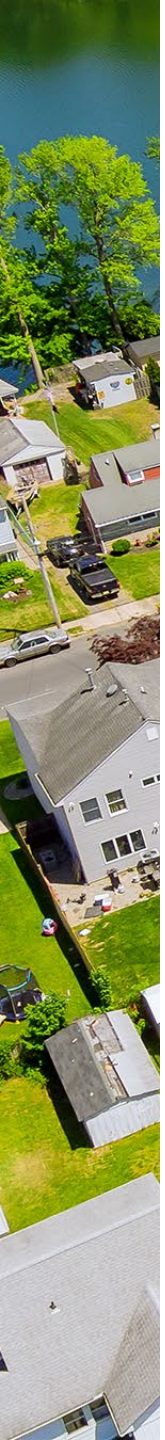
R404.1

2009 IECC

- 50% high-efficacy lamps
- High-efficacy:
  - CFLs
  - T-8 or smaller linear fluorescent
  - Any lamp w/min efficacy of:
    - ✓ 60 lumens/watt for lamps > 40 W
    - ✓ 50 lumens/watt for lamps 16-40 W
    - ✓ 40 lumens/watt for lamps ≤ 15 W

2021

- 100% high-efficacy lamps
  (excluding kitchen appliance lighting)
- High-efficacy:
  - Lamps ≥ 65 lumens per watt
  - Fixtures ≥ 45 lumens per watt



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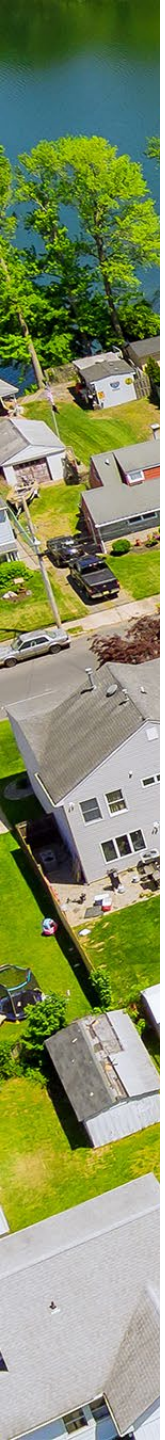
Exterior Lighting

R404.1.1

- Connected exterior lighting for residential buildings shall comply with Section C405.5
  - Exceptions:
    - ✓ Detached one- and two-family dwellings
    - ✓ Townhouses
    - ✓ Solar-powered lamps not connected to electrical service
    - ✓ Luminaires controlled by a motion sensor
    - ✓ Lamps and luminaires that comply with Section R404.1 (100% high-efficacy)



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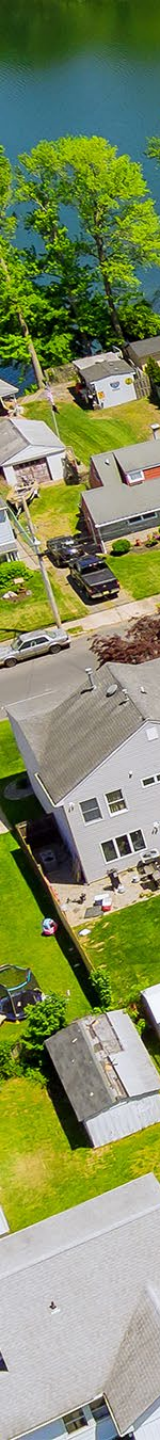
Interior Lighting: Lighting Controls

R404.2

- Permanently installed lighting fixtures shall be controlled with either
  - A dimmer
  - An occupant sensor
  - Control installed or built into the fixture

  - Exceptions:
    - ✓ Bathrooms
    - ✓ Hallways
    - ✓ Exterior lighting fixtures
    - ✓ Lighting designed for safety or security



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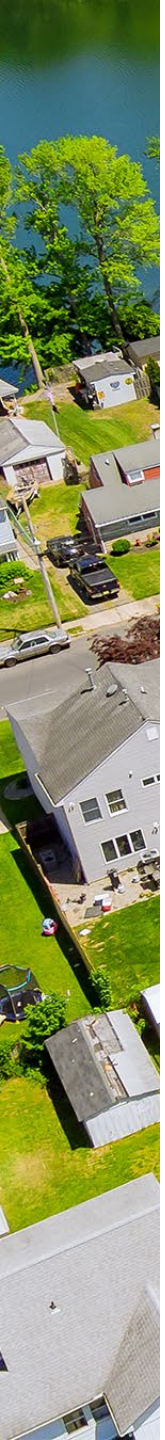
Exterior Lighting Controls R404.3

- Where the total permanently installed exterior lighting power is > 30 watts:
  1. Lighting shall be controlled by a manual on and off switch which permits automatic shut-off actions
     - ✓ Exception: Lighting serving multiple dwelling units
  2. Lighting shall be **automatically shut off when daylight is present** and satisfies the lighting needs
  3. Override limited to 24 hours



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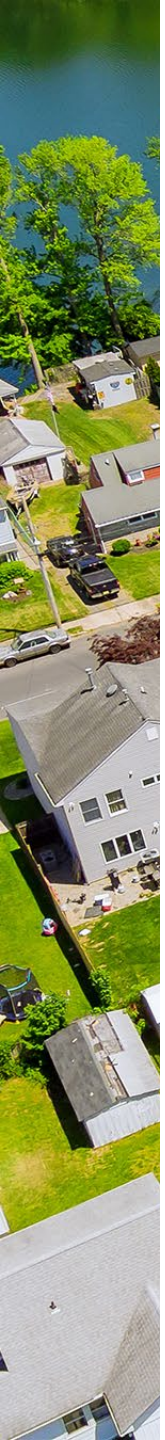
Additional Efficiency Package Options R401.2.5, R408

- **Prescriptive:** Meet 1 of 5 options
- **Performance:** Meet 1 of 5 options or 5% better than the reference home
- **ERI:** 5% better than max ERI in Table R406.5

Additional Efficiency Package Options

1. Enhanced envelope performance
2. More efficient HVAC equipment
3. Reduced energy use in service water heating
4. More efficient duct thermal distribution system
5. Improved air sealing and efficient ventilation



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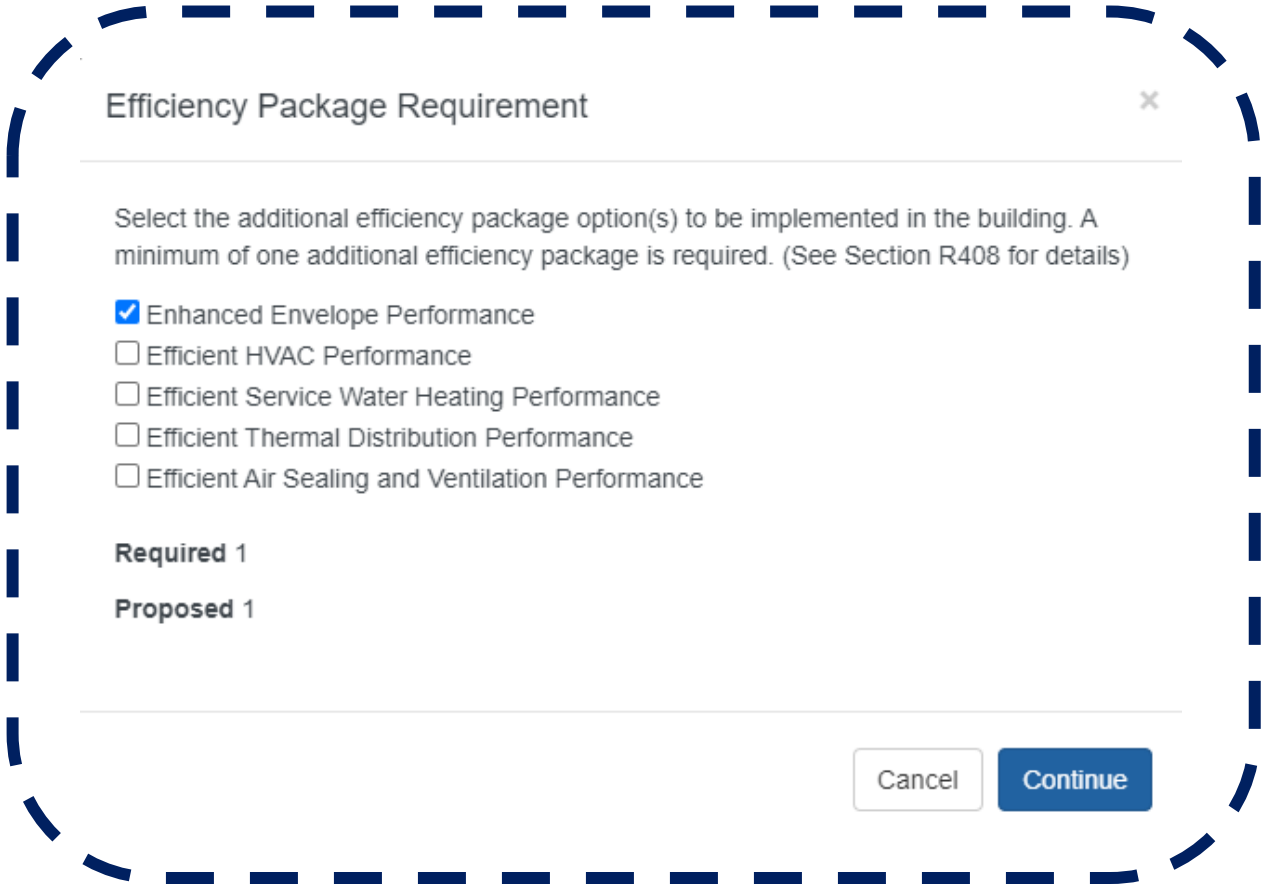
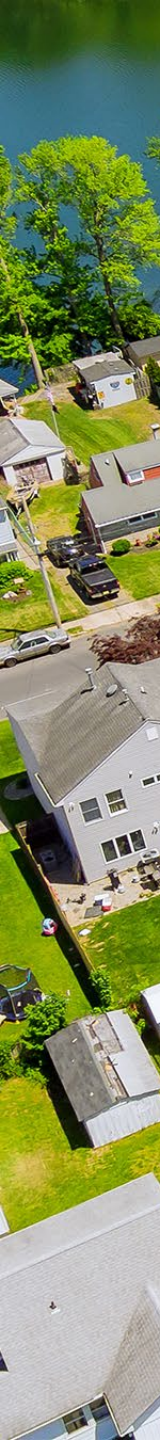
Additional Efficiency Package Options R408

REScheck•Web™

Enhanced envelope performance option

- U-factor times area (UA) ≤ 95% of baseline home





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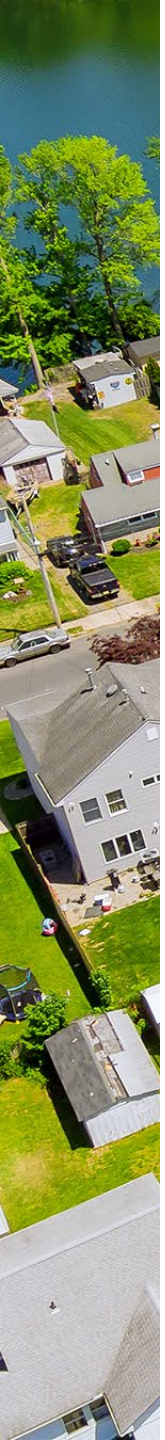
Additional Efficiency Package Options R408

More efficient HVAC equipment option

1. ≥ 95 AFUE natural gas furnace + 16 SEER AC
2. ≥ 10 HSPF/16 SEER air source heat pump
3. ≥ 3.5 COP ground source heat pump



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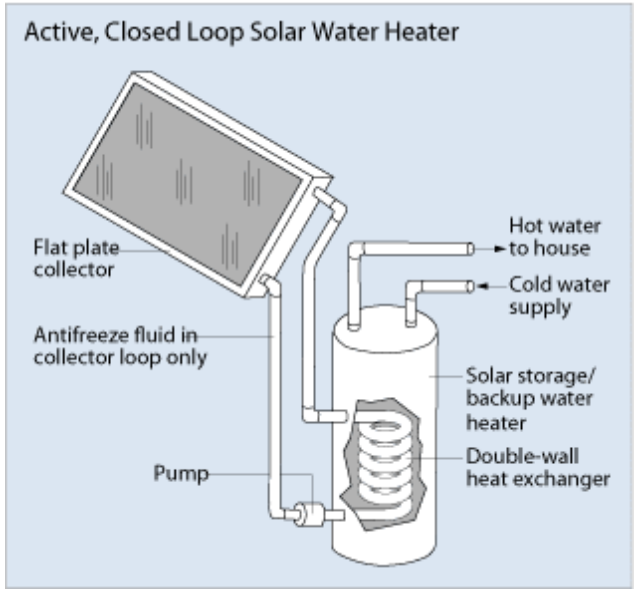
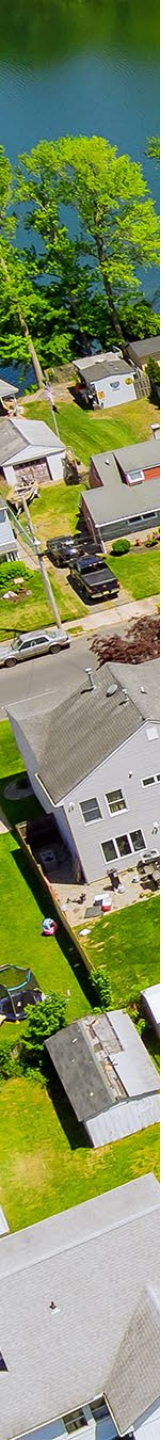
Additional Efficiency Package Options R408

Reduced energy use in service water heating option

1. ≥ 0.82 EF fossil fuel water heater
2. ≥ 2.0 EF electric water heater
3. ≥ 0.4 solar fraction solar water heater





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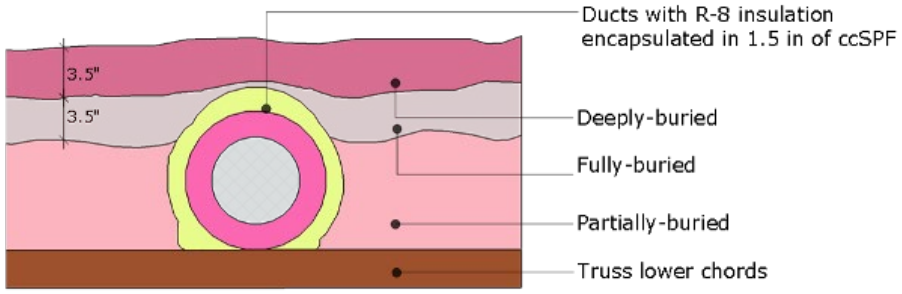
Additional Efficiency Package Options R408



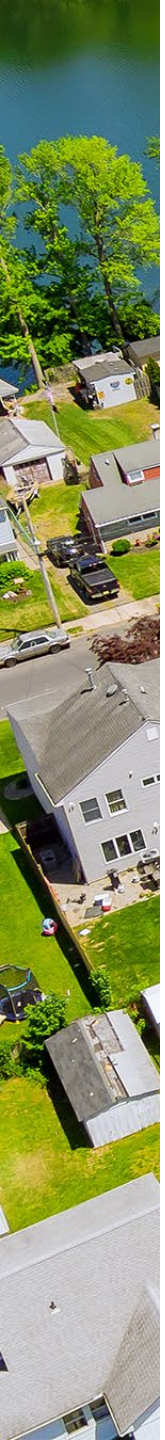
Source: Building America Solution Center (www.basc.pnnl.gov)

More efficient duct thermal distribution system option

1. 100% of ducts and air handlers located entirely within the building thermal envelope

2. 100% ductless thermal distribution system or hydronic thermal distribution system located entirely inside the building thermal envelope

3. 100% of duct thermal distribution system located in conditioned space as defined by Section R403.3.2



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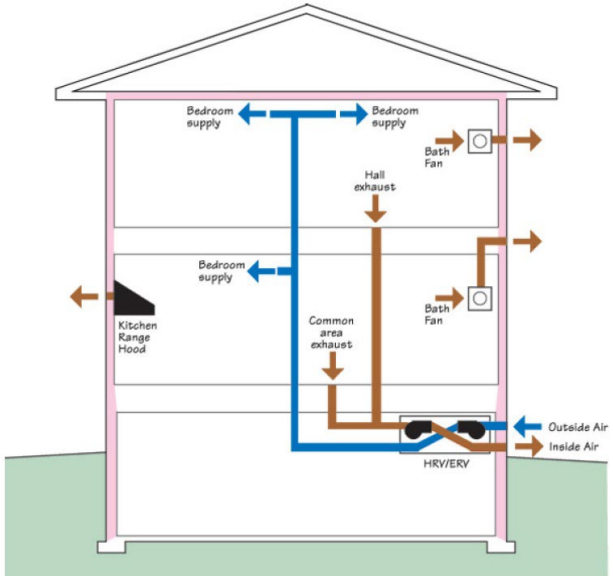
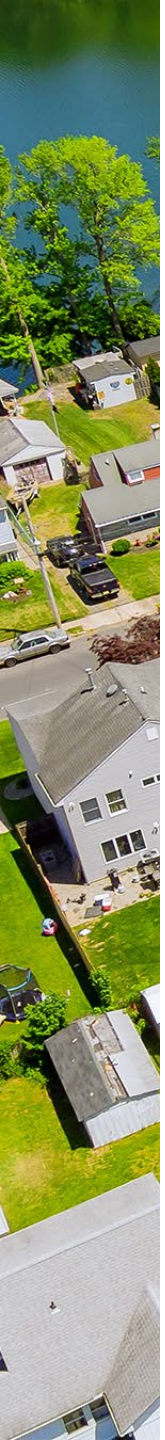
Additional Efficiency Package Options R408



Source: Building America Solution Center (www.basc.pnnl.gov)

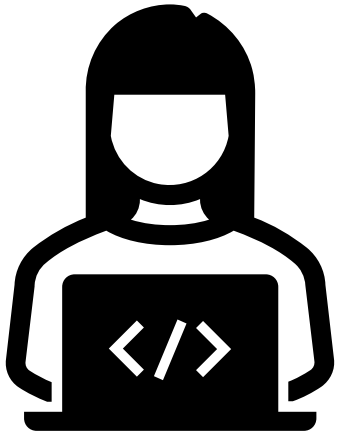
Improved air sealing and efficient ventilation system option

- ≤ 3 ACH50 with ERV or HRV
- ERV/HRV requirements:
  - Sensible recovery efficiency (SRE) ≥ 75%
  - ≤ 1.1 watts per cfm [refer to ICC Errata Central]
  - Recirculation not used as defrost strategy
  - ERV ≥ 50% latent recovery/moisture transfer (LRMT)



Alternative Compliance Paths

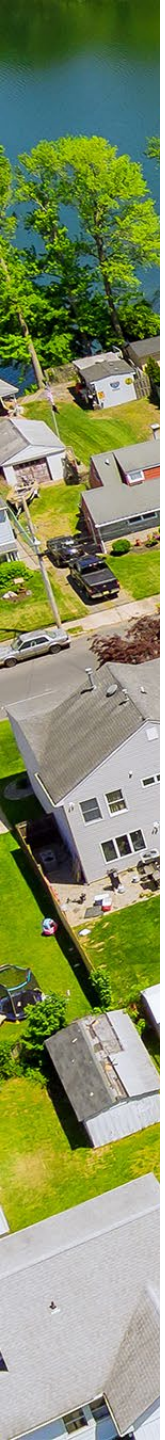
- Whole-building energy simulation paths
  - Total Building Performance
  - Energy Rating Index (ERI)



- Generally, the same software used for HERS Ratings and 45L tax credits.

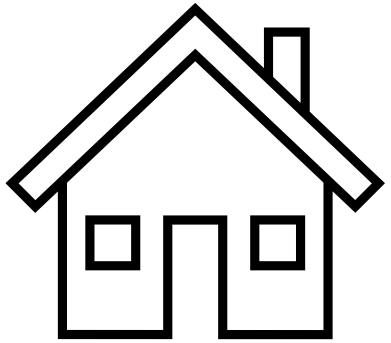
- Examples:
  - APEX
  - Ekotrope
  - EnergyGaugeUSA
  - REM/Rate

https://www.resnet.us/providers/accredited-providers/hers-software-tools/



Alternative Compliance Paths:
Total Building Performance
R405

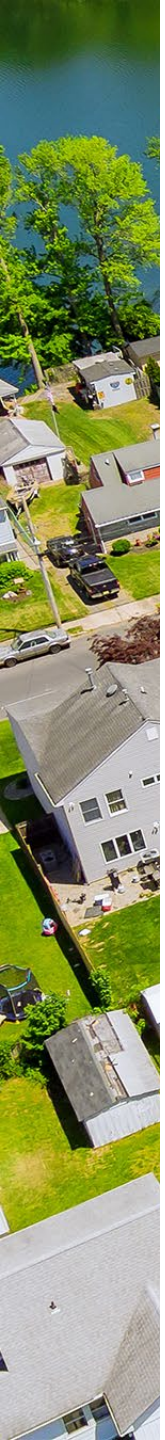
≤



Energy Cost
Proposed Home

≤

Energy Cost
Reference Home



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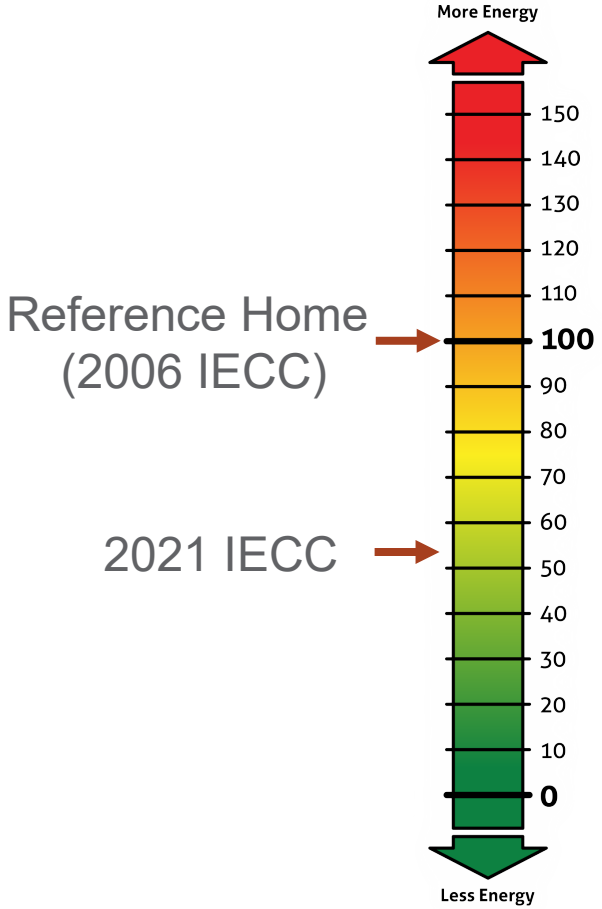
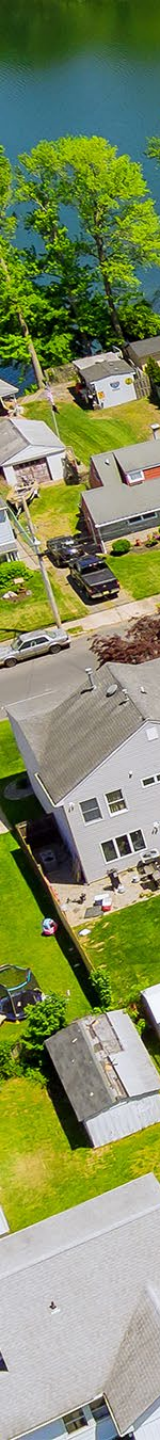
Alternative Compliance Paths:
Energy Rating Index (ERI)

R401.2.5, Item 3
R406



Climate Zone	Maximum ERI	Maximum ERI w/ Add'l Eff
0-1	52	**49.4**
2	52	**49.4**
3	51	**48.5**
4	54	**51.3**
5	55	**52.3**
6	54	**51.3**
7	53	**50.4**
8	53	**50.4**



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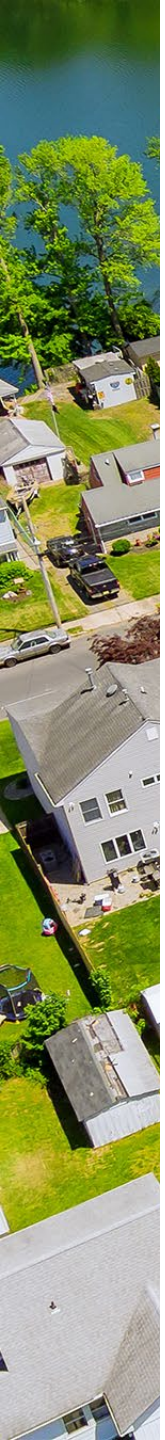
Certifying Compliance with the 2021 IECC

- HUD requires builders to certify that homes meet the 2021 IECC
- Builders should verify that construction documents meet the requirements of R103.2 *Information on Construction Documents* and that the home is designed to meet the 2021 IECC
- Builders or their agents should verify that homes are built to meet the 2021 IECC per R105.2.1 through R105.2.5 of R105.2 *Required Inspections*
- Assessing code compliance requires individuals with specialized knowledge and/or equipment. For example…
  - Duct leakage testing
  - Envelope air leakage testing
  - Air sealing and insulation installation criteria
- There are a variety of certifications requiring demonstration of knowledge and skills. For example…
  - Home Energy Rating System (HERS) Rater
  - Ratings Field Inspector (RFI)
  - IECC/HERS Compliance Specialist
  - Building Performance Institute (BPI) Infiltration and Duct Leakage (IDL)



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Summary

- **Climate Zone changes**
- **Compliance paths**
- **Chapter 4 – Residential Energy Efficiency changes**
  - **Building Thermal Envelope**
    - Prescriptive R-value/U-factors
    - Air barrier and insulation installation criteria
    - Air leakage testing and ACH50 limits
  - **Lighting**
    - Interior lighting
      - ✓ % high-efficacy
      - ✓ Controls
    - Exterior lighting controls
  - **Mechanical system**
    - Building cavities used as ducts
    - Duct leakage testing options and limits
    - Hot water pipe insulation
    - Whole-house ventilation and testing
    - HRV/ERV for Climate Zones 7 and 8
  - **Additional Efficiency Packages**

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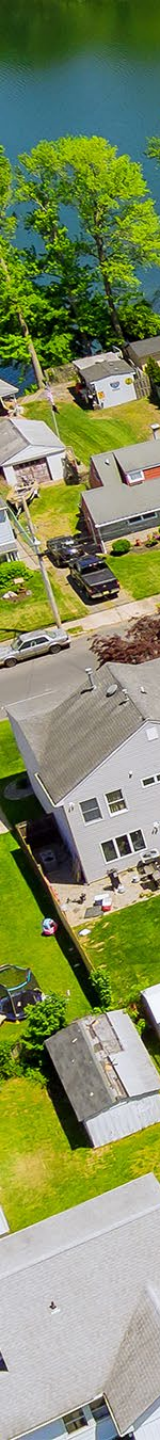
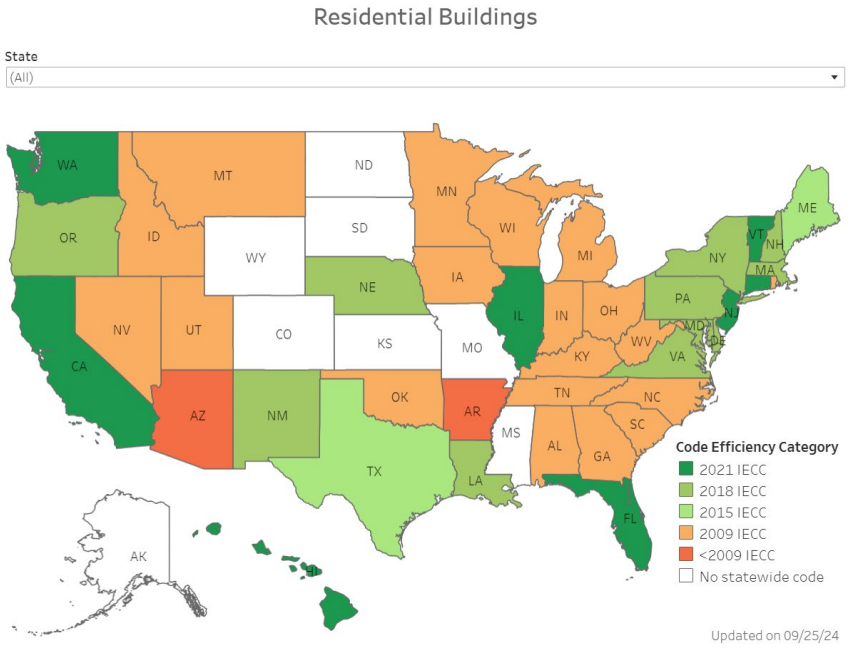
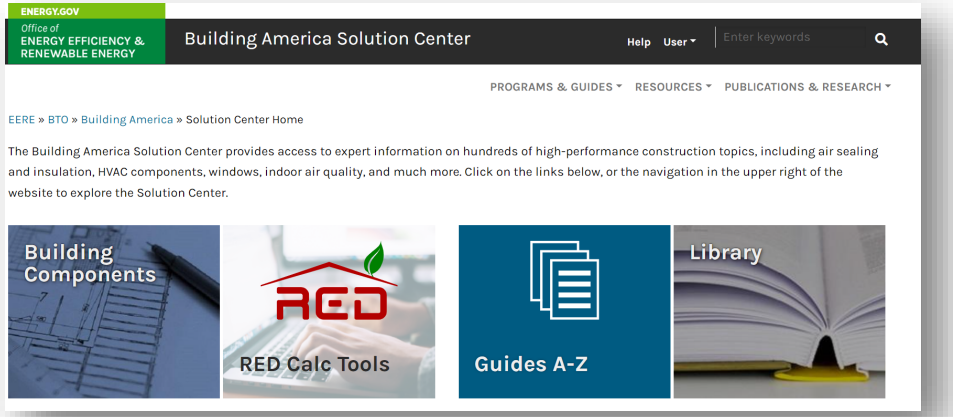
Thank you



Minimum Energy Standards Resources

- Introductory Code Resources
- Compliance Tools
- State-level Resources
- Technical Assistance Information
- Funding Opportunities
- Webinars and Recordings





Questions?

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