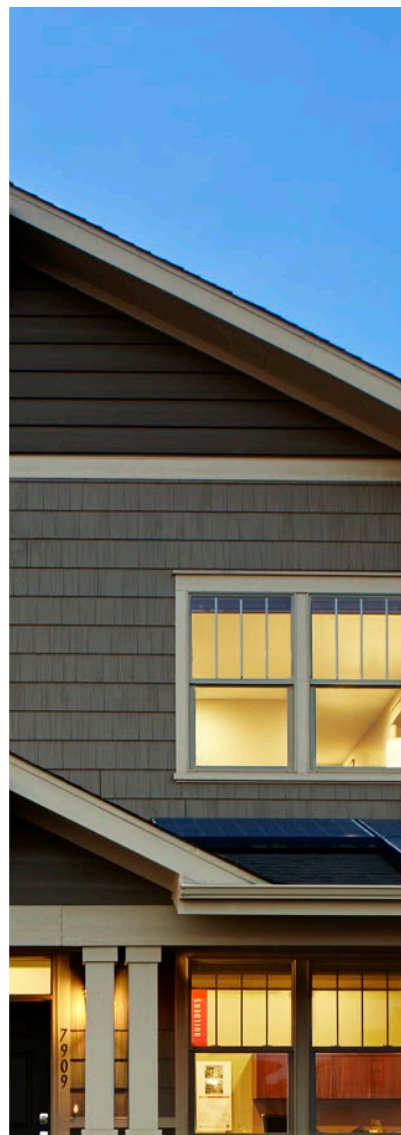
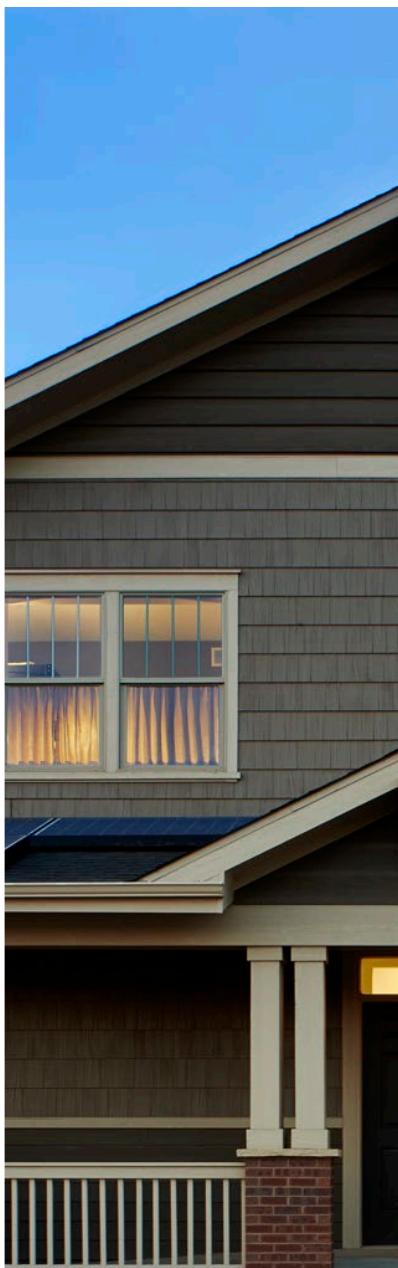
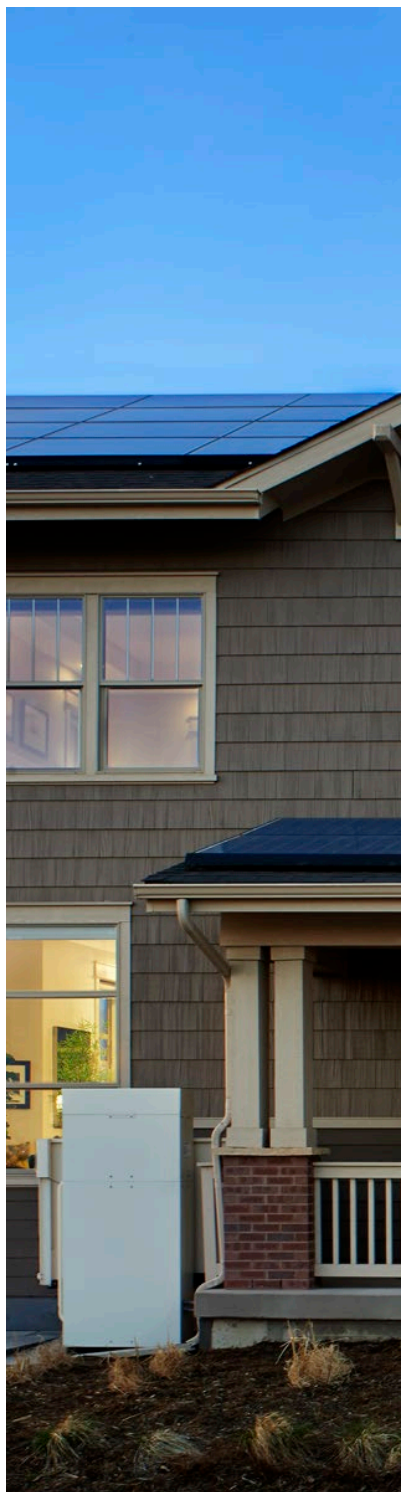




Advanced Code Overlay to the 2024 International Energy Conservation Code

Step 2 on the Pathway to Net Zero Energy and Carbon

June 2026

Photo credit: DOE Efficient Homes Tour

Introduction

Building energy codes have steadily improved in stringency since 1980. ASHRAE, the sponsor of the leading U.S. model commercial code, has established a goal for its model commercial code to achieve net zero energy and carbon by the 2031 edition.¹ The leading U.S. model residential code, published by the International Code Council, presently has no specific plans for a net zero code. In order to provide a path for states and localities to move toward net zero energy and carbon for new homes, the Next Generation Codes Coalition was formed. This Codes Coalition supports states and jurisdictions in adopting forward-looking enhancements to the residential chapter of the International Energy Conservation Code (IECC). These enhancements significantly reduce energy use and emissions in new homes, placing states on a clear pathway to dramatically improved energy efficiency.

The Coalition is led by the American Council for an Energy-Efficient Economy (ACEEE) and comprises the states of California, Colorado, Maryland, Massachusetts, New York, and Washington, as well as the City of Seattle, Enterprise Community Partners, the National Association of State Energy Officials, and New Buildings Institute.

The Coalition decided to develop a set of three model codes that together provide a path from the 2024 International Energy Conservation Code (IECC; the model residential code used by most U.S. states) to net zero energy and carbon codes. The 2024 version of IECC was used because that was the most recent published version of the IECC when this work was undertaken, with the 2027 version still in development. The Coalition decided to base the first model code tier on DOE's Zero Energy Ready program (subsequently renamed Efficient New Homes) as these homes were eligible for a \$5,000 tax incentive under the federal section 45L new homes tax credit. We call step one Efficient Homes. The Coalition decided that step two, called the Advanced code, will maximize energy efficiency without requiring renewable energy, and the third step, called the Net Zero code, will build on the second tier but require enough renewable energy for a home to be net zero energy and/or carbon over the course of a year.

This document provides the Step Two code. The Step Two code builds on the Step One code with additional energy efficiency measures and greater stringency. Step Three, the Net Zero code, will also be published separately and builds on the Step Two code, but also includes use of renewable energy in order to achieve zero energy and carbon emissions on a net basis over the course of a calendar year.

The Coalition sent each draft code it developed to more than 25 groups known to be interested in and active in code development issues. Through this process, more than 200 comments and suggestions were received on the draft codes. The Coalition's committees worked through these comments, making many refinements to the code language and technical requirements.

This document is the final version of the Step Two code, reflecting this process. We include a compilation of changes relative to Chapter 4 of the 2024 International Energy Conservation Code. A companion document, with changes to Chapter 2 (Definitions) and Chapter 6 (Referenced Standards) will be published as well. In addition, for states and other jurisdictions that adopt codes, and experts who work with them, we have also prepared two other versions of the code, a redline and strikeout relative to the 2024 IECC, and a clean version with just the final code language without redline and strikeout. If you are

¹ ASHRAE. 2022. ASHRAE Position Document on Building Decarbonization. Atlanta, GA: American Society of Heating, Refrigerating and Air Conditioning Engineers.
www.ashrae.org/file%20library/about/ashrae_building_decarbonization_pd_2022.pdf.

interested in obtaining copies of these other versions, please email Steve Nadel (snadel@aceee.org) or Skye Gruen (sgruen@aceee.org).

To aid use of these codes, after this front matter, we include a summary of key aspects of the Step One (Efficient Homes code, published separately) and the Step Two code (Advanced code -- this document). When the Step Three code (Net Zero), we will include a summary comparing that code to the other codes.

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Two Pathways Toward Net-Zero Homes

- Step 1: Efficient Homes → Readiness-driven: future-proof for electrification & renewables
- Step 2: Advanced → High performance-driven: achieve near-Passive House efficiency now

	Step 1: Efficient Homes Code	Step 2: Advanced Code
Compliance Pathways	Prescriptive path; Passive House cert path; Energy Rating Index (ERI) path; Tropical Climate Region Path	Prescriptive path; Passive House cert path; ERI/CO2e path; Tropical Climate Region Path
Prescriptive Pathway	No size limitation	Available to buildings <12,000 sf
ERI (R406) Requirements	Max ERI = 45 for most climate zones. 42 for mixed fuels, 48 if renewables added	Option to use ERI or combined ERI + CO2e index; Max ERI is ~38 for all-electric / ~35 for mixed fuel buildings; Max CO2e = TBD
	Mandatory Prescriptive Provisions	Mandatory Prescriptive Provisions
Envelope	Aligned with Energy Star/ DOE Efficient New Homes (formerly Zero Energy Ready Homes)	~5–15% lower U-factors than code; thermal bridge mitigation strategies required
Air Tightness	~25–40% tighter than 2024 IECC depending on climate zone	~10% tighter than Efficient Homes Code
HVAC (HP = heat pump)	Energy Star efficiency levels for furnaces, AC and HPs (can be lower with additional credits). Any system allowed, but HP “ready” circuits required if fossil systems installed	Heat pumps required (electric or gas) (with alternative compliance pathways requiring additional credits)
Ducts	Must be inside conditioned space with some small exceptions	Must be inside conditioned space
Ventilation/IAQ	Balanced ERV/HRV required in CZ 4C–8; EPA Indoor Air Plus required	Balanced ERV/HRV required in CZs 4–8; EPA Indoor Air Plus required
Electrification (HP = heat pump)	Electrification Ready baseline: EV-ready, HP-ready (space + water), electric cooking ready. Electric resistance restricted.	Electrification Ready baseline: EV-ready, HP-ready (space + water), electric cooking ready. Electric resistance restricted
Renewables & Storage	Credits for PV & battery storage; PV-ready zone required	Credits for PV & battery storage; PV-ready zone required
EV	EV-ready (40A/240V) baseline; EVSE optional for credit	Same
Water Heating (HPWH = Heat pump water heater) (HW=hot water) (ES = ENERGY STAR)	ES efficiency levels for water heating equip (can be lower with additional credits); demand response capable WH; HW pipe insulation follows ENH/WaterSense	HPWH required for one- and two-family and townhouses (with alternate compliance pathways requiring additional credits); rest same as Efficient Homes Code
Water Conservation	Low-flow fixtures and compact water distribution system required; option to instead follow WaterSense	Lower flow rates than Efficient Homes Code for bathroom faucets and showerheads; compact water distribution system required
Embodied Carbon	Credit for reduced embodied energy or carbon	Same
Credit System (R408)	+ 5 credits if >4000 sf + credits required if HVAC, HW does not meet Energy Star efficiency	10 credits from ≥2 measures + 5 credits if >4000 sf + additional credits required for non-heat pump HVAC or HW equipment

Amendments to 2024 IECC Chapter 4 – Residential Energy Code

This document lists amendments made by the Step Two (Advanced) Code, Chapter 4 (Final Draft, June 30, 2026), relative to the 2024 International Energy Conservation Code (IECC) Chapter 4 residential provisions.

R401

Modify Section R401.2.1 as follows:

R401.2.1 Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with Sections R401 through R404 and R408. **This compliance path shall not be used to demonstrate compliance for any of the following:**

4. Residential buildings with a conditioned floor area greater than 12,000 square feet
5. Dwelling units with a conditioned floor area greater than 4,000 square feet where combustion equipment is used for space heating or service water heating
6. New residential buildings with curtain walls, storefront systems, or window walls

Modify Section R401.2.2 as follows:

R401.2.2 ~~Simulated Building Performance~~ Passive House Building Certification Option. The ~~Simulated Building Performance~~ Passive House Building Certification Option requires compliance with Section R405 and Sections R404.5 through R404.9.

Modify Section R401.3 as follows:

R401.3 Certificate.

4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. ~~Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric heat pump,” “gas-fired heat pump,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.~~

R402

Modify Table R402.1.2 as follows:

- a. Revise the values and text as shown (unchanged values, text and footnotes are not shown):

TABLE R402.1.2—MAXIMUM ASSEMBLY U-FACTORS ^a AND FENESTRATION REQUIREMENTS								
CLIMATE ZONE	0	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7 AND 8
Vertical fenestration U-factor	0.50 0.30	0.50 0.30	0.40 0.30	0.30 0.28	0.30 0.25	0.28 0.25 ^d	0.28 0.25 ^d	0.27 0.25 ^d
Glazed vertical fenestration SHGC	0.25 0.23	0.25 0.23	0.25 0.23	0.25 0.23	0.40 0.30			
Attic roofline and ceiling U-factor ^f			0.030 0.26	0.030 0.26	0.026 0.24	0.026 0.24	0.026 0.24	0.026 0.24
Wood-framed and metal-framed wall U-factor	0.084 0.060	0.084 0.060	0.084 0.060	0.060 0.045	0.045 0.035	0.045 0.035	0.045 0.030	0.045 0.030

Mass wall <i>U</i> -factor, >50% insulation on interior ^b	0.170	0.170	0.140	0.087	0.087	0.065	0.057	0.057
Mass wall <i>U</i> -factor, all other mass walls ^b								
Floor <i>U</i> -factor		0.064 7	0.064 7					
Unheated slab <i>F</i> -factor ^e					0.51 0.48	0.51 0.48		
Crawl space wall <i>U</i> -factor		0.477 6	0.477 6					
Opaque door (U-Factor)	0.17							
Door with glazing (U-Factor/SHGC)	U-Factor: 0.25 / SHGC: 0.25							
b. Mass walls shall be in accordance with Section R402.2.6. Where more than half the insulation is on the interior, the mass wall <i>U</i>-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8. d. A maximum <i>U</i>-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either: 1. Above 4,000 feet in elevation above sea level, or 2. in windborne debris regions where protection of openings is required by Section R301.2.1.2 of the <i>International Residential Code</i>. f. Attic roofline insulation is part of the roof assembly and installed on the attic side of the roof deck. g. Doors with glazing greater than 50 percent of the door area shall comply with the requirements for vertical fenestration.								

Modify Table R402.1.3 as follows:

- a. Revise the values and text as shown (unchanged values, text and footnotes are not shown):

TABLE R402.1.3—INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT ^a								
CLIMATE ZONE	0	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7 AND 8
Vertical fenestration maximum <i>U</i> -factor	0.50 0.30	0.50 0.30	0.40 0.30	0.30 0.28	0.30 0.25	0.28 0.25 ^g	0.28 0.25 ^g	0.27 0.25 ^g
Skylight maximum <i>U</i> -factor								
Glazed vertical fenestration SHGC	0.25 0.23	0.25 0.23	0.25 0.23	0.25 0.23	0.40 0.30			
Attic roofline and ceiling <i>R</i> -value ⁱ			38 49	38 49	49 60	49 60	49 60	49 60
Insulation entirely above roof deck				25 30 ^{ci}				
Wood-framed wall <i>R</i> -value ^e	13 or 08&10ci 15&5ci or 08&15ci	13 or 08&10ci 15&5ci or 08&15ci	13 or 08&10ci 15&5ci or 08&15ci	20 or 13&5ci or 08&15ci 20&5ci or 13&10ci or 08&20ci	30 or 20&5ci or 13&10ci or 08&20ci 21&10ci or 13&15ci	30 or 20&5ci or 13&10ci or 08&20ci 21&10ci or 13&15ci	30 or 20&5ci or 13&10ci or 08&20ci 21&10ci or 13&15ci	30 or 20&5ci or 13&10ci or 08&20ci 21&10ci or 13&15ci
Mass wall <i>R</i> -value, >50% insulation on interior ^f	4	4	6	13	13	17	20	21
Mass wall <i>R</i> -value, all other mass walls ^f	3 /4	3 /4	4 /6	8 /13	8 /13	13 /17	15 /20	19 /21

Floor <i>R</i> -value ^h	13 or 7+5ci or 10ci 19 or 13+5ci or 15ci	13 or 7+5ci or 10ci 19 or 13+5ci or 15ci	13 or 7+5ci or 10ci 19 or 13+5ci or 15ci					
Unheated slab <i>R</i> -value & depth ^c					10ci, 34 ft	10ci, 34 ft		

Heated slab <i>R</i> -value & depth ^c					R-10ci, 34 ft and R-5 full slab	R-10ci, 34 ft and R-5 full slab		
Crawl space wall <i>R</i> -value ^{b, e}	0 5 ci or 13 ^d	0 5 ci or 13 ^d	0 5 ci or 13 ^d					
Opaque door (maximum U-Factor)	0.17							
Door with glazing (maximum U-Factor/SHGC)	U-Factor: 0.25 / SHGC: 0.25							
a. <i>R</i>-values are minimums. <i>U</i>-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed <i>R</i>-value of the insulation shall be not less than the <i>R</i>-value specified in the table. Window and skylight u-factors and SHGC shall be based on procedures in NFRC standard 100 as specified in chapter 3. f. Mass walls shall be in accordance with Section R402.2.6. The second <i>R</i>-value applies where more than half of the insulation is on the interior of the mass wall. g. A maximum <i>U</i>-factor of 0.30 0.28 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either: 1. Above 4,000 feet in elevation above sea level, or 2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the <i>International Residential Code</i>. i. Attic roofline insulation is part of the roof assembly and installed on the attic side of the roof deck. See also Section R402.2.1. j. Doors with glazing greater than 50 percent of the door area shall comply with the requirements for vertical fenestration.								

Modify Section R402.1.5 as follows:

R402.1.5 Component performance alternative. Where the proposed total *building thermal envelope* thermal conductance (TC_p) is less than or equal to the total *building thermal envelope* thermal conductance (TC_e) using factors in Table R402.1.2, the *building* shall be considered to be in compliance with Table R402.1.2. The total thermal conductance (TC) shall be determined in accordance with Equation 4-1. Proposed U-factors and slab-on-grade F-factors shall be taken from **Appendix RF of the 2024 International Energy Conservation Code, ANSI/ASHRAE/IES Standard 90.1 Appendix A**, or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to TC compliance, the SHGC requirements of Table R402.1.2 **and Section R402.4.2** and the maximum fenestration U-factors of Section R402.6 shall be met.

Modify Section R402.2.1 as follows:

R402.2.1 Ceilings with attics. Where Section R402.1.3 requires R-~~38~~49 insulation in the ceiling or attic, installing R-~~30~~38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-~~38~~49 insulation wherever the full height of uncompressed R-~~30~~38 insulation extends over the wall top plate at the eaves. Where Section R402.1.3 requires R-~~49~~60 insulation in the ceiling or attic, installing R-~~38~~49 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-~~49~~60 insulation wherever the full height of uncompressed R-~~38~~49 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the insulation and *fenestration* criteria in Section R402.1.2 and the component performance alternative in Section R402.1.5.

Modify Section R402.2.7 as follows:

R402.2.7 ~~Metal-frame~~ Steel-frame ceilings, walls and floors. ~~Metal-frame~~ Steel-frame ceilings, walls, and floors shall comply with the U-factor requirements of Table R402.1.2. The calculation of the U-factor for ~~metal-frame~~ steel framed ceilings and walls, **ceilings and floors** in a *building thermal envelope* assembly shall be determined in accordance with AISI S250, modified as follows:

1. Where the ~~metal-frame~~ steel-framed wall contains no *cavity insulation*, and uses *continuous insulation* to satisfy the U-factor maximum, ~~metal-frame~~ steel-framed wall member spacing is permitted to be installed at any on-center spacing.
2. Where the ~~metal-frame~~ steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23 percent framing factor or framing spaced at 16 inches (400 mm) on center with a 25 percent framing factor, the next lower framing member spacing input values shall

- be used when calculating using AISI S250.
- Where the ~~metal-frame steel-framed~~ wall contains less than 23 percent framing factors AISI S250 shall be used without any modifications.
 - Where the ~~metal-frame steel-framed~~ wall contains other than standard C-shaped framing members the AISI S250 calculation option for other than standard C-shaped framing is permitted to be used.

Modify Section R402.2.10.2 as follows:

R402.2.10.2 Alternative slab-on-grade insulation configurations. For *buildings* complying with Section ~~R405~~ or R406, slab-on-grade insulation shall be installed in accordance with the *proposed design* or *rated design*.

Modify Section R402.4.1 as follows:

R402.4.1 U-factor. An area-weighted average of *fenestration* products, ~~excluding opaque doors~~, shall be permitted to satisfy the *U-factor* requirements.

Add the following footnote to Table R402.5.1.1:

b. See Sections R402.5.1.2 and R402.5.1.3 for building air leakage testing requirements and maximum air leakage rates.

Modify Section R402.5.1.2.1 as follows:

R402.5.1.2.1 Unit sampling – air leakage. For buildings of eight or more *dwelling units* or *sleeping units*, air leakage testing shall be conducted in accordance with the unit sampling protocol in Section R107.7. Corrective actions and retesting for units that exceed the maximum permitted air leakage rate shall also be performed in accordance with Section R107.7. ~~For buildings with eight or more dwelling units or sleeping units, seven or 20 percent of the dwelling units or sleeping units, whichever is greater, shall be tested. Tested units shall include a top-floor unit, a ground-floor unit, a middle-floor unit and the dwelling unit or sleeping unit with the largest testing unit enclosure area. Where the air leakage rate of a tested unit is greater than the maximum permitted rate, corrective actions shall be taken and the unit retested until it passes. For each tested dwelling unit or sleeping unit with an air leakage rate greater than the maximum permitted rate, three additional units, including the corrected unit, shall be tested. Where buildings have fewer than eight dwelling units or sleeping units, each unit shall be tested.~~

Modify Section R402.5.1.3 as follows:

R402.5.1.3 Maximum air leakage rate. ~~Where tested in accordance with Section R402.5.1.2, the~~ The air leakage rate for *buildings*, *dwelling units* or *sleeping units* shall be as follows:

- Where complying with Section R401.2.1, ~~the building or the dwelling units or sleeping units in the building~~, buildings tested at the building level, including detached one-family dwellings with greater than 1,500 square feet of *conditioned floor area* and Group R-2, R-3 and R-4 buildings, shall have an *air leakage rate* not greater than 4.0 air changes per hour in Climate Zones 0, 1 and 2; 3.0 air changes per hour in Climate Zones 3 through 5; and 2.5 air changes per hour in Climate Zones 6 through 8. 0.12 cubic feet per minute per square foot [0.6 L/(s × m²)] of the *building thermal envelope area*. *Dwelling units* and *sleeping units* tested individually shall have an air leakage rate not greater than 0.23 cubic feet per minute per square foot [1.1 L/(s × m²)] of the *testing unit enclosure area*.
- Where complying with Section ~~R401.2.2 or R401.2.3, the building or the dwelling units or~~

~~sleeping units in the building shall have an air~~ buildings tested at the building level, including detached one-family dwellings with greater than 1,500 square feet of *conditioned floor area* and Group R-2, R-3 and R-4 buildings, shall have a building leakage rate not greater than 4.0 air changes per hour, or 0.22 cubic feet per minute per square foot $[1.1 \text{ L}/(\text{s} \times \text{m}^2)]$ of the ~~building thermal envelope area or the dwelling testing unit enclosure area, as applicable.~~ 0.15 cubic feet per minute per square foot $[0.7 \text{ L}/(\text{s} \times \text{m}^2)]$ of the *building thermal envelope area*. *Dwelling units* and *sleeping units* tested individually shall have an air leakage rate not greater than 0.25 cubic feet per minute per square foot $[1.25 \text{ L}/(\text{s} \times \text{m}^2)]$ of the *testing unit enclosure area*.

Exceptions:

1. ~~Where dwelling units or sleeping units are attached or located in an R-2 occupancy, and are tested without simultaneously testing adjacent dwelling units or sleeping units, the air leakage rate is permitted to be not greater than 0.27 cubic feet per minute per square foot $[1.4 \text{ L}/(\text{s} \times \text{m}^2)]$ of the testing unit enclosure area.~~ Where adjacent *dwelling units* are simultaneously tested in accordance with ASTM E779, the air leakage rate **and the enclosure area shall be** is permitted to be not greater than 0.27 cubic feet per minute per square foot $[1.4 \text{ L}/(\text{s} \times \text{m}^2)]$ of **calculated using only the portion of** the *testing unit enclosure area* that separates *conditioned space* from the exterior.
2. ~~Where buildings have 1,500 square feet (139.4 m²) or less of conditioned floor area, the air leakage rate is permitted to be not greater than 0.27 cubic feet per minute per square foot $[1.4 \text{ L}/(\text{s} \times \text{m}^2)]$.~~

Delete Section R402.6 *Maximum fenestration U-factor and SHGC*.

Add new Section R402.6, including subsections R402.6.1 and R403.6.6:

R402.6 Thermal bridge mitigation. *Above-grade walls* shall comply with Sections R402.6.1 through R402.6.6, or an *approved design*.

Exceptions:

1. Blocking, coping, flashing, and other similar materials for attachment of roof coverings.
2. *Thermal bridges* mitigated and accounted for in accordance with Section C402.1.4 of the 2024 IECC-Commercial Provisions.

R402.6.1 Above-grade wall design. One of the following options shall be used for *above-grade walls*:

1. Continuous insulation.
2. Structural insulated panels.
3. Insulated concrete forms.
4. *Double-wall framing*.

R402.6.2 Balconies and cantilevered floor decks. Balconies and concrete floor decks shall not penetrate the *building thermal envelope*. Such assemblies shall be separately supported.

Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where:

1. An area-weighted *U-factor* is used for *above-grade wall* compliance that includes a *U-factor* of 0.8 Btu/h·°F·ft² for the area of the *above-grade wall* penetrated by the concrete floor deck in accordance with Section R402.1.2.1.5, or
2. An *approved* thermal break element with not less than R-10 insulation material is installed in accordance with the manufacturer's instructions, or
3. An *approved design* where the *above-grade wall U-factor* used for compliance accounts for all balcony and concrete floor deck *thermal bridges*.

R402.6.3 Cladding supports. Linear elements supporting opaque cladding shall be offset from the structure with attachments that allow the continuous insulation, where present, to pass behind the cladding support element except at the point of attachment.

Exceptions:

1. An *approved design* where the *above-grade wall U-factor* used for compliance accounts for

the cladding support element *thermal bridge*.

2. Anchoring for *curtain wall* and window wall systems where *curtain wall* and window wall systems comply with R402.6.4.

R402.6.4 Structural beams and columns. Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of an insulation component within the *building thermal envelope*.

Exception: Where an *approved* thermal break element is installed in accordance with the manufacturer's instructions.

R402.6.5 Vertical fenestration. *Vertical fenestration* intersections with *above-grade walls* shall comply with one or more of the following:

1. Where *above-grade walls* include continuous insulation, the plane of the exterior glazing layer or, for metal frame *fenestration*, a non-metal thermal break in the frame shall be positioned within 2 inches (50 mm) of the interior surface of the continuous insulation.
2. The surface of the rough opening, not covered by the *fenestration* frame, shall be insulated with not less than R-3 air-impermeable insulation or covered with a wood buck that is not less than 1.5 inches (38 mm) thick.

Exception: Doors.

R402.6.6 Parapets. Parapets shall comply with one or more of the following:

1. Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the continuous insulation shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior continuous insulation applied to the parapet, shall comply with the fire resistance ratings of the building code.
2. Where continuous insulation is installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the continuous insulation shall extend up the exterior side of the parapet to not less than the height of the top surface of the *roof assembly*.
3. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent *R*-value insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.
4. Where continuous insulation is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be continuous to each other at the roof-ceiling-wall intersection.
5. Where a thermal break element with not less than R-5 insulation material aligned with the *above-grade wall* and roof insulation, and forming a continuous thermal barrier, is installed in accordance with the thermal break manufacturer's instructions.

R403

Add new Section R403.1, including subsections R403.1.1 and R403.1.2:

R403.1 Heating and cooling systems

R403.1.1 Heating and cooling equipment. Heating and cooling systems shall utilize a heat pump complying with Sections R403.1.2 and R403.1.3.

Exceptions:

1. Cooling-only spaces: Spaces that are cooled but not heated shall be permitted to utilize cooling equipment with a cooling efficiency that meets or exceeds the cooling efficiency in the most recently published ENERGY STAR heat pump specification at the time of permit application, or shall comply with Exception 2.
2. Noncompliant or alternative heating or cooling systems: Where the heating or cooling system does not utilize a heat pump or utilizes equipment that does not meet the requirements of

Sections R403.1.2 and R403.1.3, the building shall comply with either of the following:

- 2.1 Comply with Section R403.1.3.1 and achieve additional energy credits as specified in Section R408.2.1 and Table R408.2.1, or
- 2.2 Comply with this code using Section R401.2.2 or R401.2.3.

R403.1.1.1 Electric-resistance space heating. Buildings in Climate Zones 2 through 8 shall not use electric-resistance space heating.

Exceptions:

1. Electric-resistance space heating is permitted as a supplemental source to a heat pump that complies with Sections R403.1.4.3 and R403.1.4.4.
2. *Dwelling units* or *sleeping units* are permitted to be heated using electric-resistance space-heating appliances where the installed HVAC heating capacity complies with all of the following:
 - 2.1 The installed HVAC heating capacity in each separate *habitable space* with exterior fenestration shall not exceed 750 watts for Climate Zones 0 – 4 or 1000 watts for Climate Zones 5 – 8.
 - 2.2 A *habitable space* with two primary walls facing different cardinal directions, each with exterior fenestration, shall be permitted an additional 250 watts of electric-resistance heating.
 - 2.3 A space within a dwelling unit or sleeping unit that adjoins the *building thermal envelope* but without exterior fenestration shall be permitted to have no more than 250 watts of electric-resistance heating.
3. Buildings in which electric-resistance appliances meet the requirements of Sections R403.1.4.3 and R403.1.4.4 and provide less than 5 percent of the total building HVAC system heating capacity or serve less than 5 percent of the *conditioned floor area*.

R403.1.2 Heating and cooling equipment efficiency. Heat pump equipment shall meet or exceed one of the following:

1. Climate zones 0, 1, 2, 3: Heat pumps shall have a heating seasonal performance factor (HSPF2) not less than 7.8 and seasonal energy efficiency ratio (SEER2) not less than 17.1.
2. Climate zones 4, 5, 6, 7, 8: Heat pumps shall have a heating seasonal performance factor (HSPF2) not less than 8.1 and seasonal energy efficiency ratio (SEER2) not less than 15.2 and shall comply with all of the following:
 - 2.1 Heating capacity at 5°F (–15°C) shall be not less than 70 percent of the rated heating capacity at 47°F (8.3°C).
 - 2.2 A coefficient of performance (COP) at 5°F (–15°C) not less than 1.75.
3. Heat pumps not rated in SEER2 or HSPF2: Heat pumps shall have a minimum coefficient of performance (COP) not less than 3.5 and an energy efficiency ratio (EER) not less than 12.6.

Renumber and modify Sections R403.1.3 and R403.1.3.1 as follows:

R403.1.3 Heating and cooling equipment sizing.

R403.1.3.1 General. Heating and cooling *equipment* serving individual *dwelling units* shall be sized in accordance with ACCA Manual S based on ~~building~~ *dwelling unit* loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies. *Heating and cooling equipment* serving multiple *dwelling units* shall be sized in accordance with C403.3.1 of the *International Energy Conservation Code—Commercial Provisions*. ~~New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed.~~

Add a new Section R403.1.3.2:

R403.1.3.2 Heat pumps. Heat pumps shall be sized to meet the full heating load without supplemental heating at 17° F or the winter design temperature at the *building site*, whichever is higher. Where the summer cooling load exceeds the heating load, heat pump capacity shall not exceed the calculated cooling design load as calculated in accordance with ACCA Manual S.

Renumber and modify Section R403.1.4:

R403.1.4 ~~R403.1~~ Controls. Not less than one *thermostat* shall be provided for each separate heating and cooling system.

Renumber the following section:

R403.1.4.1 Programmable thermostat.

Renumber and modify Section R403.1.4.2:

R403.1.4.2 Demand response. The *thermostat* controlling the primary heating or cooling system of each *dwelling unit* shall be provided with a *demand responsive control* capable of communicating with the *Virtual End Node (VEN)* using a wired or wireless bi-directional communication pathway that provides the occupant the ability to voluntarily participate in utility demand response programs, where available. The *thermostat* shall be capable of executing the following actions in response to a *demand response signal*:

1. Automatically increasing the zone operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C) and 4°F (2°C).
2. Automatically decreasing the zone operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C) and 4°F (2°C).

Thermostats controlling single-stage HVAC systems shall comply with Section **R403.1.4.2.1**. Thermostats controlling variable capacity systems shall comply with Section **R403.1.4.2.2**. Thermostats controlling multistage HVAC systems shall comply with either Section **R403.1.4.2.1** or **R403.1.4.2.2**. Where a *demand response signal* is not available, the *thermostat* shall be capable of performing all other functions.

Renumber the following sections:

R403.1.4.2.1 Single-stage HVAC system controls.

R403.1.4.2.2 Variable-capacity and two-stage HVAC system controls.

Add new Section R403.1.4.3:

R403.1.4.3 Thermostats for heat pumps with supplementary heating. In heat pump systems with *supplementary heating*, the supplementary heating source, whether electric-resistance or fuel-fired, shall be controlled by a thermostat (or thermostats) in accordance with the following:

1. The thermostat shall receive outdoor air temperature from an outdoor air temperature sensor or a weather service.
2. The thermostat shall display the outdoor air temperature or the outside temperature shall be displayed on a connected app.
3. The thermostat and heat pump shall have the capability to lock out *supplementary heating* in accordance with Section R403.1.4.4.
4. The thermostat shall have an indicator to notify when *supplementary heating* or emergency heating is in use.
5. *Climate zones* 6-8: The thermostat shall be configured to permit compressor operation down to an outdoor temperature of 5°F (-15°C) or lower.
6. *Climate zones* 4-5: The thermostat shall allow the compressor to operate down to the lowest outdoor design temperature for which the heat pump is rated. *Supplementary heating* shall be permitted to operate in conjunction with the heat pump to meet the heating load when outdoor air temperature is below 17°F (-8°C) or the winter design temperature at the building site, whichever is higher.

Exception: Room heat pumps and packaged terminal heat pumps.

Renumber and modify Section R403.1.4.4:

R403.1.4.4 R403.1.2 Heat pump supplementary heat. Heat pumps having supplementary electric-resistance, *fuel gas*

or *liquid fuel* heating systems shall have controls **configured to limit supplementary heating operation to where one or more of the following apply:** ~~that are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. Supplemental heat operation shall be limited to only where one of the following applies:~~

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the *thermostat* setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions.
4. The *thermostat* malfunctions.
5. **The user selects emergency heating**

Renumber the following section:

R403.1.4.5 R403.2 Hot water boiler temperature reset.

Renumber and modify Section R403.1.5:

R403.1.5 R403.3 Duct systems. *Duct systems* shall be installed in accordance with Sections **R403.1.5.1 R403.3.1** through **R403.1.5.10 R403.3.9**.

Renumber the following sections:

R403.1.5.1 R403.3.1 Duct system design.

R403.3.1.5.2 Building cavities.

Delete Section R403.3.3 *Ductwork located outside conditioned space*.

Add new Sections R403.1.5.3, R403.1.5.4, R403.1.5.5 and R403.1.5.6:

R403.1.5.3 Duct system location. All heating and cooling *ductwork* and *space conditioning equipment* shall be located inside *conditioned space*.

Exceptions:

1. A total duct length of up to 10 feet shall be permitted for *ductwork* located outside the thermal and air barrier boundary of the building. Such ductwork shall be included in duct leakage testing as required by Section 403.1.5.8.
2. A total duct length of up to 20 feet shall be permitted for *ductwork* contained within wall or floor assemblies separating unconditioned space from *conditioned space*, if the following requirements are met: A *continuous air barrier* is installed between the ductwork and the unconditioned space and not less than R-10 insulation is installed continuously between the *ductwork* and the unconditioned space
3. *Ductwork* located within the ceiling insulation of an attic floor assembly shall be permitted if all of the following are met:
 - 3.1. Duct leakage to the outdoors, as measured at 25 Pascals, does not exceed 1.5 CFM25 per 100 square feet of conditioned floor area.
 - 3.2. *Ductwork* is buried in ceiling insulation. At all points along the *ductwork*, the sum of the ceiling insulation R-value against and above the top of the *ductwork*, and against and below the bottom of the *ductwork*, shall be not less than R-19, excluding the R-value of the duct insulation.
 - 3.3. In Moist (A) *climate zones* (as defined in Figure R301.1), one of the following requirements shall be met for supply *ductwork* that is located more than 3 feet from the supply outlet:
 - 3.3.1 Supply ductwork is insulated to an R-value not less than R-13; OR
 - 3.3.2 Supply ductwork is encapsulated with a minimum of 1.5 inches of closed-cell spray foam and buried under at least 2 inches of blown-in insulation; OR

3.3.3 Supply *ductwork* is insulated to an R-value not less than R-8 and is located in an unvented attic with vapor diffusion ports complying with Section R806.5 of the *International Residential Code*.

4. *Jump ducts* that do not deliver or return conditioned air directly to or from the *space conditioning equipment* shall be permitted to be located in attics, provided that all of the following are met:
 - 4.1. All joints, including boot-to-drywall connections, are properly air-sealed.
 - 4.2. The *jump duct* is fully encapsulated by attic insulation.
5. *Ductwork* and *air-handling units* associated with rooftop make-up air units or dedicated outdoor air systems (DOAS) shall be permitted to be located outside the thermal and air barrier boundary of the building.
6. Where the *space conditioning equipment* is a single package system, it shall be permitted to be located outside *conditioned space*.
7. Where a ground-source heat pump is located in an unconditioned space, the associated *air-handling units* are permitted to be located outside *conditioned space*, provided that:
 - 7.1. All *ductwork* connected to the air handler meets the insulation and air-sealing requirements of Sections R403.1.5.4 and R403.1.5.7.
 - 7.2. Any supply and return ducts extending from the air handler to *conditioned spaces* are tested for leakage in accordance with Section R403.1.5.8.

R403.1.5.4 Ductwork insulation. *Ductwork* meeting the Exceptions in R403.1.5.3 shall be insulated with not less than R-8 insulation or the insulation R-value required by the exception, whichever is highest. All other *ductwork* shall be insulated with not less than R-4 insulation.

R403.1.5.5 Ductwork installation. Flexible *ductwork* shall be installed in accordance with the manufacturer's installation instructions, in conformance with ANSI/SMACNA standard 006-2020 for flexible ductwork, and in accordance with the following requirements:

1. Ducts shall be installed without kinks, sharp bends, compression, or coiling.
2. Bends in flexible ducts shall have a centerline radius not less than one duct diameter.
3. Flexible ducts shall be supported at intervals not greater than 4 feet (1.2 m) and shall not sag more than ½ inch per foot (13 mm per 305 mm) between supports.

R403.1.5.6 Pressure balancing. Each bedroom supplied with conditioned air shall be pressure-balanced to maintain a pressure differential not greater than 3 pascals (Pa) relative to the main body of the *dwelling unit* when interior doors are closed. Compliance shall be achieved through one or more of the following: transfer grilles, *jump ducts*, dedicated return ducts, or door undercuts providing adequate free area in accordance with the mechanical design.

Exception: Bedrooms with a design supply airflow ≥ 150 cfm are permitted to maintain a pressure differential not greater than 5 Pa relative to the main body of the *dwelling unit* when interior doors are closed.

Delete Sections R403.3.3 *Ductwork located outside conditioned space*, R403.3.4 *Duct systems located in conditioned space*, R403.3.5 *Ductwork buried within ceiling insulation* and Section R403.3.5.1 *Effective R-value of deeply buried ducts*.

Renumber the following sections:

~~R403.3.6~~ R403.1.5.7 Sealing.

~~R403.3.6~~ R403.1.5.7.1 Sealed air-handling unit.

Renumber and modify the Sections R403.1.5.8 and R403.1.5.9:

R403.1.5.8 ~~R403.3.7~~ Duct system testing. Each *duct system* serving an individual *dwelling unit* shall be tested for air leakage in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 or ACCA Standard 5 by a *HERS Rater*, *HERS Rating Field Inspector*, or an applicable *BPI Certified Professional*. Where the *space conditioning equipment* is not installed at the time of the test, testing of ductwork alone shall be permitted. Total leakage shall be measured with a pressure differential of 0.1 inch water gauge (25

Pa) across the *duct system or ductwork* and shall include the measured leakage from the supply and return *ductwork*. A written report of the test results shall be signed by the party conducting the test and provided to the *code official*. ~~Duct system leakage~~ **Leakage** testing at either rough-in or post construction shall be permitted with or without the installation of registers or grilles. Where installed, registers and grilles shall be sealed during the test. Where registers and grilles are not installed, the face of the register boots shall be sealed during the test.

Exceptions:

1. Testing shall not be required for *duct systems* serving *ventilation* systems that are not integrated with *duct systems* serving heating or cooling systems.
2. Testing shall not be required where there is not more than 10 feet (3048 mm) of total *ductwork* external to the *space conditioning equipment* and both the following are met:
 - 2.1. The *duct system* is located entirely within *conditioned space*.
 - 2.2. The *ductwork* does not include *plenums* constructed of building cavities or gypsum board.
3. ~~Where the *space conditioning equipment* is not installed, testing shall be permitted. The total measured leakage of the supply and return *ductwork* shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of *conditioned floor area*.~~
4. Where tested in accordance with Section **R403.1.5.10** ~~R403.3.9~~, testing of each *duct system* is not required.

R403.1.5.9 ~~R403.3.8~~ **Duct system leakage.** The total measured *duct system* leakage shall not be greater than the values in Table R403.3.8, based on the *conditioned floor area*, number of ducted returns, and location of the *duct system*. ~~For buildings complying with Section R405 or R406, where *duct system* leakage to outside is tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554, the leakage to outside value shall not be used for compliance with this section, but shall be permitted to be used in the calculation procedures of Section R405 and R406.~~

Renumber and modify Table R403.1.5.9 as follows (unchanged rows and values are not shown):

TABLE R403.3.8 R403.1.5.9 —MAXIMUM TOTAL DUCT SYSTEM LEAKAGE—continued			
EQUIPMENT AND DUCT CONFIGURATION	DUCT SYSTEMS SERVING MORE THAN 1,000 FT ² OF CONDITIONED FLOOR AREA		DUCT SYSTEMS SERVING 1,000 FT ² OR LESS OF CONDITIONED FLOOR AREA
	cfm/100 ft ²		cfm
	Number of ducted returns ^a		
	< 3	≥ 3	Any
Space conditioning equipment is not installed, but the ductwork is located entirely in conditioned space ^{c,d}	6	8	60
All components of the duct system are installed and entirely located in conditioned space ^e	8	12	80
^{c.} For duct systems to be considered inside a conditioned space, where the ductwork is located in ventilated attic spaces or unvented attics with vapor diffusion ports, duct system leakage to outside must comply with Item 2.1 of Section R403.3.4. ^{d.} Prior to the issuance of a certificate of occupancy, where the air handling unit is not verified as being located in conditioned space, the total duct system leakage must be retested.			

Renumber and modify Section R403.1.5.10 as follows:

R403.1.5.10 ~~R403.3.9~~ **Unit sampling – duct systems.** For buildings with eight or more *dwelling units* or *sleeping units*, duct system testing for leakage and pressure balancing shall be conducted in accordance with the unit sampling protocol in Section R107.7. Corrective actions and retesting for units that exceed the maximum permitted duct system leakage or do not meet the pressure balancing requirements of Section R403.1.5.6 shall also be performed in accordance with Section R107.7. ~~For buildings with eight or more *dwelling units* or *sleeping units*, the *duct systems* in the greater of seven or 20 percent of the~~

~~dwelling units or sleeping units shall be tested, including a top floor unit, a ground floor unit, a middle floor unit and the unit with the largest conditioned floor area. Where buildings have fewer than eight dwelling units or sleeping units, the duct systems in each unit shall be tested. Where the leakage of a duct system is greater than the maximum permitted duct system leakage, corrective actions shall be made to the duct system and the duct system shall be system retested until it passes. For each tested dwelling unit or sleeping unit that has a greater total duct system leakage than the maximum permitted duct system leakage, an additional three dwelling units or sleeping units, including the corrected unit, shall be tested.~~

Add a new Section R403.1.6:

R403.1.6 HVAC system grading. HVAC systems shall comply with all of the following in accordance with ANSI/RESNET/ACCA Standard 310, with documentation by a *HERS Rater, HERS Rating Field Inspector, or an applicable BPI Certified Professional*:

1. Airflow shall be Grade I, and the field-measured airflow shall be within 15 percent of the airflow specified in the design.
2. Watt draw shall be Grade I or Grade II, and the watt draw per cubic foot per minute (W/CFM) shall be no more than 0.58.
3. Refrigerant charge shall be Grade I.

Exception:

1. HVAC systems not within the scope of ANSI/RESNET/ACCA Standard 310.

R403.1.6.1 Unit sampling - HVAC system grading. For buildings with eight or more *dwelling units or sleeping units*, HVAC system grading shall be conducted in accordance with the unit sampling protocol in Section R107.7. Corrective actions and retesting for units that do not meet the requirements of Section R403.1.6 shall also be performed in accordance with Section R107.7.

Renumber and modify Section R403.1.7, including subsections R403.1.7.1 through R403.1.7.4:

R403.1.7 ~~R403.4~~ Mechanical system piping insulation. Mechanical system piping, including piping for space heating, space cooling, and ground-source heat pump systems, shall comply with Sections R403.1.7.1 through R403.1.7.4.

R403.1.7.1 Systems serving one- and two-family dwellings and townhouses. Mechanical system piping serving one- and two-family dwellings and townhouses that conveys fluids having a design operating temperature range greater than 105°F (41°C) or less than 55°F (13°C) shall be insulated to an *R-value* of not less than R-6 ~~R-3~~. If space constraints prevent the noted R-value from being used, the maximum thickness of insulation possible shall be installed where those constraints exist.

Exception. Refrigerant piping complying with Section R403.1.7.4.

R403.1.7.2 Systems serving Group R-2, R-3, and R-4 buildings. Mechanical system piping serving heating or cooling systems in group R-2, R-3, and R-4 *buildings* shall be thermally insulated in accordance with Tables R403.1.7.2. If space constraints prevent the noted R-value from being used, the maximum thickness of insulation possible shall be installed where those constraints exist.

Exceptions:

1. Factory-installed piping that is integral to HVAC equipment and included in the equipment's certified performance rating.
2. Piping that conveys fluids having a design operating temperature range between 60°F and 105°F.
3. In piping 1 in. or less, insulation is not required for strainers, control valves, and balancing valves.
4. Refrigerant piping complying with Section R403.1.7.4.

TABLE R403.1.7.2—PIPE INSULATION REQUIREMENTS FOR MECHANICAL PIPING (in R-value)				
FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	NOMINAL PIPE OR TUBE SIZE (inches)			
	< 1	1 to < 1.5	1.5 to < 4	4 to < 8
	Minimum R-value Required			
>140	6	6	6	6

105-140	6	6	6	6
40-60	2	2	3	3
< 40	2	3	3	3

R403.1.7.3 ~~R403.4.1~~ Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, physical contact and wind. The protection shall provide shielding from solar radiation that can cause degradation of the material and shall be removable not less than 6 feet (1828 mm) from the equipment for maintenance. Adhesive tape shall be prohibited.

R403.1.7.4 Insulation of HVAC system refrigerant piping. Field installed HVAC refrigerant piping, other than piping factory installed in HVAC equipment, shall have insulation as listed below, at a conductivity rating of 0.21 to 0.26 Btu x in/(h x ft² x °F) with a mean temperature rating of 75°F. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted. Manufacturer's required minimum pipe insulation shall be maintained.

1. For lines that convey hot gas for space heating:
 - 1.1 Minimum 1-inch insulation on the portions outside the *building thermal envelope*.
 - 1.2 Minimum ½-inch insulation on the portions within the *building thermal envelope*.
2. Minimum ½-inch insulation on the liquid line for mini-split systems and other systems for which insulation is required by the manufacturer, or where the metering device is located in the outdoor unit.
3. No insulation is required on the liquid line for other heat pump types or for cooling-only units where insulation is not required by the manufacturer.

Renumber and modify Section R403.1.8 as follows:

R403.1.8 ~~R403.9~~ Mechanical systems serving spaces outside of the building thermal envelope. Mechanical systems providing heat outside of the *building thermal envelope* of a *building* shall comply with Sections ~~R403.9.1~~ **R403.1.8.1** through ~~R403.9.4~~ **R403.1.8.4**.

Renumber the following sections:

- R403.1.8.1 Heating outside a building.**
- R403.1.8.2 Snow melt and ice system controls.**
- R403.1.8.3 Roof and gutter deicing controls.**
- R403.1.8.4 Freeze protection system controls.**

Delete Section R403.8 *Systems serving multiple dwelling units*.

Renumber and modify Section R403.2 as follows:

R403.2 ~~R403.5~~ Service hot water systems. Energy conservation measures for service hot water systems shall be in accordance with Sections **R403.2.1** ~~R403.5.1~~ through **R403.2.7** ~~R403.5.3~~.

Add new Sections R403.2.1, R403.2.2, R403.2.3 and R403.2.4:

R403.2.1 Water heater equipment and efficiency.

R403.2.1.1 Water heater systems for one- and two-family dwellings and townhouses. One- and two-family dwellings and townhouses shall be provided with a heat pump water heater. Electric split-system heat pump water heaters shall have a UEF of not less than 2.2. Electric integrated heat pump water heaters shall have a UEF of not less than 3.3. Installation shall comply with the manufacturer's installation instructions, including minimum space volume and equipment venting requirements, and shall be verified by the *code official*, an *approved third-party inspection agency*, or an *approved source*

Exception: The water heating system is not required to be a heat pump where the building achieves

additional energy credits as specified in Section R408.2.1 and Table R408.2.1 or complies with this code using Section R401.2.2 or R401.2.3.

R403.2.1.2 Water heater systems for Group R-2, R-3, and R-4 buildings. For Group R-2, R-3, and R-4 buildings, the minimum efficiency shall be:

1. A UEF of not less than 2.2 for residential water heaters
2. A COP of not less than 1.6 for all other water heaters

Exception: A water heater with lower efficiency is permitted where the building achieves additional energy credits as specified in Section R408.2.1 and Table R408.2.1 or complies with this code using Section R401.2.2 or R401.2.3.

R403.2.2 Grid integrated water heating. Electric storage water heaters with a rated storage volume of 40 gallons (150 L) to 120 gallons (450 L) and a nameplate input rating equal to or less than 12 kW shall be capable of *demand responsive control* that complies with AHRI Standard 1430 (I-P).

R403.2.3 Service hot water pipe insulation. Insulation for service hot water piping shall comply with Section R403.2.3.1 or Section R403.2.3.2.

R403.2.3.1 One- and two-family dwellings and townhouses. Service water piping shall be insulated to a minimum thickness of 1 inch with a conductivity of 0.21–0.28 Btu × in/(h × ft² × °F) at a mean rating temperature of 100°F.

Exception: Piping less than 3 feet in length between the branch and the fixture outlet shall not be required to be insulated.

R403.2.3.2 Group R-2, R-3, and R-4 Buildings. Service water pipe insulation in Group R-2, R-3, and R-4 buildings shall comply with Sections R403.2.3.2.1 and R403.2.3.2.2.

R403.2.3.2.1 Recirculating hot water distribution. In Group R-2, R-3, and R-4 buildings, insulation for recirculating hot water distribution piping shall comply with Table R403.2.3.2.1. If space constraints prevent the noted R-value from being used, the maximum thickness of insulation possible shall be installed where those constraints exist.

TABLE R403.2.3.2.1—MINIMUM PIPE INSULATION FOR RECIRCULATING HOT WATER SYSTEMS IN GROUP R-2, R-3 and R-4 BUILDINGS	
NOMINAL PIPE OR TUBE SIZE (inches)	MINIMUM INSULATION
< 1.5	R10
≥ 1.5	R12

R403.2.3.2.2 Other hot water distribution piping. In Group R-2, R-3, and R-4 buildings, hot water distribution piping not covered by Section R403.2.3.2.1 shall be insulated according to Table R403.2.3.2.2.

Exception: Piping less than 3 feet in length between the branch and the fixture outlet shall not be required to be insulated.

TABLE R403.2.3.2.2—MINIMUM PIPE INSULATION FOR OTHER HOT WATER PIPING IN GROUP R-2, R-3, and R-4 BUILDINGS	
NOMINAL PIPE OR TUBE SIZE (inches)	MINIMUM INSULATION
< 1	R4
≥ 1	R6

R403.2.4 Hot water distribution systems. Hot water distribution systems shall comply with the compact distribution requirements of Items 1 and 2.

1. The volume of water stored in piping between the nearest source of heated water and the termination of a fixture supply pipe shall not exceed 0.5 gallons (1.9 L).

Exception: Fixtures in bathrooms that do not contain a shower or bathtub.

2. Stored volume shall be determined in accordance with Section R403.2.4.1.

Exception to R403.2.4: For systems serving one- and two-family dwellings and townhouses where the dwelling unit is certified under the EPA WaterSense Labeled Homes program.

Delete Section R403.5.2 *Hot water pipe insulation*.

Renumber and modify Sections R403.2.4.1 and R403.2.4.1.1 as follows:

R403.2.4.1 ~~R403.2.3.1.1~~ **Water volume determination.** The water volume in the piping between a source of heated water and the termination of a fixture supply pipe shall be calculated in accordance with this section. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered to be sources of heated water. Compliance shall be determined using either the calculation method in Section R403.2.4.1.1 or the field verification method in Section R403.2.4.1.2.

R403.2.4.1.1 Calculation method. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from Table R403.2.4.1 ~~R403.2.3.1~~. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

Renumber Table R403.2.4.1 as follows:

TABLE R403.2.4.1—INTERNAL VOLUME OF VARIOUS WATER DISTRIBUTION TUBING

Add the following footnote to Table R403.2.3.3.1:

2. 1 gallon = 128 ounces

Add new Section R403.2.4.1.2:

R403.2.4.1.2 Field verification method. The water volume in the piping between a source of heated water and the termination of a fixture supply pipe shall be verified in accordance with Items 1 through 3.

1. Where a demand recirculation system is installed, the system shall be activated and allowed to operate for not less than 40 seconds.
2. Hot water shall be drawn from the fixture located at the greatest piping distance from the source of heated water.
3. The volume of water collected prior to a temperature increase of not less than 10°F (5.6°C) shall not exceed 0.6 gallons (2.3 L).

Renumber and modify Sections R403.2.5 and subsections R403.2.5.1, R403.2.5.1.1 and R403.2.5.1.2 as follows:

R403.2.5 ~~R403.5.1~~ **Heated water circulation and temperature maintenance systems.** Heated water circulation systems shall be in accordance with Section R403.2.5.1 ~~R403.5.1.1~~. Heat trace temperature maintenance systems shall be in accordance with Section R403.2.5.2 ~~R403.5.1.2~~. *Automatic* controls, temperature sensors and pumps shall be in a location with access. *Manual* controls shall be in a location with *ready access*.

R403.2.5.1 ~~R403.5.1.1~~ **Circulation systems.** Heated water circulation systems shall be provided with a circulation pump. Gravity and thermosyphon circulation systems shall be prohibited. Controls for *circulating hot water system* pumps shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water. The circulation loop shall include a dedicated return line for the loop that begins after the branch to the last fixture on the supply portion of the loop and runs back to the water heater. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Where a cold water supply pipe is used as the return pipe, a temperature sensor connected to the controls shall be located on the hot water supply not more than two feet (305 mm) from the connection to the cold water supply pipe. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104°F (40°C).

R403.2.5.1.1 ~~R403.5.1.1.1~~ Demand recirculation water systems serving one- and two-family dwellings and townhouses. Demand recirculation water systems serving one- and two-family dwellings and townhouses shall comply with Items 1 and 2.

1. The system shall have controls that start the pump upon receiving a signal from the action of a user of user activation of a fixture or appliance, sensing the presence of a user of a fixture, or sensing the flow of hot or tempered water to a fixture fitting or appliance. The system shall not be activated solely by a timer or temperature sensor. The controls shall limit pump operation by:
2. Controls shall be installed for each fixture or group of fixtures within the dwelling unit where the stored water volume between the recirculation loop and the fixture exceeds 0.5 gallons (1.9 L), as determined in accordance with Section R403.2.4.1.

Exception: Demand recirculation water systems that automatically learn and adapt to hot water demand patterns shall be permitted and shall not be required to comply with Items 1 and 2.

R403.2.5.1.2 ~~R403.5.1.1.1~~ Demand recirculation water systems serving Group R-2, R-3, and R-4 buildings. Demand recirculation water systems serving Group R-2, R-3, and R-4 buildings shall have controls that start the pump upon receiving a signal from the action of a user of user activation of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance. The controls shall limit pump operation by:

1. Shutting off the pump when the temperature sensor detects one of the following:
 - 1.1. An increase in the water temperature of not more than 10°F (5.6°C) above the initial temperature of the water in the pipe.
 - 1.2. The temperature of the water in the pipe reaches 104°F (40°C).
2. Limiting pump operation to a maximum of 5 minutes following activation.
3. Not activating the pump for at least 5 minutes following shutoff or when the temperature of the water in the pipe exceeds 104°F (40°C).

Renumber the following section:

R403.2.5.2 Heat trace systems.

Delete Section R403.5.2 Hot water pipe insulation.

Add new Section R403.2.6:

R403.2.6 Low-flow bathroom faucets and showerheads. Bathroom sink faucets and showerheads shall not exceed the following maximum flow rates:

1. Bathroom sink faucets: 1.2 gallons per minute (4.5 L/min) at 60 psi (414 kPa).
2. Showerheads and kitchen sinks: 1.8 gallons per minute (6.8 L/min) at 80 psi (552 kPa).

Renumber the following section:

R403.2.7 Drain water heat recovery units.

Renumber and modify Sections R403.3, R403.3.1 and R403.3.2 as follows:

R403.63 Mechanical ventilation systems and indoor air quality. The buildings and dwelling units complying with Section R402.5.1.1 and Section R402.5.1.3 shall be provided with mechanical ventilation that complies with the requirements of Section M1505 of the *International Residential Code* or the *International Mechanical Code*, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

R403.63.1 Heat or energy recovery ventilation. Dwelling units shall be provided with a heat recovery or energy recovery ventilation system in Climate Zones 4C, 5, 6, 7 and 8. The system shall be a balanced ventilation system. Equipment shall comply with the performance requirements listed in Table R403.3.1a with a sensible recovery efficiency (SRE) of not less than 65 percent at 32°F (0°C) at an airflow greater than equal to the design airflow. The sensible recovery efficiency (SRE) shall be determined from a listed value or from interpolation of listed values. In Climate Zone 8, recirculation shall not be used as a defrost strategy. There shall be ready access to filters to permit homeowners to clean them in

accordance with manufacturer instructions. Manufacturer instructions for maintaining the energy recovery equipment shall be posted on the equipment or within the equipment enclosure.

1. **Systems over 300 CFM** Energy recovery ventilation and heat recovery ventilation systems with a rated airflow greater than 300 cfm (141 L/s) shall comply with the enthalpy recovery ratio and sensible recovery ratio requirements of Table R403.3.1a.
2. **Systems under 300 CFM.** Energy recovery ventilation and heat recovery ventilation systems with a rated airflow not greater than 300 cfm (141 L/s) shall comply with the sensible recovery efficiency requirement of Table R403.3.1b. The equipment's sensible recovery efficiency shall be determined from a rated value, or interpolation of rated values, at an airflow rate not less than the design minimum outdoor air rate. Compliance with the requirement shall be demonstrated by a listing in Home Ventilating Institute's Certified Product Directory.

TABLE R403.3.1a—MINIMUM EFFICIENCY REQUIREMENTS FOR SYSTEMS >300 CFM			
CLIMATE ZONES	TEST CONDITION	PERFORMANCE REQUIREMENTS	Test Standard
4C, 5, 6, 7, 8	Heating	Enthalpy Recovery Ratio or Sensible Energy Recovery Ratio at the design minimum outdoor air rate $\geq 60\%$, or Sensible Energy Recovery Ratio at the design minimum outdoor air rate $\geq 65\%$	AHRI 1060
4C, 5, 6, 7, 8	Cooling	Enthalpy Recovery Ratio at the design minimum outdoor air rate $\geq 50\%$	AHRI 1060

TABLE R403.3.1b—MINIMUM EFFICIENCY REQUIREMENTS FOR SYSTEMS ≤ 300 CFM		
CLIMATE ZONES	PERFORMANCE REQUIREMENTS	Test Standard
4C, 5, 6, 7, 8	SRE $\geq 65\%$ at 32°F (0°C) at an airflow not less than the design outdoor air rate	CAN/CSA-C439

R403.63.2 Fan efficacy for whole-house mechanical ventilation systems and outdoor air ventilation systems. Fans used to provide whole-dwelling mechanical *ventilation* shall meet the efficacy requirements of Table R403.67.2 at one or more rating points. Fans shall be tested in accordance with the test procedure referenced by Table R403.6.2 and *listed*. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ERV, *balanced ventilation* systems and in-line fans shall be determined at a static pressure of not less than 0.2 inch water gauge (50 Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch water gauge (25 Pa).

Renumber and modify Table R403.3.2 as follows (unchanged rows and values are not shown):

TABLE R403.63.2—FAN EFFICACY FOR WHOLE-HOUSE MECHANICAL VENTILATION SYSTEMS AND OUTDOOR AIR VENTILATION SYSTEMS ^a			
SYSTEM TYPE	AIRFLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV or ERV		1-2 1.7 ^a	
Balanced ventilation system without heat or energy recovery		1-2 1.7 ^a	
Air-handling unit that is integrated to tested and listed HVAC equipment		1-2 2.2	

Renumber and modify Sections R403.3.3 and R403.3.4 as follows:

R403.6.3.3 Testing. Mechanical *ventilation* systems shall be tested and verified to provide the minimum *ventilation* flow rates required by Section R403.6.3 in accordance with ANSI/RESNET/ICC 380. Installed performance of the mechanical *ventilation* system shall be tested and verified by a *HERS Rater*, *HERS Rating Field Inspector*, or an applicable *BPI Certified Professional*, and measured using a flow hood, flow grid, Residential IAQ Fault Indicator Display certified to the California Energy Commission, or other airflow measuring device in accordance with either ANSI/RESNET/ICC 380 or ACCA Standard 5. 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*.

Exceptions:

1. Kitchen range hoods that are ducted to the outside with ducting having a diameter of 6 inches (152 mm) or larger, a length of 10 feet (3028 mm) or less, and not more than two 90-degree (1.57 rad) elbows or equivalent shall not require testing.
2. A third-party test shall not be required where the *ventilation* system has an integrated diagnostic tool used for airflow measurement, and a user interface that communicates the installed airflow rate.
3. Where tested in accordance with Section R403.6.4, testing of each mechanical *ventilation* system is not required.

R403.3.4 Unit sampling – mechanical ventilation systems. For buildings of eight or more *dwelling units* or *sleeping units*, mechanical ventilation system testing shall be conducted in accordance with the unit sampling protocol in Section R107.7. Corrective actions and retesting for units with ventilation flow rates below the minimum permitted shall also be performed in accordance with Section R107.7. ~~For buildings with eight or more dwelling units or sleeping units, the mechanical ventilation systems in the greater of seven units or 20 percent of the total units shall be tested. Tested systems shall include systems in a top floor unit, systems in a ground floor unit, systems in a middle floor unit, and the systems in the dwelling unit or sleeping unit with the largest conditioned floor area. Where buildings have fewer than eight dwelling units or sleeping units, the mechanical ventilation systems in each unit shall be tested. Where the ventilation flow rate of a mechanical ventilation system is less than the minimum permitted rate, corrective actions shall be taken and the system retested until it passes. For each tested dwelling unit or sleeping unit system with a ventilation flow rate lower than the minimum permitted, three additional systems, including the corrected system, shall be tested.~~

Add new Section R403.3.5:

R403.3.5 Location of ERV and HRV ductwork. Ductwork serving heat recovery ventilation (HRV) or energy recovery ventilation (ERV) systems shall be located entirely within conditioned space.

Exception: Location within conditioned space is not required where ductwork is insulated to a minimum of R-8 and sealed in accordance with Section R403.1.5.7.

Renumber the following section:

R403.6.5.6 Intermittent exhaust control for bathrooms and toilet rooms.

Delete Section R403.7 *Equipment sizing and efficiency rating* and Section R403.7.1 *Electric resistance space heating*.

Add new Section R403.3.7:

R403.3.7 Indoor air quality. The *building* shall be certified under Indoor AirPlus.

Renumber and modify Section R403.4 as follows:

R403.4 ~~R403.10~~ Energy consumption of pools and spas. The energy consumption of pools and permanent *spas* shall be controlled by the requirements in Sections **R403.4.1** ~~R403.10.1~~ through **R403.4.5** ~~R403.10.3~~.

Renumber the following section:

R403.10.1 ~~R403.4.1~~ Heaters.

Add new Section R403.4.1.1:

R403.4.1.1 Electric-resistance heating. Electric-resistance heating shall not be used as the primary method of pool or permanent *spa* water heating. Electric-resistance heating shall be permitted only as an integrated supplemental or backup heating system that is:

1. Factory installed or listed as part of a heat pump pool heater, or
2. Installed as auxiliary backup heat serving a solar thermal pool heating system or permanent *spa* heating system.

Supplemental electric-resistance heating shall be equipped with controls that lock out operation of the supplemental heat when the heating load can be met by the heat pump, the solar thermal system, or a combination thereof.

Exception: Where permanent *spas* are heated by a heating system that is independent from the pool heating system, electric-resistance heating shall be permitted as the *primary heating system* for the permanent *spa*.

Renumber the following sections:

R403.104.2 Time switches.

R403.104.3 Covers.

Renumber and modify Section R403.4.4 as follows:

R403.4.4 R403.11 Portable spas. The energy consumption of electric-powered portable *spas* shall be controlled by the requirements of APSP 14.

Renumber the following section:

R403.124.5 Residential pools and permanent residential spas.

Renumber and modify Section R403.5 and R403.5.1 as follows:

R403.5 Fireplaces R403.13 Gas fireplaces. **Fireplace** Gas fireplace systems shall not be equipped with a *continuous pilot* and shall be equipped with an *on-demand pilot, intermittent ignition or interrupted ignition*, as defined by ANSI Z21.20. **Connection to pipeline natural gas shall not be permitted.**

Exception: Gas-fired appliances using pilots within a *listed combustion safety device*.

R403.5.1 R403.13.1 Propane Gas fireplace efficiency. Vented **propane** gas fireplace heaters shall have a fireplace efficiency (FE) rating not less than 50 percent as determined in accordance with CSA P.4.1, and shall be *listed* and *labeled* in accordance with CSA/ANSI Z21.88. Vented **propane** gas fireplaces (decorative appliances) shall be *listed* and *labeled* in accordance with CSA/ANSI Z21.50.

R404

Modify Section R404.1 and R404.1.1 as follows:

R404.1 Lighting equipment. A minimum of 95 percent of all permanently installed luminaires shall use light-emitting diode (LED) lamps or luminaires, or other lamp types with an efficacy of not less than 120 lumens per watt. ~~All permanently installed luminaires shall be capable of operation with an efficacy of not less than 45 lumens per watt or shall contain lamps capable of operation with an efficacy of not less than 65 lumens per watt.~~

Exceptions:

1. Appliance lamps.
2. Antimicrobial lighting used for the sole purpose of disinfecting.
- ~~3. General service lamps complying with DOE 10 CFR, Part 430.32.~~
3. Luminaires with a rated electric input of not greater than 3.0 watts.
4. Luminaires in *common areas of Group R buildings*, where lighting power in those spaces is not more than the lighting power allowances specified in Table C405.3.2(2) of the 2024 IECC-

Commercial Provisions.

R404.1.1 ~~R404.1.5~~ Gas lighting. Gas-fired lighting appliances shall not be ~~permitted~~. ~~equipped with a continuous pilot and shall be equipped with an on-demand pilot, intermittent ignition or interrupted ignition as defined by ANSI Z21.20.~~

Delete Table R404.1 and Sections R404.1.1 *Exterior lighting*, R404.1.2 *Exterior lighting power requirements*, R404.1.3 *Exterior lighting power allowance*, and R404.1.4 *Additional exterior lighting power*.

Modify Sections R404.2, R404.3, and R404.4 as follows:

R404.2 Interior lighting controls. All permanently installed luminaires shall be controlled as required in Sections R404.2.1, R404.2.2 and ~~R404.2.3~~.

~~Exception: Lighting controls shall not be required for safety or security lighting.~~

R404.2.1 Controls for habitable spaces and specific locations. Lighting controls for *habitable spaces* within *sleeping units* and *dwelling units* shall comply with R404.2.1.1. Lighting controls for *private garages* and other specific locations within *sleeping units* and *dwelling units* shall comply with R404.2.1.2.

R404.2.1.1 ~~R404.2.1~~ Habitable spaces. All permanently installed luminaires in ~~a~~ habitable spaces shall be controlled with ~~either~~ a *manual dimmer* or with an *automatic* shutoff control that automatically turns off lights within ~~15~~20 minutes after all occupants have left the space and shall incorporate a *manual* control to allow occupants to turn the lights on or off.

R404.2.1.2 ~~R404.2.2~~ Specific locations. All permanently installed luminaires in ~~rooms other than habitable spaces~~ *garages*, *unfinished basements*, *laundry rooms* and *utility rooms* shall be controlled by an *automatic* shutoff control that automatically turns off lights within ~~15~~20 minutes after all occupants have left the space and shall incorporate a *manual* control to allow occupants to turn the lights on or off.

Exception: Lighting required for safety or security.

R404.2.2 Occupant sensor control function in corridors and interior exit stairways in Group R buildings. *Occupant sensor controls* in interior corridors and interior exit stairways that serve *Group R* buildings shall uniformly reduce lighting power to an unoccupied setpoint not more than 50 percent of full power within 15 minutes after all occupants have left the space.

Exceptions:

1. Corridors and stairways provided with less than two footcandles of illumination on the floor at the darkest point with all lights on.
2. Emergency lighting.

R404.2.3 Controls for all other common areas in Group R buildings. *Occupant sensor controls* for *common areas* other than interior corridors and stairways in *Group R* buildings shall comply with the following:

1. They shall automatically turn off lights with 15 minutes after all occupants have left the space.
2. They shall be manual on or controlled to automatically turn on the lighting to not more than 50 percent power.
3. They shall incorporate a manual control to allow occupants to turn off lights.

Exceptions:

1. Full automatic-on controls with no manual control shall be permitted in restrooms, locker rooms, lobbies, and areas where manual operation would endanger occupant safety or security.
2. Lighting controls shall not be required where an automatic shutoff could endanger occupant safety or security.

R404.3 Exterior lighting controls. Exterior lighting controls shall comply with Sections R404.3.1 and R404.3.2.

R404.3.1 Controls for individual dwelling units. ~~For individual dwelling units, where the total~~

permanently installed exterior lighting ~~power is greater than 30 watts, the permanently installed exterior lighting~~ shall comply with the following:

1. Lighting shall be controlled by a *manual* on and off switch which permits *automatic* shutoff actions.
2. Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs.
3. Controls that override *automatic* shutoff actions shall ~~not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours.~~

R404.3.2 Controls for all other exterior lighting. Exterior lighting systems for *Group R buildings*, such as lighting for uncovered or covered parking areas, *carports*, landscaping, or building façades, shall be provided with *time-switch controls* or shall be automatically turned off when daylight is present and satisfies the lighting needs.

Exception: Emergency lighting systems operating in emergency mode.

R404.4 Renewable energy certificate (REC) documentation. Where ~~on-site~~ renewable energy generation is used to comply with this code, documentation shall be provided to the *code official* by the property owner or owner's authorized agent demonstrating that where renewable energy certificates (RECs) or energy attributable certificates (EACs) are associated with that portion of renewable energy used to comply with this code, the RECs or EACs shall be retained, or retired, on behalf of the property owner ~~and retired~~. Compliance using off-site renewable energy shall be permitted for community solar and where the building is certified under an *approved* third-party program such as Phius, LEED ZERO, Living Building Challenge Zero Carbon, and other third-party programs with renewable energy quality control provisions.

Add new Sections R404.5:

R404.5 Solar photovoltaic (PV) ready. *Residential buildings* shall be provided with infrastructure to support future installation of an on-site solar photovoltaic (PV) system in accordance with this section.

Exceptions. The solar PV-ready provisions of Section R404.5 shall not apply where any of the following conditions are met:

1. The building includes an installed on-site solar PV system of at least 5 kW for one-family and two-family buildings, 5 kW per townhouse, or 2.5 kW per *dwelling unit* for R-2 and R-4 buildings at the time of final inspection.
2. The building is a new *townhouse* and meets the solar-ready provisions in the 2024 International Energy Conservation Code, Appendix RB or RL.
3. The building is certified under Phius, LEED Zero, or Living Buildings Zero Carbon standards and receives off-site renewable energy through renewable energy credits (RECs), power purchase agreements, or community solar as part of that certification.
4. The roof area oriented between 110 and 270 degrees of true north is smaller than 250 square feet (27.9 m²), exclusive of mandatory setbacks.
5. For *Group R buildings*, the roof area oriented between 110 and 270 degrees of true north is less than 20 percent of the total roof area, exclusive of mandatory setbacks.

R404.5.1 Solar PV-ready requirements. The building shall include the following features to enable future solar PV installation:

1. **Solar-ready zone:** Roof area meeting Items 1.1 through 1.4 shall be designated and labeled as the *solar-ready zone*. For one-family, two family, and townhouses, the *solar-ready zone* shall be not less than 500 square feet (46.5 m²). For *Group R buildings*, the *solar-ready zone* shall be not less than 40 percent of the total roof area. The *solar-ready zone* shall:
 - 1.1 Be located on roof areas oriented between 110 degrees and 270 degrees of true north.
 - 1.2 Be free from obstructions, including vents, chimneys, and roof-mounted equipment.
 - 1.3 Be free from permanent natural shading or shading from adjacent structures that block direct-beam sunlight for more than 2,500 annual hours between 8:00 a.m. and 4:00 p.m.
 - 1.4 Be permitted to be composed of non-contiguous sub-zones provided that each sub-zone is not less than 5 feet wide in the narrowest dimension and not less than 80 square feet.

Solar energy equipment is permitted to occupy any portion of the *solar-ready zone*.

Exceptions:

1. For one-family, two-family, and townhouses, where the available roof area oriented between 110 and 270 degrees of true north between 250 square feet (23.2 m²) and 500 square feet (46.5 m²), the solar-ready zone shall be permitted to be sized to the maximum available roof area meeting the orientation and obstruction requirements of this section.
2. For Group R buildings, where the available roof area oriented between 110 and 270 degrees of true north is between 20 percent and 40 percent of the total roof area, the *solar-ready zone* shall be permitted to be sized to the maximum available roof area meeting the orientation and obstruction requirements of this section.
3. **Roof structural load capacity:** The roof shall be designed to support the additional *dead load* of 4 pounds per square foot and *live loads* of a future solar PV system.
4. **Interconnection pathway:** A reserved pathway shall be provided for routing a raceway or cable assembly from the solar zone to the electrical distribution equipment.
5. **Electrical service capacity and reserved space:** The electrical service distribution equipment shall have reserved space for a 2-pole circuit breaker for future solar installation and sufficient capacity to accommodate a future solar PV system.
6. **Documentation:** A permanent label shall be affixed adjacent to the main service disconnect indicating the presence of solar-ready infrastructure and identifying the locations of the reserved pathway and *solar-ready zone* or sub-zones, and a completed DOE ZERH PV-Ready Checklist (Single-Family or Multifamily as applicable) shall be submitted to the *code official*.

R404.5.2 Documentation of exceptions. Where any exception in Section R404.5.1 is claimed, documentation of the applicable condition(s) shall be provided to the code official by a certified home energy rater or other approved professional.

Add new Sections R404.6 (including new Sections R404.6.1 – R404.6.3.1, and renumbered and modified Section R404.6.4):

R404.6 Electric vehicle (EV) charging infrastructure. Where new parking is provided, *EV charging infrastructure* shall be installed in accordance with Sections R404.6.1 through R404.6.4. Construction documents shall include all information necessary to verify compliance with this section, including *EV charging infrastructure* location, branch circuit location and sizing, electrical distribution capacity, labeling, and automatic *load management system (ALMS)* configuration where applicable.

R404.6.1 Dwelling units with private parking. For each dwelling unit where a private driveway or garage is provided, at least one parking space per dwelling unit shall be provided with *EV ready* or *EVSE* infrastructure in accordance with Section R404.6.3.

R404.6.2 Dwelling units without private parking. *Dwelling units* in developments that provide assigned or unassigned parking serving *dwelling units*, but do not provide a private driveway or garage for individual *dwelling units*, shall comply with the following:

1. *EV charging infrastructure* shall be provided for not less than 20 percent of *dwelling units* or 20 percent of parking spaces serving those *dwelling units*, whichever is less, in accordance with Section R404.6.3.
2. Where both assigned and unassigned parking serve *dwelling units*, required *EV charging infrastructure* spaces shall be allocated between assigned and unassigned parking spaces in proportion to the number of *dwelling units* served by each parking type.
3. Not more than one *EV charging infrastructure* space per *dwelling unit* shall be counted toward compliance with this section.
4. Of the required *EV charging infrastructure* spaces:
 - 4.1 At least 50 percent shall be *Level 2 EVSE*.
 - 4.2 The remaining *EV charging infrastructure* spaces shall be *EV ready*.
 - 4.3 Where DC Fast EVSE with a minimum power output of 50 kW are installed, the total number of *EV charging infrastructure* spaces required by this section shall be permitted to be reduced by five for each installed DC Fast EVSE, provided not less than one *Level 2 EVSE* space is installed for each DC Fast EVSE installed.

R404.6.3 Infrastructure. Spaces required by Sections R404.6.1 and R404.6.2 to be provided with *EV charging infrastructure* shall be installed in accordance with this section.

R404.6.3.1 EV ready and EVSE spaces. Spaces required to be provided with *EV ready* or *EVSE* infrastructure shall be installed in accordance with all of the following:

1. An individual 208/240-volt branch circuit rated at not less than 40 amperes or the nameplate rating of the installed EVSE, whichever is greater.
2. The circuit shall terminate at a receptacle or installed *EVSE* located within 6 feet (1828 mm) of the parking space and, where a garage is provided for the *dwelling unit*, within that garage.
3. Service by an electrical distribution system and circuit capacity in accordance with Section R404.6.4.
4. The circuit shall be labeled as “Electric Vehicle Charging” in the service distribution equipment where the branch circuit originates.

R404.6.4 RE101.2.5 Electrical distribution system capacity.

1. Electrical service and main service equipment shall be sized to accommodate the installation of Level 2 *EVSE* at a quantity not less than one per dwelling unit or for each parking space provided for the *dwelling units*, whichever is less. The calculated service load shall include an *EV* charging load of not less than 3.3 kVA for each space required to accommodate *EVSE*.

Exception: Where an *automatic load management system* is used to control *EV* charging loads in accordance with NFPA 70, the calculated service load shall be based on the setpoint of the system as permitted by NFPA 70.

2. The branch circuits and electrical distribution system serving each *EV ready* space and *EVSE* space required by Section R404.6.1 or R404.6.2 shall comply with one of the following:
 - 2.1 Sized for a calculated *EV* charging load of not less than ~~6.2~~ 7.2 kVA per *EVSE*, or *EV ready* or *EV capable* space. Where ~~a~~ circuits are shared or managed, ~~it~~ they shall be in accordance with NFPA 70.
 - 2.2 Where *EV* charging loads are controlled by an *automatic load management system* in accordance with NFPA 70, the electrical distribution system and branch circuits serving multiple *EV ready* or *EVSE* spaces shall be sized for a calculated *EV* charging load of not less than 2.1 kVA per space. Where an *automatic load management system* is used to control *EV* charging loads for the purposes of this section, it shall maintain continuous availability of electrical capacity to *EVSE* spaces used to comply with Sections R404.6.1 through R404.6.3.

R404.6.4.1 Electrical capacity plan. Construction documents shall include an electrical capacity plan demonstrating the ability of the electrical distribution system to accommodate *EV* charging loads in accordance with Section R404.6.4, Item 1. The plan shall include:

1. The estimated electrical load associated with the required *EV* charging infrastructure installation;
2. The proposed strategy for accommodating such load, including load management systems, service upgrades, or phased installation;
3. The maximum *EV* charging load to be served by the installed electrical service at time of construction.

Add new Sections R404.7 through R404.9:

R404.7 Heat Pump Water Heater Ready. Where *liquid fuel* or *fuel gas* water heating equipment is provided, an individual branch circuit shall be installed with an outlet terminated within 3 feet of each installed liquid or fuel gas water heater. The individual branch circuit shall have a rating not less than 30A at 240V or 20A at 120V. Installed water heaters using a branch circuit meeting one of these ratings satisfies this requirement. In addition, a space is located within the home or garage that is at least 3' x 3' wide and 7' high surrounding or within 3 feet of the installed liquid or fuel gas water heater, to facilitate future heat pump water heater installation. A condensate drain shall be included in this space, or a pump and tubing shall be provided to bring condensate water to a drain. The 3' x 3' x 7' volume may contain the existing water heater.

Exception: The 3' x 3' x 7' space is not required when the installed water heater is a tankless water heater system.

R404.8 Heat Pump Space Heating Ready. Where *liquid fuel* or *fuel gas* space heating equipment is provided, an individual branch circuit outlet shall be installed to facilitate future wiring for a heat pump installation and is labeled “For future heat pump.” If a branch circuit outlet is installed, it shall be in compliance with either IRC Section E3702.11 and E3702.1 or NFPA 70 based on heat pump space heating equipment sized in

accordance with IECC R403.7 and shall terminate within three feet of each liquid or fuel gas space heating system. A circuit to provide power to a central air conditioning system can be used to comply with this requirement provided that the circuit is in compliance with IRC Section E3702.11 based on heat pump space heating equipment sized in accordance with IECC R403.7. Where liquid or fuel gas space heating equipment is provided, natural drainage or a condensate drain location shall be located within 3 feet (914 mm) of the *combustion equipment*, and a designated outdoor location appropriate for the siting of a heat pump condenser shall be provided, including natural drainage for condensate or a condensate drain location located within 3 feet (914 mm) of the location.

Exceptions:

1. Space in the distribution equipment for an overcurrent device where the branch circuit originates shall be reserved for heat pump space heating and code-compliant wiring conduit installed to facilitate future wiring for a heat pump installation. This conduit shall terminate within three feet of each liquid or fuel gas space heating system.
2. *Buildings* utilizing electric heating systems as the *primary heating system* are exempt from this requirement.

R404.9 Electric Ready Cooking Equipment. Where *liquid fuel* or *fuel gas* cooking equipment is provided, an individual branch circuit shall be installed to facilitate future electric cooking equipment installation and is labeled "For future electric cooking equipment." The individual branch circuit shall have a rating not less than 50A at 240V and shall terminate at an outlet within three feet of each piece of liquid or fuel gas cooking equipment.

R405

Replace R405 in its entirety with the following section:

R405.1 Compliance. Projects shall document compliance with either Phius certification in accordance with R405.2.1, PHI certification in accordance with R405.2.2, or follow R405.3. If complying with Phius certification, *buildings* shall be pre-certified as meeting the Phius CORE 2021 or Phius ZERO 2021 Passive Building Standard – North America, or newer, demonstrated using approved Passive House certification software and program criteria by PHIUS, where design-certification is demonstrated by Phius and a Certified Passive House Consultant (CPHC). If complying with PHI certification, projects shall meet the Certified Passive House standard, demonstrated using the approved Passive House certification software and program criteria by the Passive House Institute (PHI), where PHI certification is demonstrated by a PHI-accredited Certifier.

R405.2 Documentation.

R405.2.1 Phius documentation.

R405.2.1.1 Building permit submittals for Phius projects. Prior to the issuance of a building permit, the following items shall be provided to the *code official*:

1. A Passive House Verification report with results from the approved Passive House certification software which demonstrates project compliance with Phius CORE or Phius ZERO performance requirements.
2. A statement from the CPHC that the verification report results accurately reflect the plans submitted.
3. Evidence of project registration from Phius.
4. Verification of compliance with Sections R404.5 through R404.9, including Photovoltaic (PV) ready, Electric vehicle (EV) charging infrastructure, Heat pump water heater ready, Heat pump space heating ready, and Electric ready cooking equipment requirements.

Exception to R405.2.1.1: Where a project has achieved Phius design certification prior to permit issuance, the owner or designee shall provide a Design Certification Letter from Phius and verification of compliance with Sections R404.5 through R404.9.

R405.2.1.2 Certificate of occupancy submittals for Phius projects. Prior to the issuance of a final certificate of occupancy, the following items shall be provided to the *code official*:

1. Design Certification Letter from Phius.

2. An updated Passive House Verification Report with results from the approved Passive House certification software which reflects “as-built” conditions and test results (blower door and *ventilation* results) that demonstrate project compliance with Phius performance requirements.
3. A statement from the CPHC that the envelope meets the Phius hygrothermal requirements found in Appendix B of the Phius 2021 Certification guidebook.
4. A statement from the Phius project Verifier that the project test results meet the model performance requirements, all the mandatory limits and any other mandatory requirements.
5. A copy of the Phius workbook listing all testing results and as-built conditions.
6. Verification of compliance with Sections R404.5 through R404.9, including Photovoltaic (PV) ready, Electric vehicle (EV) charging infrastructure, Heat pump water heater ready, Heat pump space heating ready, and Electric ready cooking equipment requirements.

Exception to R405.2.1.2: Where a project has achieved final PHIUS certification prior to final Certificate of Occupancy, the owner or designee shall provide a Final Certification Letter from PHIUS and verification of compliance with Sections R404.5 through R404.9.

R405.2.2 Passive House Institute (PHI) documentation.

R405.2.2.1 Building permit submittals for PHI projects. Prior to the issuance of a building permit, the following items shall be provided to the *code official*:

1. A PHPP (Passive House Planning Package) compliance report with results from the approved Passive House certification software which demonstrates project compliance with current PHI performance requirements;
2. A statement from the PHI-accredited Consultant or Certified Passive House Designer that the approved Passive House certification software results and compliance report accurately reflect the plans submitted;
3. Evidence of project registration from a PHI-accredited Certifier.
4. Verification of compliance with Sections R404.5 through R404.9, including Photovoltaic (PV) ready, Electric vehicle (EV) charging infrastructure, Heat pump water heater ready, Heat pump space heating ready, and Electric ready cooking equipment requirements.

Exception to R405.2.2.1. Where a Design Stage Conditional Assurance Letter has been issued by a PHI-accredited Certifier, the owner or designee shall provide the Conditional Assurance Letter and verification of compliance with Sections R404.5 through R404.9.

R405.2.2.2 Certificate of occupancy submittals for PHI projects. Prior to the issuance of a final certificate of occupancy, the following items shall be provided to the *code official*:

1. A Design State Conditional Assurance Letter from a PHI-accredited Certifier.
2. An updated compliance report with results from the approved Passive House certification software which reflects “as-built” conditions and test results (blower door and *ventilation* results) that demonstrates project compliance with PHI performance requirements;
3. A copy of both the air leakage test results and report on the commission settings and performance of the building’s *ventilation* system;
4. A statement from the Certified Passive House Consultant or Certified Passive House Designer that the project test results meet the model performance requirements, all the mandatory limits and any other mandatory requirements.
5. Verification of compliance with Sections R404.5 through R404.9, including Photovoltaic (PV) ready, Electric vehicle (EV) charging infrastructure, Heat pump water heater ready, Heat pump space heating ready, and Electric ready cooking equipment requirements.

Exception to R405.2.2.2: Where a project has achieved final PHI certification prior to issuance of the certificate of occupancy, the owner or designee shall provide a Final Certification Letter from a PHI-accredited Certifier and verification of compliance with Sections R404.5 through R404.9.

R405.3 Documentation of projects that pursued Phius or PHI certification that did not achieve final certification.

R405.3.1 Compliance. *Buildings* shall be pre-certified per Section R405.1. If, at construction completion, final certification cannot be received from either Phius or PHI, this compliance pathway may be followed to receive a certificate of occupancy based on compliance with R405.3.2 Documentation. Compliance via R405.3.2 is not equivalent to either Phius or PHI Certification and will not designate the project as a certified passive house.

R405.3.2 Near passive house documentation. The following materials are required:

1. Statement from the Phius certified consultant or PHI-accredited verifier confirming project has completed all interim, final, and corrective testing and modeling requirements, including a summary of deviations from certification requirements.
2. Copy of executed contracts with Phius consultant or PHI rater/verifier covering all required inspections and testing requirements for certification.
3. Design phase pre-certification/approval, in the form of a statement issued from Phius or PHI-accredited verifier confirming design certification or pre-certification was achieved.
4. Report from rater/verifier demonstrating as-built conditions, including those that comply with Phius or PHI requirements, and those that do not.
 - 4.1 If the initial whole building blower door tests do not meet the Phius or PHI airtightness requirement, a statement shall be provided to reflect evidence of a re-test. Statement shall include an explanation for sources of leakage and attempted remediation efforts. Final test results shall not exceed Phius or PHI airtightness thresholds by more than 30%.
 - 4.2 If the mechanical ventilation flow rates and balance do not meet the requirements of Phius or PHI, report shall show that installed ventilation system demonstrates compliance with the mechanical code in accordance with Section C403 of the *International Energy Conservation Code—Commercial Provisions*.
5. For projects with Phius design certification, provide final Energy Star and Zero Energy Ready Homes certificates.
6. A letter from a licensed design professional that states that the potential hygrothermal or moisture risk of the as-built assemblies, with the measured blower door test result, is acceptably low.
7. Verification of compliance with Sections R404.5 through R404.9, including Photovoltaic (PV) ready, Electric vehicle (EV) charging infrastructure, Heat pump water heater ready, Heat pump space heating ready, and Electric ready cooking equipment requirements.

R406

Modify Section R406.1 as follows:

R406.1 Scope. This section establishes criteria for compliance using *either an Energy Rating Index (ERI) analysis or combination of both Energy Rating Index (ERI) and CO₂e Index (ERI + CO₂e) analysis*. Such analysis shall be limited to *dwelling units or sleeping units*. Spaces other than *dwelling units or sleeping units* in Group R-2, R-3 or R-4 buildings shall comply with Sections R402 through R404.

R406.2 ERI compliance. Compliance based on the *ERI or ERI + CO₂e* requires that the *rated design* and as-built *dwelling* unit meet all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum *ERI or ERI + CO₂e* values indicated in Table R406.5.
3. The requirements of Chapters 1, 2, 3, 5, 6, and 9 of the RESNET HERS Standards.

Modify Table R406.2 as follows:

TABLE R406.2—REQUIREMENTS FOR ENERGY RATING INDEX

SECTION ^a	TITLE
Mechanical	
R403.1.3 R403.7, except Section R403.7.1	Heating and cooling equipment sizing Equipment sizing and efficiency rating
R403.1.4 R403.1	Controls
R403.1.4.5 R403.2	Hot water boiler temperature reset
R403.1.5 R403.3	Duct systems
R403.1.6	HVAC system grading
R403.1.7 R403.4	Mechanical system piping insulation
R403.1.8.2 R403.9.2	Snow melt and ice system controls
R403.2, except Section R403.2.1 R403.5	Service hot water systems
R403.3 R403.6	Mechanical ventilation systems and indoor air quality
R403.8	Systems serving multiple dwelling units
R403.4 R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
R403.5 R403.13	Fireplaces Gas fireplaces

Add the following rows to Table R406.2:

R404.3	Exterior lighting controls
R404.4	Renewable energy certificate (REC) documentation
R404.5	Solar photovoltaic (PV) ready
R404.6	Electric vehicle (EV) charging infrastructure
R404.7	Heat pump water heater ready
R404.8	Heat pump space heating ready
R404.9	Electric ready cooking equipment

Modify Sections R406.3, R406.4, and R406.5 as follows:

R406.3 Building thermal envelope. The proposed total *building thermal envelope* shall comply with Section R402.1. ~~thermal conductance (TC) shall be less than or equal to the required total building thermal envelope TC using the prescriptive U factors and F factors from Table R402.1.2 multiplied by 1.08 in Climate Zones 0, 1 and 2, and by 1.15 in Climate Zones 3 through 8, in accordance with Equation 4-2 and Section R402.1.5. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.~~ Thermal bridges, including but not limited to those associated with cladding supports, balconies, parapets, and concrete floor decks shall be accounted for in the U-factors for the *building thermal envelope*.

R406.4 Energy Rating Index and CO₂e Index. The *Energy Rating Index* (ERI) and *CO₂e Index* shall be determined in accordance with ANSI/RESNET/ICC 301, including any approved addenda. ~~The mechanical ventilation rates used for the purpose of determining the ERI shall not be construed to establish minimum ventilation requirements for compliance with this code.~~

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the *building site* shall not be included in the *ERI reference design*, *CO₂e Index reference home*, or the *rated design*.

R406.5 Maximum ERI and CO₂e Index ERI-based compliance. Compliance based on an *ERI analysis* or *combined ERI + CO₂e index* requires that the *rated design* and each confirmed as-built *dwelling unit* be simulated without on-site power production and be shown to have an *ERI index values* less than or equal to the appropriate values indicated in Table R406.5 where compared to the *ERI reference design* as follows:

1. Where compliance is based on both the ERI and CO₂e Index, compliance shall be permitted using the higher ERI values under the “ERI and CO₂e INDEX” column, provided the CO₂e Index does not exceed 50.
2. Where compliance is based only on the ERI, the values in the “ERI ONLY” column apply.
3. Where on-site ~~renewables~~ *solar photovoltaic* systems are not installed, the values in the rows for “All electric building” or “Mixed fuel building” apply ~~under ENERGY RATING INDEX NOT INCLUDING OPP~~ apply.
4. Where on-site ~~renewables~~ *solar photovoltaic* systems of at least 5 kW for one-family and two-family buildings, 5 kW per townhouse, or 2.5 kW per *dwelling unit* for R-2, R-3, and R-4 buildings are installed, the values in the rows for “All electric building including solar” or “Mixed fuel building including solar” apply ~~under ENERGY RATING INDEX WITH OPP~~ apply.

Exceptions:

- ~~1. Where the ERI analysis excludes on-site power production (OPP), the values under ENERGY RATING INDEX NOT INCLUDING OPP shall be permitted to be applied.~~
1. For buildings with 20 or more *dwelling units*, where *approved* by the *code official*, compliance shall be permitted using the Average Dwelling Unit Energy Rating Index *or CO₂e Index*, as calculated in accordance with ANSI/RESNET/ICC 301.

Modify Table R406.5 as follows:

TABLE R406.5—MAXIMUM ENERGY RATING OR CO ₂ e INDEX		
BUILDING TYPE	ERI and CO ₂ e INDEX	ERI ONLY
All electric building	ERI ≤ 41 and CO ₂ e ≤ 50	ERI ≤ 38
All electric building including solar	ERI ≤ 44 and CO ₂ e ≤ 50	ERI ≤ 41
Mixed fuel building	ERI ≤ 38 and CO ₂ e ≤ 50	ERI ≤ 35
Mixed fuel building including solar	ERI ≤ 41 and CO ₂ e ≤ 50	ERI ≤ 38

Modify Sections R406.6 and R406.7 as follows:

R406.6 Verification by approved agency. Verification of compliance with Section R406 as outlined in Sections R406.5 and R406.7 shall be completed by an *approved RESNET HERS Rater third party*. Verification of compliance with Section R406.2 shall be completed by the authority having jurisdiction or an *approved* third-party inspection agency in accordance with Section R107.4.

R406.7 Documentation. Documentation of the software used to determine the *ERI or CO₂e Index* and the parameters for the *ERI reference design or CO₂e Index reference home* shall be in accordance with Sections R406.7.1 through R406.7.4.

R406.7.1 Compliance software tools. Software tools used for determining *ERI or CO₂e Index* shall be *approved* software rating tools as defined by ANSI/RESNET/ICC 301 *and shall be approved for accreditation by RESNET*. ~~Software vendors shall publish, on a publicly available website, documentation that the software tool has been validated using the Class II, Tier 1 test procedure in ANSI/ASHRAE 140.~~

R406.7.2 Compliance report. Compliance software tools shall generate a report that documents that the *ERI or CO₂e Index* of the *rated design* and as-built *dwelling unit* complies with Sections R406.2 through R406.5. Compliance documentation shall be created for the proposed design and shall be submitted with the application for the building permit. Confirmed compliance documents of the as- built *dwelling unit* shall be created and submitted to the *code official* for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R406.7.2.1 and R406.7.2.2.

R406.7.2.1 Proposed compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other *building site* identification.
2. Declare *ERI or CO₂e Index* on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.

5. Documentation of all inputs entered into the software used to produce the results for the *ERI reference design or CO₂e Index reference home* and the *rated design*.
6. A certificate indicating that the proposed design has an *ERI or CO₂e Index* less than or equal to the appropriate score indicated in Table R406.5 ~~when compared to the ERI reference design~~. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R-values* or *U-factors*; assumed *duct system* and *building thermal envelope* air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical *ventilation* and service water-heating equipment to be installed. Where *on-site renewable energy* systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated *dwelling unit*.

R406.7.2.2 Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of *ERI or CO₂e Index* on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the *ERI reference design or CO₂e Index reference home* and the as-built *dwelling unit*.
6. A final confirmed certificate indicating that the as-built *building* complies with Sections R406.2, R406.4 and R406.5. The certificate shall report the energy features that were confirmed to be in the *building*, including: component-level insulation *R-values* or *U-factors*; results from any required *duct system* and *building thermal envelope* air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical *ventilation*, and service water-heating equipment installed. *The certificate shall report the estimated dwelling unit or sleeping unit energy use by fuel type, inclusive of all end uses.* Where *on-site renewable energy* systems have been installed on or in the *building*, the certificate shall report the type and production size of the installed system.

R406.7.3 Renewable energy certificate (REC) documentation. Where renewable energy power production is included in the calculation of an *ERI or CO₂e Index*, documentation shall comply with Section R404.4.

R406.7.4 Additional documentation. The *code official* shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *ERI reference design or CO₂e Index reference home*.
2. A certification signed by the builder providing the building component characteristics of the *rated design*.
3. Documentation of the actual values used in the software calculations for the *rated design*.

R407

Modify Section R407.2 as follows:

R407.2 Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned.
2. The *occupied* space is not heated.
3. Solar, wind or other renewable energy source supplies not less than ~~90~~80 percent of the energy for *service water heating*.

4. ~~Glazing~~ Fenestration in dwelling units and other conditioned spaces shall have a maximum solar heat gain coefficient (SHGC) of less than or equal to 0.40, and ~~or has an overhang with a projection factor equal to or greater than 0.30.~~ Alternatively, the SHGC shall be less than 0.25 if the projection factor is less than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior low slope roof surface complies with one of the options in Table R407.2 and the roof or ceiling insulation has an R-value of R-13 or greater or the roof or ceiling has insulation with an R-value of R-19 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a slope of not less than $\frac{1}{4}$ unit vertical in 12 units horizontal (2 percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.
12. Walls, floors and ceilings separating air-conditioned spaces from non-air-conditioned spaces shall be constructed to limit air leakage in accordance with the requirements in Table 402.5.1.1 and Section R402.5.1.3.
13. Cooling and heating systems, if installed, shall meet the requirements of Section 403.1. Buildings utilizing Exception 2 to Section R403.1.1 shall achieve the number of additional energy efficiency credits specified in Table R408.2.1 for the applicable equipment type and climate zone. Credits shall be earned using measures from Table R408.2.2.

R408

Modify Section R408.2 as follows:

R408.2 Additional energy efficiency credit requirements. Residential buildings shall earn not less than 10 credits from not less than two measures specified in Table R408.2.2. Five additional credits shall be earned for dwelling units with more than 54,000 square feet (465 m²) of living space located above grade plane. To earn credit as specified in Table R408.2 for the applicable climate zone, each measure selected for compliance shall comply with the applicable subsections of Section R408. Each dwelling unit or sleeping unit shall comply with the selected measure to earn credit. Interpolation of credits between measures shall not be permitted.

R408.2.1. Additional offset credits for equipment utilizing efficiency exceptions. Dwelling units utilizing space heating, space cooling, or service water heating equipment that does not meet the minimum performance requirements of Sections R403.1.1, R403.2.1.1, or R403.2.1.2, as permitted by the applicable exceptions to those sections, shall achieve additional credits in accordance with Table R408.2.1. Such credits shall be provided for each piece of installed equipment that does not meet the applicable minimum performance requirements. The required credits shall be earned using measures specified in Table R408.2.2.

R408.2.1.1 Exclusion for large dwellings using combustion equipment. Dwelling units with conditioned floor area greater than 4,000 square feet where combustion equipment is used for space heating or service water heating shall not be eligible for compliance under the prescriptive provisions per Section R401.2.1. Such dwelling units shall demonstrate compliance using either the Passive House alternative in Section R405 or the Energy Rating Index alternative in Section R406.

Add new Tables R408.2.1:

TABLE R408.2.1—ADDITIONAL ENERGY EFFICIENCY CREDITS REQUIRED FOR NON-HEAT-PUMP HEATING, COOLING, AND SERVICE WATER HEATING EQUIPMENT

EQUIPMENT TYPE	Climate Zones 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 Except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
Air conditioning	10	10	8	8	8	8	0	0	0
Gas furnace or boiler (AFUE < 90)	0	0	6	13	13	13	18	20	23
Gas furnace or boiler (AFUE ≥ 90)	0	0	5	9	9	9	13	15	17
Heat pump rated in HSPF2 and SEER2	11	11	10	12	9	9	9	9	11
Heat pump rated in COP and EER	11	11	9	11	8	9	9	9	11
Gas-fired instantaneous water heater	8	8	9	7	11	6	5	5	4
Gas-fired storage water heater	12	8	9	7	11	6	5	5	4
Electric-resistance water heater	6	6	6	5	7	5	4	3	3

Renumber and replace Table R408.2.2 in its entirety:

TABLE R408.2.2—CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

MEASURE NUMBER	MEASURE DESCRIPTION	CREDIT VALUE								
		Climate Zones 0 & 1	Climate Zone 2	Climate Zone 3	Climate Zone 4 Except Marine	Climate Zone 4 Marine	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
R408.2.2.1(1)	≥ 5% and < 10% reduction in total TC	0	1	2	3	4	4	5	5	6
R408.2.2.1(2)	≥ 10% and < 15% reduction in total TC	1	3	3	6	7	8	9	10	12
R408.2.2.1(3)	≥ 15% reduction in total TC	3	6	8	9	10	12	13	15	18
R408.2.2.2(1)	Vertical fenestration U-factor meeting the 10% improvement value in Table R408.2.1.2	0	1	1	1	1	2	2	2	2
R408.2.2.2(2)	Vertical fenestration U-factor meeting the 20% improvement value in Table R408.2.1.2	0	1	1	2	2	3	3	3	4
408.2.2.3(1)	Low slope roof solar reflectance per Table R408.2.1.3 (reflectance ≥ 0.65)	1	0	0	0	0	0	NA	NA	NA
408.2.2.3(2)	Steep slope asphalt roof solar reflectance per Table R408.2.1.3 (reflectance ≥ 0.25)	1	0	0	0	0	0	NA	NA	NA
R408.2.2.4(1)	Air leakage ≥ 10% and < 20% below R402.5.1.3 values	0	0	1	1	1	1	NA	NA	NA
R408.2.2.4(2)	Air leakage ≥ 20% below R402.5.1.3 values	0	1	1	2	2	3	NA	NA	NA
R408.2.2.4(3)	Meets PHIUS air leakage requirements	1	1	2	7	6	10	14	13	9
R408.2.3(1) ^b	Water-to-air ground source heat pump	0	1	4	6	5	10	12	16	20
R408.2.3(2) ^b	High Performance Cooling (Option 1 - CZs 0, 1, 2, 3, 4A, and 4B)	8	9	7	7	NA	NA	NA	NA	NA
R408.2.3(3) ^b	High Performance Heat pump (Option 1 - CZs 0, 1, 2)	10	9	NA	NA	NA	NA	NA	NA	NA
R408.2.3(4) ^b	High Performance Heat pump (Option 2- CZs 3, 4A, 4B, 4C, 5, 6, 7, and 8)	NA	NA	8	8	5	8	9	9	11
R408.2.3(5) ^b	VRF multi-split air-cooled heat pump	10	9	8	9	9	10	8	6	5
R408.2.3(6) ^b	VRF multi-split water-cooled heat pump	1	1	1	1	1	1	1	1	1
R408.2.3(7) ^b	Gas-fired heat pump	0	2	2	6	6	6	6	6	6
R408.2.3(8) ^b	Packaged Terminal Heat Pump	7	7	7	9	6	9	10	10	12
R408.2.4.1(1) ^d	Electric water heater (Option 1)	5	6	6	5	6	5	3	3	3

R408.2.4.1(2) ^d	Electric water heater (Option 2)	8	7	7	6	5	3	2	2	2
R408.2.4.1(3) ^d	Electric water heater (Option 3)	11	10	10	8	7	5	4	3	2
R408.2.4.1(4) ^d	Gas heat pump water heater	10	9	8	6	2	3	6	6	4
R408.2.4.1(5) ^d	Solar water heaters (electric backup)	10	10	10	7	6	4	3	3	2
R408.2.5 ^c	ERV or HRV installed (Option 2 - CZs 4, 5, 6, 7, 8)	NA	NA	NA	3	3	3	3	3	3
R408.2.6 ^a	Energy efficient appliances	1	1	1	1	1	1	0	0	0
R408.2.7	On-site photovoltaic systems	17	16	17	11	11	9	8	7	4
R408.2.8	On-site battery energy storage system	1	1	1	1	1	1	1	1	1
R408.2.9	Electric vehicle supply equipment	1	1	1	1	1	1	1	1	1
R408.2.10	Reduced embodied energy or carbon	1	1	1	1	1	1	1	1	1

NA = Not Applicable.

a. Where the measure is selected, each dwelling unit, sleeping unit and common area where the measure is applicable must have the measure installed.

b. Where multiple heating or cooling systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

c. Where the measure is selected, each dwelling unit and sleeping unit must comply with the measure.

d. Where the measure is selected, each dwelling unit shall be served by a water heater meeting the applicable requirements. Where multiple service water heating systems are installed, credits shall be determined using a weighted average of the square footage served by each system.

e. Eleven credits are available for Climate Zone 4 where the following measure is used: gas furnace and heat pump (Option 3): greater than or equal to 95% AFUE fuel gas furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump.

Renumber the following sections:

R408.2.12 Enhanced building thermal envelope options

R408.2.12.1 Enhanced building thermal envelope performance

Modify Section R408.2.2.2 as follows:

R408.2.12.2 Improved fenestration. The area weighted average *U-factor* and SHGC of all vertical *fenestration* shall be equal to or less than the values specified in Table R408.2.12.2.

Renumber and modify Table R408.2.2.2 as follows:

TABLE R408.2.12.2—IMPROVED FENESTRATION				
CLIMATE ZONE	<i>U-FACTOR</i>	U-FACTOR 10% IMPROVEMENT	U-FACTOR 20% IMPROVEMENT	SHGC
0	0.32	0.27	0.24	0.23
1	0.32	0.27	0.24	0.23
2	0.30	0.27	0.24	0.23
3	0.28	0.25	0.22	0.23
4 except Marine 4	0.25	0.22	0.20	NR
5 and Marine 4	0.25	0.22	0.20	NR
6	0.25	0.22	0.20	NR
7 and 8	0.25	0.22	0.20	NR
NR = No Requirement.				

Modify Sections R408.2.2.3, R408.2.2.4, and R408.2.3 as follows:

R408.2.12.3 Roof solar reflectance index. ~~High reflectance~~ ~~Low-slope~~ roofs in Climate Zones 0 through 2 shall earn credit for Table R408.2 measure numbers R408.2.12.3(1) and R408.2.12.3(2) where the 3-year-aged solar reflectance index (SRI) is greater than or equal to the values specified in Table R408.2.2.3. The earned credit shall be prorated as the ratio of the net high reflectance roof area to the gross roof area rounded to the nearest whole number. 75. To earn credit, not less than 95 percent of the roof area shall comply. The combined area of the following portions of roof shall not be greater than 5 percent of the roof area:

1. Portions that include or are covered by the following:
 - 1.1. Photovoltaic systems or components.
 - 1.2. Solar air or water heating systems or components.
 - 1.3. Vegetative roofs or landscaped roofs.
 - 1.4. Above roof decks or walkways.
 - 1.5. Skylights.
 - 1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions shaded during the peak sun angle on the summer solstice by permanent features of the building, permanent features of adjacent buildings or natural objects.
3. Portions that are ballasted with a minimum stone ballast of 17 pounds per square foot (psf) (74 kg/m²) or 23 psf (117 kg/m²) pavers.

The 3-year-aged SRI shall be determined using certified product data from the Cool Roof Rating Council, or in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft² × °F (12 W/m² × K). Calculation of aged SRI shall be based on 3-year-aged solar reflectance values tested in accordance with ASTM C1549, ASTM E903, ASTM E1918 or CRRC S100 and 3-year-aged thermal emittance values tested in accordance with ASTM C1371, ASTM E408 or CRRC S100.

R408.2.12.3.1 Aged solar reflectance. Where a tested 3-year-aged solar reflectance value is not

available, an assigned value shall be determined in accordance with Equation 4-34.

Equation 4-34

$$R_{aged} = [0.2 + 0.7\delta(R_{initial} - 0.2)] \text{ where:}$$

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with ASTM C1549, ASTM E903, ASTM E1918 or CRRC S100.

δ = 0.65 for field applied coatings and 0.70 for other roofing materials

TABLE R408.2.2.3 IMPROVED ROOF SOLAR REFLECTANCE

SLOPE AND ROOF TYPE	MINIMUM AGED SOLAR REFLECTANCE	THERMAL EMITTANCE
Low slope ^a	0.65	0.75
Steep slope ^b , asphalt and cement tile	0.25	0.75

a. Low-slope = < 2:12 or less than approximately 9.5 degrees from horizontal

b. Steep slope = ≥ 2:12 or greater than approximately 9.5 degrees from horizontal

R408.2.4 Reduced air leakage. Three options are provided. A building meeting more than one option shall receive credit only for the most stringent option satisfied.

Option one: The *building* shall have a measured air leakage rate at least 10 percent lower than the values specified in R402.5.1.3, not less than 2.0 ACH50 and not greater than 2.5 ACH50 or the dwelling units in the *building* shall have an average measured air leakage rate not greater than 0.24 cubic feet per minute per square foot [1.2 L/(s × m²)].

Option two: The *building* shall have a measured air leakage rate at least 20 percent lower than the values specified in R402.5.1.3.

Option three: The building shall meet the PHIUS requirements for air leakage.

If the measured air leakage rate is 1.5 ACH or less under any option, a heat recovery ventilator (HRV) or energy recovery ventilator (ERV) shall be installed. The HRV or ERV shall be a balanced ventilation system with a sensible recovery efficiency (SRE) of not less than 75 percent at 32°F (0°C) at an airflow greater than or equal to the design airflow. The SRE shall be determined from a listed value or from interpolation of listed values.

Both the credits for reduced air leakage and for installation of an ERV or HRV may be earned provided the criteria for each credit are met.

R408.2.3 More efficient HVAC equipment performance options. Heating and cooling *equipment* shall meet one of the following measures as applicable for the *climate zone* where heating and cooling efficiencies are represented by Annual Fuel Utilization Efficiency (AFUE), Coefficient of Performance (COP), Energy Efficiency Ratio (EER and EER2), Heating Season Performance Factor (HSPF2) and Seasonal Energy Efficiency Ratio (SEER2). Where multiple heating or cooling systems are installed serving different *zones*, credits shall be earned based on the weighted average of square footage of the *zone* served by the system.

1. Water-to-air ground source heat pump applicable to all *climate zones*: Greater than or equal to 17.1 EER and 3.65 COP ground source heat pump.
2. High performance cooling (Option 1) applicable to all *climate zones*: Greater than or equal to 18.0 SEER2 air conditioner. Credit for this measure shall not be permitted where credit is claimed for any of measures R408.2.2(4) through R408.2.2(8).
3. High performance heat pump (Option 1) applicable to *climate zones* 0 through 3: Greater than or equal to 8.5 HSPF2 and 18 SEER2.
4. High performance heat pump (Option 2) applicable to *climate zones* 4 through 8: Greater than or equal to 9.0 HSPF2 and 18 SEER2 with a capacity ratio greater than or equal to 70 percent of heating capacity at

5°F (-15°C) versus rated heating capacity at 47°F (8.3°C).

5. VRF multi-split air-cooled heat pump: Air-cooled VRF greater than or equal to 18.9 IEER and 3.4 COP @ 47°F and 2.25 COP @ 17°F with a capacity ratio greater than or equal to 70 percent of heating capacity at 5°F (-15°C) versus rated heating capacity at 47°F (8.3°C)
6. VRF multi-split water-cooled heat pump: Water-cooled VRF greater than or equal to 14 EER @ 86°F entering water temp for cooling and 4.6 COP at 68°F entering water temp for heating.
7. Gas-fired heat pump: Gas heat pump greater than or equal to 130% AFUE. The gas-fired heat pump space heating system shall not provide cooling.
8. Packaged terminal heat pump: Greater than or equal to 12.6 EER and 3.5 COP.

HVAC options applicable to all *climate zones*:

9. ~~Ground source heat pump: Greater than or equal to 16.1 EER and 3.1 COP ground source heat pump.~~
10. ~~Cooling (Option 1): Greater than or equal to 15.2 SEER2 and 12.0 EER2 air conditioner.~~
11. ~~Cooling (Option 2): Greater than or equal to 16.0 SEER2 and 12.0 EER2 air conditioner.~~
12. ~~Gas furnace (Option 1): Greater than or equal to 97 percent AFUE *fuel gas* furnace.~~
13. ~~Gas furnace (Option 2): Greater than or equal to 95~~

~~percent AFUE *fuel gas* furnace.~~ HVAC options applicable to

~~Climate Zones 0, 1, 2 and 3:~~

14. ~~Gas furnace (Option 3): Greater than or equal to 90 percent AFUE *fuel gas* furnace.~~
15. ~~Gas furnace and cooling (Option 1): Greater than or equal to 90 percent AFUE *fuel gas* furnace and 15.2 SEER2 and 10.0 EER2 air conditioner.~~
16. ~~Gas furnace and cooling (Option 2): Greater than or equal to 95 percent AFUE *fuel gas* furnace and 16.0 SEER2 and 10.0 EER2 air conditioner.~~
17. ~~Gas furnace and heat pump (Option 1): Greater than or equal to 90 percent AFUE *fuel gas* furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump.~~
18. ~~Heat pump (Option 1): Greater than or equal to 7.8 HSPF2, 15.2 SEER2, and 11.7 EER2 air source heat pump.~~ HVAC options applicable to Climate Zones 4, 5, 6, 7 and 8:

19. ~~Gas furnace and cooling (Option 3): Greater than or equal to 95 percent AFUE *fuel gas* furnace and 15.2 SEER2 and 12.0 EER2 air conditioner.~~
20. ~~Gas furnace and cooling (Option 4): Greater than or equal to 97 percent AFUE *fuel gas* furnace and 16.0 SEER2 and 12.0 EER2 air conditioner.~~
21. ~~Gas furnace and heat pump (Option 2): Greater than or equal to 95 percent AFUE *fuel gas* furnace and 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio $\geq$ 70 percent of heating capacity at 5°F (-15°C) versus rated heating capacity at 47°F (8.3°C).~~
22. ~~Heat pump (Option 2): Greater than or equal to 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio $\geq$ 70 percent of heating capacity at 5°F (-15°C) versus rated heating capacity at 47°F (8.3°C).~~

R408.2.2.1 More efficient HVAC equipment for Climate Zone 4. For Climate Zone 4, the following HVAC options shall also apply:

1. ~~Gas furnace and heat pump (Option 3): Greater than or equal to 95 percent AFUE *fuel gas* furnace and 7.8 HSPF2, 15.2 SEER2 and 10.0 EER2 air source heat pump.~~
2. ~~Heat pump (Option 1): Greater than or equal to 7.8 HSPF2, 15.2 SEER2 and 11.7 EER2 air source heat pump.~~

Renumber and modify Sections R408.2.4 and R408.2.4.1 as follows:

R408.2.34 Reduced energy use in service water-heating options. A residential building shall achieve credits for reduced energy use in service water-heating by complying with any of the options in Section R408.2.4.1.

R408.2.4.1 More efficient service water heating. For measure numbers R408.2.34(1) through

R408.2.3.4(75), the installed hot water system shall meet one of the Uniform Energy Factors (UEF), coefficients of performance (COP), or Solar Uniform Energy Factors (SUEF) in Table R408.2.3.4. For measure number R408.2.3(8), the hot water distribution system shall comply with Section R408.2.3.1.

Replace Table R408.2.4 in its entirety:

TABLE R408.2.4—SERVICE WATER HEATING EFFICIENCIES				
MEASURE NUMBER	WATER HEATER	SIZE AND DRAW PATTERN	TYPE	EFFICIENCY
R408.2.4.1(1)	Electric water heater (Option 1)	All storage volumes, low, medium, or high	Integrated or split-system HPWH	UEF ≥ 3.30
R408.2.4.1(2)	Electric water heater (Option 2)	Rated input capacity > 12 kW	—	COP ≥ 3.0
R408.2.4.1(3)	Electric water heater (Option 3)	Rated input capacity > 12 kW	—	COP ≥ 4.3
R408.2.4.1(4)	Gas heat pump water heater	All storage volumes, low, medium, or high	Integrated or split-system HPWH	UEF ≥ 1.30
R408.2.4.1(5)	Solar water heaters (electric backup)	All storage volumes, all draw patterns	Electric backup	SUEF ≥ 3.00

Delete Section R408.2.3.1 *Compact hot water distribution system option*, Table R408.2.3.1 – *Internal Volume of Various Water Distribution Tubing*, Section R408.2.3.1.1 *Water volume determination*, and Section R408.2.4 *More efficient thermal distribution system options* in their entirety.

Modify Section R408.2.5 as follows:

R408.2.5 Improved air sealing and efficient ventilation system options. In Climate Zones 4 through 8, Energy Recovery Ventilators (ERVs) and Heat Recovery Ventilators (HRVs) with a rated airflow not greater than 300 cfm (141 L/s) shall comply with the enhanced performance requirements of Table R408.2.5 to earn this credit. In Climate Zone 8, recirculation shall not be used as a defrost strategy. The measured air leakage rate and ventilation system shall meet one of the following:

1. Either an Energy Recovery Ventilator (ERV) or a Heat Recovery Ventilator (HRV) installed.
2. Less than or equal to 2.0 ACH50, with either an ERV or HRV installed.
3. Less than or equal to 2.0 ACH50, with a *balanced ventilation system*.
4. Less than or equal to 1.5 ACH50, with either an ERV or HRV installed.
5. Less than or equal to 1.0 ACH50, with either an ERV or HRV installed.

In addition, for measures requiring either an ERV or HRV, HRV and ERV Sensible Recovery Efficiency (SRE) shall be not less than 75 percent at 32°F (0°C) at the lowest *listed* net airflow. ERV Latent Recovery/Moisture Transfer (LRMT) shall be not less than 50 percent at the lowest *listed* net airflow. In Climate Zone 8, recirculation shall not be used as a defrost strategy.

The equipment's sensible recovery efficiency (SRE) shall be determined from a rated value, or interpolation of rated values, at an airflow rate not less than the design minimum outdoor air rate. The required performance values shall be verified using equipment listed in the Home Ventilating Institute (HVI) Certified Product Directory.

TABLE R408.2.5—MINIMUM EFFICIENCY REQUIREMENTS FOR SYSTEMS ≤ 300 CFM

CLIMATE ZONES	PERFORMANCE REQUIREMENTS	Test Standard
4, 5, 6, 7, 8	SRE ≥ 85% at 32°F (0°C) at an airflow not less than the design outdoor air rate	CAN/CSA-C439

Modify Section R408.2.6 as follows:

R408.2.6 Energy efficient appliances. ~~To obtain the credits specified in Table R408.2, all~~ Each appliance of a types listed in Table R408.2.6 ~~shall be installed in a residential building and shall comply with the required efficiency improvement. requirements specified in that table. Each appliance specified in Table R408.2.6 shall be installed.~~ A clothes washer shall be installed at each location plumbed for a clothes washer.

Exception: In *dwelling units* of Group R-2 occupancies where a dishwasher is not installed in each unit, not fewer than ~~four~~ **two** appliance types complying with Table R408.2.6 shall be installed.

TABLE R408.2.6—MINIMUM EFFICIENCY REQUIREMENTS: APPLIANCES		
APPLIANCE TYPES	EFFICIENCY IMPROVEMENT	TEST PROCEDURE
Refrigerator	Maximum Annual Energy Consumption (AEC), not greater than 546 620 kWh/yr	10 CFR 430, Subpart B, Appendix A
Dishwasher	Maximum Annual Energy Consumption (AEC), not greater than 220 240 kWh/yr	10 CFR 430, Subpart B, Appendix C1
Clothes washer and clothes dryer	Clothes washer located within dwelling units: Maximum Annual Energy Consumption (AEC), not greater than 110 130 kWh/yr, and Integrated Modified Energy Factor (IMEF) > 2.92 1.84 cu ft/kWh/cycle Clothes washer not located within dwelling units and where dwelling units are not provided with rough-in plumbing for washers: Modified Energy Factor (MEF) > 2.0 cu ft/kWh/cycle	10 CFR 430, Subpart B, Appendices D1, D2 and J2
Clothes dryer	Combined energy factor > 4.3 (lbs / kWh)	10 CFR 430, Subpart B, Appendices D1, D2 and J2
Stoves	Stove (electric): induction or annual energy use < 186 kWh/yr	10 CFR 430, Subpart B, Appendix I1
For SI: 1 cubic foot per kilowatt hour per cycle = 0.028 m³/kWh/cycle.		

Modify Section R408.2.7 as follows:

R408.2.7 On-site photovoltaic (PV) systems ~~Renewable energy.~~ *An on-site photovoltaic system* ~~Renewable energy resources~~ shall be permanently installed ~~where a solar zone exists and shall be designed and installed in accordance with the manufacturer's installation instructions. The system shall be sized in accordance with one of the following:~~

1. ~~For one- and two-family dwellings and townhouses, and have the rated capacity to produce shall be not less than 2.0~~ **1.0** ~~watts of on-site renewable energy per square foot of conditioned floor area.~~
2. ~~For Group R-2, R-3, and R-4 residential buildings, the rated capacity shall be not less than 0.75 watts per square foot of conditioned floor area.~~

To qualify for this option, *renewable energy certificate* (REC) documentation shall meet the requirements of Section R404.4.

Add new Sections R408.2.8 through R408.2.10:

R408.2.8 Battery energy storage system. A *battery energy storage system (BESS)* shall be permanently installed and shall have a *BESS usable capacity* of at least 5 kWh.

R408.2.9 Electric vehicle supply equipment. In addition to the EV-ready spaces required by Section R404.6, additional EVSE spaces shall be provided to achieve this credit. All EVSE requirements other than quantity (including branch-circuit sizing, electrical distribution, *automatic load management system (ALMS)* configuration, and installation) shall comply with Sections R404.6.

R408.2.9.1 Quantity.

In addition to the EV-ready spaces required by Section R404.7, the following spaces shall be provided as EVSE spaces:

1. **One- and two-family dwellings and townhouses with private parking only:** Not less than one EVSE space for each dwelling unit.
2. **Group R-1, R-2, and R-3 buildings, dormitories, and townhouses with common parking only:** At least 20 percent of total parking spaces shall be fully wired EVSE (Level 2).
3. **Developments with a mix of private and common parking:** Where a development includes both private parking and common parking, EV charging infrastructure shall comply with all of the following:
 - 3.1 Private parking serving individual dwelling units shall comply with R408.2.9.1(1).
 - 3.2 Common parking shall comply with R408.2.9.1(2).
 - 3.3 EVSE quantity requirements shall be applied independently to private parking spaces and to common parking spaces, based on the number of dwelling units served by each.

R408.2.9.1.1 Reduction for DC fast charging. In Group R-2 occupancies or mixed-use building parking, the required number of EVSE spaces may be reduced by five for each DC fast EVSE having a minimum power output of 50 kW, provided that not less than one Level 2 EVSE is installed for each DC fast EVSE.

R408.2.10 Reduced embodied energy or carbon. For measure number R408.2.10, buildings shall comply with one of the following:

1. R408.2.10.1, Low *global warming potential (GWP)* products.
2. R408.2.10.2, Whole-Building Life Cycle Assessment.
3. R408.2.10.3, Building re-use.

R408.2.10.1 Low GWP products. Type III product-specific or facility-specific *environmental product declarations* (EPDs), for all covered products in accordance with Section R402.4.2.1, shall be included in the construction documents. The GWP for the total mass, volume, or area of the covered products shall not be greater than 75 percent of the sum of the applicable GWP values in Tables R408.2.10.1(a-b), for the same total mass, volume, or area of the covered products. Where a product-specific or facility-specific EPD is not available for a building product, a product reference value in accordance with Tables R408.2.10.1(a-b) shall be permitted.

Exceptions:

1. For cellulose and other *biogenic* products, the maximum GWP is 90% of the sum of the applicable GWP values in Tables R402.4.2.1(a-b), for the same total mass, volume, or area of the covered products.
2. Covered products for unaltered portions of existing buildings shall not require an EPD.

R408.2.10.1.1 Covered products. Covered products shall include the product(s) used in the building that are included in Tables R408.2.10.1(a-b). These tables also show maximum GWP for these products.

Table R408.2.10.1(a) Maximum GWP (kg CO₂e) limits for concrete

Normal Weight Concrete		Light Weight Concrete	
Specified Compressive Strength (psi)	Maximum GWP per cubic meter	Specified Compressive Strength (psi)	Maximum GWP per cubic meter
0-2500	240	0-3000	492
2501-3000	262	3001-4000	540
3001-4000	308	4001-5000	588
4001-5000	365		
5001-6000	385		
6001-8000	446		

Table R408.2.10.1(b) Maximum GWP (kg CO₂e) limits for insulation ^a

Product	Maximum GWP per 1 square meter @ RSI-1^a	Product	Maximum GWP per 1 square meter @ RSI-1^b
Expanded polystyrene (EPS) – Type I	2.53	Heavy-density mineral wool board	6.82
Polyiso – wall	3.5	Mineral wool blanket	2.68
Polyiso – roof	2.5	Fiberglass blanket	1.06
Polyiso – roof – GRF facer	2.11	Blanket insulation (general)	1.9
Polyiso – roof – CFG facer	2.95	Closed-cell spray polyurethane foam – medium density	2.63
Polyiso – aluminum foil facer	4.10	Closed-cell spray polyurethane foam – roofing	3.87
Extruded polystyrene (XPS) board ≤25 psi	8.9	Open-cell spray polyurethane foam	1.17
Extruded polystyrene (XPS) board 40 psi	10.9	Cellulose	0.487
Extruded polystyrene (XPS) board, 60 psi	14.1	Loose-fill mineral wool	1.89
Extruded polystyrene (XPS) board, 100 psi	20.1	Loose-fill fiberglass	0.988
Fiberglass board	5.02	Loose-fill insulation (all types)	1.1
a. GWP values are based on industry averages, sourced from industry-wide EPDs for all products for which there was one available. b. This unit refers to the embodied carbon per one square meter of wall constructed at the RSI-1 level of thermal performance. RSI is the metric equivalent to the imperial R-value.			

R408.2.10.2 Whole-Building Life Cycle Assessment. A whole-building life cycle assessment (LCA) shall be submitted as part of the *construction documents*. The LCA shall be developed in accordance with Section R408.2.10.2.1 and comply with one of the following:

1. **Absolute reduction.** For Group R2, R-3, and R-4 buildings, the GWP of the proposed building shall be no more than 107 lbs CO₂e per square foot (520 kgCO₂e/m²) of *floor area*. For one- and two-family dwellings and townhouses, the GWP of the proposed building shall be no more than 65 lbs CO₂e-per square foot (316 kgCO₂e/m²) of *floor area*.
2. **Relative reduction.** The GWP of the proposed building shall be no more than 90 percent of the GWP of a functionally equivalent reference building. The reference building shall be of the same size, geographic location, and thermal performance as the proposed building, subject to the same code requirements as the proposed building, and be functionally equivalent to the proposed building in accordance with ASTM E2921-22. The same LCA tool(s) or software shall be used to complete the LCA for both the reference and proposed building designs.

R408.2.10.2.1 Whole-Building Life Cycle Assessment Requirements. LCAs shall comply with the following:

1. ISO standards 14040 and 14044.

2. Software used to conduct a LCA shall conform to ISO standard 21931—1 and shall have a data set compliant with ISO 14044 and ISO 21930. The software shall utilize a calculation methodology compliant with ISO 21931—1 and ISO 21929—1. Environmental impact data shall not be sourced from expired or retired data sources, except where no valid alternative data exists.
3. The life cycle scope shall cover cradle-to-grave, including one or more of modules A1-A4, one or more of modules B1-B5, and one or more of modules C1-C4, as defined by ISO standards 21931—1 or 21930. The life cycle scope is permitted to exclude modules B6 and B7.

Exception: Where the LCA includes mechanical, electrical, plumbing, and finishes, the life cycle scope shall be permitted to address only modules A1 to A3.

4. The LCA shall include the following building elements: foundations; *exterior wall* envelope; *primary structural elements*; secondary structural members; roof covering; roof deck; *fenestration*; load-bearing walls; and insulation. An assessment submitted for an *addition* or *alteration* shall include elements within the boundary of the *addition* and the *work area* of the *alteration*.
5. The reference study period shall be not less than 60 years.
6. Existing and salvaged and reused products shall be included or excluded at the discretion of the project team. For in-situ reused materials it is permissible to assume the A1-A4 stages carry no impact in the proposed building's LCA while retaining the A1-A4 estimated impacts for these materials in the LCA of the reference design. For salvaged materials, it is permissible to assume the A1-A3 stages carry no impact in the proposed building's LCA while retaining the A1-A3 estimated impacts for these materials in the LCA of the reference design.
7. Biogenic carbon and carbon sequestration shall be reported separately from fossil GWP.

R408.2.10.3 Building re-use. An existing building complies with this section where not less than 50 percent of the *existing building envelope* area is retained. The existing building envelope area shall be the sum of the *conditioned floor area*, gross *exterior wall* surface area, and gross roof surface area of the existing building. *Additions* to a building or structure shall not have an area of more than two times the *conditioned floor area* of the *existing building area*.