Efficient New Homes Code Overlay to the 2024 International Energy Conservation Code

Step 1 on the Pathway to Net-Zero Energy and Carbon

April 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's work is supported by the U.S. Department of Energy's Office of Critical Minerals and Energy Innovation under the Building Technologies Office's Resilient and Efficient Codes Implementation (RECI) program. RECI is a program enacted under the Infrastructure Investment and Jobs Act passed by Congress in 2021 to help states and local governments adopt, implement, and enforce updated building energy codes. It provides grants for training, workforce development, and technical assistance to increase energy efficiency, improve resilience, and reduce utility bills.

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. The first model code tier is therefore called the Efficient New Homes code. The Coalition decided that the second model code tier, called the Near-Zero code, will seek to maximize energy efficiency without requiring renewable energy, and the third model code tier, 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 Efficient New Homes code with decisions on content guided by the requirements of the DOE program. Only in a few cases (e.g., for a few window and floor U-values in warm climate zones or use of heat or energy recovery ventilators in climate zones 4C and 5) did the committee go beyond the program requirements. In these cases, the committee decided the case for increased stringency was compelling, often because these elements were already included in coalition states' codes and are working well. Virtually all elements in this first tier were also included in the Near-Zero code, which builds on the first tier with additional energy efficiency measures and greater stringency and will be published separately. The third model code tier, the Net-Zero code, will also be published separately and builds on the Near-Zero 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.

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[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.

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 Efficient New Homes 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 in June 2026. 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 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 Efficient New Homes code (this document) and the Near-Zero code (published separately). When the Net-Zero code is published, we will include a summary comparing that code to the Near-Zero code.

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Two Pathways Toward Net-Zero Homes

- Efficient New Homes → Readiness-driven: future-proof for electrification & renewables
- Near-Zero Energy → High performance-driven: achieve near-Passive House efficiency now

	Efficient New Homes (ENH) Code	**Near-Zero (NZ) 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 New Homes (ENH)
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 ENH Code
Water Conservation	Low-flow fixtures and compact water distribution system required; option to instead follow WaterSense	Lower flow rates than ENH 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 Zero Energy Ready Code, Chapter 4 (Final Draft, February 20, 2025), 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. For *buildings* using equipment permitted by exceptions to Sections R403.1.2 and R403.2.1, compliance with Section R408 is required.

Modify Section R401.2.2 as follows:

R401.2.2 Passive House Building Certification Option. The Passive House Building Certification Option requires compliance with Sections R405, R404.5, and R404.6.

Modify Section R401.3(4) as follows:

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, t~~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 Section R402.1 as follows:

R402.1 General. The *building thermal envelope* shall comply with the requirements of one of the following:

1. Sections R402.1.1 through R402.1.4 and Section R402.1.6.
2. Sections R402.1.1~~,~~ and R402.1.5 ~~and R402.1.6~~.

Modify Table R402.1.2 as follows:

a. Remove Climate Zone 0 from the table
b. Revise the values and text as shown:

TABLE R402.1.2—MAXIMUM ASSEMBLY *U*-FACTORS[a] AND FENESTRATION REQUIREMENTS							
CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7 AND 8
Vertical fenestration *U*-factor	~~0.50~~0.30	~~0.40~~0.30	~~0.30~~0.28	~~0.30~~0.25	~~0.28~~0.25[d,e]	~~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	~~0.40~~0.30			
Attic roofline and ~~C~~ceiling *U*-factor[g]							
Mass wall *U*-factor, >50% insulation on interior[b]	0.170	0.140	0.087	0.087	0.065	0.057	0.057
Mass wall *U*-factor, all other mass walls[b]							
Floor *U*-factor	~~0.064~~0.047	~~0.064~~0.047					
Unheated slab *F*-factor[fe]				~~0.51~~0.48	~~0.51~~0.48		
Heated slab *F*-factor[fe]							
Crawl space wall *U*-factor	~~0.477~~0.136	~~0.477~~0.136					
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 *U*-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 *U*-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:~~

~~Above 4,000 feet in elevation above sea level, or~~ in windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

e. Alternatively, in climate zones 5 and Marine 4, acceptable alternatives are U ≤ 0.27 and any SHGC, U=0.29 and SHGC ≥ 0.37 or U=0.30 and SHGC ≥ 0.42.

f. *F*-factors for slabs shall correspond to the *R*-values of Table R402.1.3 and the installation conditions of Section R402.2.10.1.

g. Attic roofline insulation is part of the roof assembly and installed on the attic side of the roof deck.

Modify Table R402.1.3 as follows:

a. Remove Climate Zone 0 from the table

b. Revise the values and text as shown:

TABLE R402.1.3—INSULATION MINIMUM *R*-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7 AND 8
Vertical fenestration maximum *U*-factor	~~0.50~~0.30	~~0.40~~0.30	~~0.30~~0.28	~~0.30~~0.25	~~0.28~~0.25[eh]	~~0.28~~0.25[g]	~~0.27~~0.25[g]
Skylight maximum *U*-factor							
Glazed vertical fenestration SHGC	~~0.25~~0.23	~~0.25~~0.23	~~0.25~~0.23	~~0.40~~0.30			
Attic roofline and ceiling *R*-value[j]							
Insulation entirely above roof deck			~~25~~30ci				
Mass wall R-value, >50% insulation on interior[f]	4	6	13	13	17	20	21
Mass wall *R*-value, all other mass walls[f]	3~~/4~~	4~~/6~~	8~~/13~~	8~~/13~~	13~~/17~~	15~~/20~~	19~~/21~~
Floor *R*-value[h]	~~13~~19 or ~~7~~ 13+5ci or ~~10~~15ci	~~13~~19 or ~~7~~ 13+5ci or ~~10~~15ci					
Unheated slab *R*-value & depth[c]				10ci, ~~3~~4 ft	10ci, ~~3~~4 ft		
Heated slab *R*-value & depth[c]				R-10ci, ~~3~~4 ft and R-5 full slab	R-10ci, ~~3~~4 ft and R-5 full slab		

Crawl space wall *R*-value[b, e]	~~0~~5ci or 13[d]	~~0~~5ci or 13[d]					
Opaque door (maximum U-Factor)	0.17						
Door with glazing (maximum U-Factor/SHGC)	U-Factor: 0.25 / SHGC: 0.25						

f. Mass walls shall be in accordance with Section R402.2.6. ~~The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.~~

g. A maximum *U*-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:~~

~~Above 4,000 feet in elevation above sea level, or~~ in windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

h. Alternatively, in climate zones 5 and Marine 4, acceptable alternatives are U ≤ 0.27 and any SHGC, U=0.29 and SHGC ≥ 0.37 or U=0.30 and SHGC ≥ 0.42.

j. Attic roofline insulation is part of the roof assembly and installed on the attic side of the roof deck.

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_r) 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 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 R402.2.7 as follows:

R402.2.7 Steel-frame ceilings, walls and floors. 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 steel-framed ~~ceilings and~~ walls, ceilings and floors in a *building thermal envelope* assembly shall comply with Section R402.2.7.1 or R402.2.7.2.~~be determined in accordance with AISI S250, modified as follows:~~

~~1. Where the steel-framed wall contains no *cavity insulation*, and uses *continuous insulation* to satisfy the *U-factor* maxi- mum, the steel-framed wall member spacing is permitted to be installed at any on-center spacing.~~

~~2. Where the 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.~~

~~3. Where the steel-framed wall contains less than 23 percent framing factors AISI S250 shall be used without any modifications.~~

~~4. Where the 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.~~

Add new Sections R402.2.7.1 and R402.2.7.2:

R402.2.7.1 Psi-factor method. The U-factor of the steel framed wall shall be determined by Equation 4-2.

Equation 4-2 $U = 1 / (R_{eff-assembly})$

where:

U =The U-factor of the steel-framed wall assembly, Btu/hr•ft^2•F (W/m•K)

$R_{eff\text{-}assembly}$ =The effective R-Value, $ft^2 \cdot hr \cdot F/Btu$ (RSI: $m \cdot K/W$) for the overall steel-framed wall assembly as given by Equation 4-3.

Equation 4-3 $R_{eff-assembly} = 1 / [(1/R_{cav}) + \psi L_f] + R_s + R_{af}$

where:

R_{cav} =The R-Value, $ft^2 \cdot hr \cdot F/Btu$ (RSI: $m \cdot K/W$), of cavity insulation located between wall framing members

ψ =0.075 $Btu/ft \cdot hr \cdot F$ (0.130 $W/m \cdot K$) linear thermal transmittance for cold-form steel framing members

L_f =12 × (FF/W_f), the length of steel framing per unit area of opaque wall assembly, ft/ft2. (SI: L_f = 1000 x (FF/W_f), m/m^2)

FF = Framing Fraction, the ratio of steel framing flange area (flange width x total length of framing) to gross opaque wall area

W_f =Steel framing flange width, taken as a nominal 1.625 inches (41 mm)

R_s =The R-value, $ft^2 \cdot hr \cdot F/Btu$ (RSI: $m \cdot K/W$), of continuous insulation and all other continuous material layers on the interior and exterior surfaces of the steel-framed wall assembly

R_{af} =The R-value of interior and exterior air surface films, taken as R-0.17 + R- 0.68 = R-0.85 (RSI-0.30 + RSI-0.12 = RSI-0.150)

R402.2.7.2 Modified AISI S250 Method. Determine the U-factor of the base wall assembly, including only steel studs at a specified spacing and cavity insulation R-value between the studs in accordance with AISI S250 and excluding the R-value of all other material layers on the steel-framed wall assembly including air film R-values. The calculated U-factor shall be substituted for $1/R_{cav}$ in Equation 4-2 to determine Reff-assembly of the overall steel-framed wall assembly including R_s and R_{af}. The term L_f in Equation 4-3 shall include only the additional length of framing other than the studs that are spaced in accordance with the AISI S250 calculation procedure. The U-factor for the overall assembly shall be determined in accordance with Equation 4-2.

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*.

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 leak- age 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, t~~The air leakage rate for *buildings*, *dwelling units* or *sleeping units* shall be as follows:

1. Where complying with Section R401.2.1, ~~the *building* or the *dwelling units* or *sleeping units* in the *building*~~ 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~~n~~ building air leakage rate not greater than the following:

Climate Zone	Air leakage rate (air changes per hour)
1, 2	2.75
3, 4A, 4B	2.25
4C, 5, 6, 7	2.0
8	1.5

All other *dwelling units* and sleeping units shall have an air leakage rate not greater than 0.25 cubic feet per minute per square foot [1.27 L/(s × m^2)] of the *testing unit enclosure area.*

~~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.~~

2. Where complying with Section ~~R401.2.2 or~~ R401.2.3, detached one-family dwellings with greater than 1,500 square feet of *conditioned floor area* and Group R-2, R-3 and R-4 ~~the~~ buildings ~~or the *dwelling units* or *sleeping units* in the *building*~~ shall have a building air leakage rate not greater than 3.0~~4.0~~ air changes per hour (2.5 in climate zones 6, 7 and 8), or for all other dwelling units or sleeping units, 0.27~~0.22~~ cubic feet per minute per square foot [1.37~~1.1~~ L/(s × m^2)] of the ~~*building thermal envelope* area or the dwelling~~ *testing unit enclosure area*~~, as applicable~~.

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 L/(s × 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 L/(s × 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 m^2) or less of *conditioned floor area*, the air leakage rate is permitted to be not greater than 0.275 cubic feet per minute per square foot [1.4 L/(s × m^2)].~~

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

R403

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

R403.1 Heating and cooling systems. Heating and cooling systems serving individual *dwelling units* shall comply with R403.1.1 through R403.1.8. Heating and cooling systems serving multiple *dwelling units* shall comply with Sections R403.1.1 through R403.1.8, or C403 of the *International Energy Conservation Code*—Commercial Provisions, where specified.

R403.1.1 Heating and cooling equipment. Heating and cooling equipment shall comply with Sections R403.1.1 through R403.1.3.

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 R403.1.4.2, R403.1.2, and R403.1.9.
2. *Dwelling units* or *sleeping units* are permitted to be heated using electric resistance space heating where the installed HVAC heating capacity in each separate *habitable space* with exterior fenestration is not greater than 750 watts for Climate Zones 1–4 or 1,000 watts for Climate Zones 5–8. Any *habitable space* with two primary walls facing different cardinal directions, each with exterior fenestration, is permitted to have an additional 250 watts of electric resistance heating. A space within a *dwelling unit* or *sleeping unit* adjoining the *building thermal envelope* but without exterior fenestration is permitted to have no more than 250 watts of electric resistance heating.
3. *Buildings* in which electric resistance or fuel-fired appliances, including decorative appliances, either 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. Heating and cooling equipment shall equal or exceed the efficiency metrics outlined in Table R403.1.2.

Table R403.1.2. Heating and Cooling System Efficiency

Climate Zone Type	**Hot and Mixed Climates**				**Cold Climates**				
2021 IECC Climate Zone	**1**	**2**	**3**	**4A&B**	**4C**	**5**	**6**	**7**	**8**
Air Conditioning (SEER2)	17.1	17.1	15.2	15.2	15.2	15.2	13.3	13.3	13.3
Gas[1] Furnace (AFUE)	80	80	92	95	95	95	95	95	95
Gas[1] Boiler (AFUE or Et)	80	80	92	95	95	95	95	95	95
Heat Pump (HSPF2)[2]	7.8	7.8	7.8	7.8	8.0	8.1, with COP > 1.75 at 5°F and capacity > 70% at 5°F			
Heat Pump (SEER2)[2]	17.1	17.1	15.2	15.2	15.2	15.2			
Oil Furnace (AFUE)	85								
Oil Boiler (AFUE)	87								

1. Propane fueled systems shall meet the requirements shown for gas.
2. Heat pumps not rated in SEER2 or HSPF2 shall have a minimum efficiency of 3.5 COP and 12.6 EER, in accordance with the relevant equipment test procedure in the most recent edition of ASHRAE 90.1.

Exception: Systems not addressed above or not meeting the minimum efficiency may be installed provided they comply with federal minimum efficiency standard requirements and they earn additional energy efficiency credits as specified in section R408.

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 Controls. Not less than one *thermostat* shall be provided for each separate heating and cooling system. For systems serving multiple *dwelling units, a* thermostat shall also be provided for each *dwelling unit*.

Renumber the following section:

R403.1.~~1~~4.1 Programmable thermostat.

Renumber and modify Section R403.1.4.2:

R403.1.4.2 ~~R408.2.8~~ 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 ~~R408.2.8.1~~. Thermostats controlling variable capacity systems shall comply with Section R403.1.4.2.2 ~~R408.2.8.2~~. Thermostats controlling multistage HVAC systems shall comply with either Section R403.1.4.2.1 ~~R408.2.8.1~~ or R403.1.4.2.2 ~~R408.2.8.2~~. ~~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 ~~R408.2.8.1~~ Single-stage HVAC system controls.

R403.1.4.2.2 ~~R408.2.8.2~~ Variable-capacity and two-stage HVAC system controls.

R403.1.~~2~~4.3 Heat pump supplementary heat.

R403.~~2~~1.4.4 Hot water boiler temperature reset.

Renumber and modify Section R403.1.5 and R403.1.5.1.

R403.~~3~~1.5 Duct systems. *Duct systems* for *space conditioning* (heating and/or cooling) and *ventilation* shall be installed in accordance with Sections R403.1.5.1~~3.1~~ through R403.1.5.10~~3.9~~. Ventilation ducts shall also comply with Section R403.3.

R403.~~3~~1.5.1 Duct system design. *Duct systems* serving one or two *dwelling units* or *sleeping units* shall be designed and sized in accordance with ANSI/ACCA Manual D. *Duct systems* serving more than two *dwelling units* or *sleeping units* shall be sized in accordance with the ASHRAE *Handbook of Fundamentals*, ANSI/ACCA Manual D or other equivalent computation procedure.

Exception: *Ventilation ductwork* that is not integrated with *duct systems* serving heating or cooling systems are exempt from Section R403.1.5.

Renumber the following section:

R403.3~~1~~1.5.2 Building cavities. *Building* framing cavities shall not be used as *ductwork* or *plenums*.

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

Renumber and modify Sections R403.1.5.3 and R403.1.5.4:

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 R403.1.5.8.
2. *Ductwork* contained within wall or floor assemblies separating unconditioned space from *conditioned space* is permitted 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 located 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. *Air-handling units* associated with ground-source heat pumps located in unconditioned spaces 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 this section.
    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 supply *ductwork* located within the conditioned space shall be insulated with not less than R-4 insulation.

~~For *duct systems* to be considered inside a *conditioned space,* the *space conditioning equipment* shall be located completely on the conditioned side of the *building thermal envelope*. The *ductwork* shall comply with the following, as applicable:~~

~~1. The *ductwork* shall be located completely on the conditioned side of the *building thermal envelope*.~~

~~2. *Ductwork* in ventilated attic spaces or unvented attics with vapor diffusion ports shall be buried within ceiling insulation in accordance with Section R403.3.5 and shall comply with the following:~~

~~2.1. The ductwork leakage, as measured either by a rough-in test of the supply and return *ductwork* or a post- construction *duct system* leakage test to outside the *building thermal envelope* in accordance with Section R403.3.7, is not greater than 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* served by the *duct system*.~~

~~2.2. The ceiling insulation *R-value* installed against and above the insulated *ductwork* is greater than or equal to the proposed ceiling insulation *R-value*, less the *R-value* of the insulation on the *ductwork*.~~

~~3. *Ductwork* contained within wall or floor assemblies separating unconditioned from *conditioned space* shall comply with the following:~~

~~3.1. A *continuous air barrier* shall be installed as part of the building assembly between the *ductwork* and the unconditioned space.~~

~~3.2. *Ductwork* shall be installed in accordance with Section R403.3.3.~~

~~**Exception:** Where the building assembly cavities containing *ductwork* have been air sealed in accordance with Section R402.5.1 and insulated in accordance with Item 3.3, *duct* insulation is not required.~~

~~3.3. Not less than R-10 insulation, or not less than 50 percent of the required insulation *R-value* specified in Table R402.1.3, whichever is greater, shall be located between the *ductwork* and the unconditioned space.~~

~~3.4. Segments of *ductwork* contained within these building assemblies shall not be considered completely inside~~

~~*conditioned space* for compliance with Section R405 or R406.~~

Delete Sections R403.3.5 *Ductwork buried within ceiling insulation* and Section R403.3.5.1 *Effective R-value of deeply buried ducts*.

Add new Sections R403.1.5.5 and R403.1.5.6:

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 *habitable space*, including bedrooms, 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: *Sleeping units* 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.

Renumber the following sections:

R403.~~3.6~~1.5.7 Sealing.

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

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

R403.~~3.7~~1.5.8 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*, and measured using a flow hood, flow grid, Residential IAQ Fault Indicator Display certified by the California Energy Commission, or other *approved* airflow measuring devise. 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* l~~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 m^2) of *conditioned floor area*.~~

3. Where tested in accordance with Section R403.1.5.10 ~~R403.3.9~~, testing of each *duct system* is not required.

R403.~~3.8~~1.5.9 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:

TABLE R403.~~3.8~~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[c]~~	~~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.~~3.9~~1.5.10 Unit sampling – duct systems. For buildings of 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, under which the field-measured airflow is within 15 percent of the airflow specified in the design.
2. Watt draw shall be Grade I or Grade II, under which watt draw per cubic foot per minute (W/CFM) is 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 of 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 the following sections:

R403.1.7 Mechanical system piping insulation.

R403.1.7.1 Protection of piping insulation.

Renumber and modify Section R403.1.8 as follows:

R403.1.8 Mechanical systems located outside of the building thermal envelope. Mechanical systems providing heat outside of the
building thermal envelope of a *building* shall comply with Sections R403.12.1 through R403.12.4.

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:

R403.5~~**5**~~**2 Service hot water systems.** Energy conservation measures for service hot water systems shall be in accordance with Sections R403.~~**5**~~2.1 through R403.~~**5.3**~~2.6.

Add new Sections R403.2.1 and R403.2.2:

R403.2.1 Water heater equipment and efficiency. Gas water heaters shall have a UEF of at least 0.95, electric split system heat pump water heaters shall have a UEF of at least 2.2, and electric integrated heat pump water heaters shall have a UEF of at least 3.3. Installation shall be verified by the *code official*, an *approved* third-party inspection agency, or an *approved source* to meet the requirements on minimum space volume and equipment venting from the manufacturer's installation instructions or other *approved* installation procedures.

Exceptions:

1. For Group R-2, R-3 and R-4 *buildings*, water heaters located in dwelling units shall have a UEF of at least 1.95, central system electric water heaters shall have a minimum COP of 1.6, and central gas water heaters shall have a minimum thermal efficiency of 95 percent.
2. A gas or electric water heater with a UEF with lower efficiency may be installed provided the efficiency meets federal minimum efficiency standards and the *building* earns additional energy efficiency credits as specified in section R408.
3. The equipment efficiency requirements in this section do not apply if a solar water heating system is present that has a minimum solar fraction, as shown in Table R403.2.4.1.

Table R403.2.1. Minimum Solar Fraction.

2021 IECC Climate Zone	1, 2	3, 4A, 4B	4C, 5, 6	7, 8
Minimum Solar Fraction (SF)	0.80	0.64	0.47	0.28

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).

Renumber and modify Section R403.2.3 as follows:

R403.2.3 ~~**R403.5.2**~~ **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.

Add new Sections R403.2.3.1, R403.2.3.2 and R403.2.3.2.1:

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 and R-4 Buildings. Service water pipe insulation in Group R-2 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 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 and R-4 BUILDINGS

NOMINAL PIPE OR TUBE SIZE (inches)	MINIMUM INSULATION
< 1.5	R10
≥ 1.5	R12

Renumber and modify Section R403.2.3.2.2:

R403.2.3.2.2 Other hot water distribution piping ~~**R403.5.2 Hot water pipe insulation**~~**.** In Group R-2 and R-4 buildings, ~~Insulation for service~~ hot water distribution piping not covered by Section R403.2.3.2.1 shall be insulated according to ~~comply with~~ Table R403~~.5.2~~.2.3.2.2. ~~and be applied to the following:~~

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 and R-4 BUILDINGS	
NOMINAL PIPE OR TUBE SIZE (inches)	MINIMUM INSULATION
< 1	R4
≥ 1	R6

~~1. Piping $^{3}/_{4}$ inch (19.1 mm) and larger in nominal diameter located inside the *conditioned space*.~~

~~2. Piping located outside the *conditioned space*.~~

~~3. Piping from the water heater to a distribution manifold.~~

~~4. Piping located under a floor slab.~~

~~5. Buried piping.~~

~~6. Supply and return piping in *circulating hot water systems*.~~

~~**Exception:** Cold water returns in *demand recirculation water systems*.~~

~~TABLE R403.2.2.2—MINIMUM PIPE INSULATION THICKNESS~~			
~~FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)~~	~~INSULATION CONDUCTIVITY~~		~~MINIMUM PIPE INSULATION THICKNESS (inches)~~
	~~Conductivity Btu × in/(h × ft² × °F)[a]~~	~~Mean rating temperature (°F)~~	
~~141–200~~	~~0.25–0.29~~	~~125~~	~~1.0~~
~~105–140~~	~~0.21–0.28~~	~~100~~	~~1.0~~

~~For SI: 1 inch = 25.4 mm, °C = (°F – 32)/1.8.~~

~~a. For insulation outside the stated conductivity range listed in this table, the minimum thickness (T) listed in this table shall be determined as follows:~~

~~$T = r\{(1 + t/r)^{K/k} - 1\}$~~

~~where:~~

~~T = Minimum insulation thickness.~~

~~r = Actual outside radius of pipe.~~

~~t = Insulation thickness listed in the table for applicable fluid temperature and pipe size (1 inch).~~

~~K = Conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × ft² × °F).~~

~~k = The upper value of the conductivity range listed in this table for the applicable fluid temperature.~~

Add new Sections R403.2.4, R403.2.4.1, and R403.2.4.2:

R403.2.4 Hot water distribution systems. Hot water distribution systems shall comply with Section R403.2.4.3 and either Section R403.2.4.1 or R403.2.4.2.

R403.2.4.1 Hot water distribution systems serving one- and two-family dwellings and townhouses. For one- and two-family dwellings and townhouses the hot water distribution system 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 the fixture branch 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 R403.2.4.3.

Exception: Where the dwelling unit is certified under the EPA WaterSense Labeled Homes program

R403.2.4.2 Hot water distribution systems serving Group R-2 and R-4 buildings. Hot water distribution systems serving dwelling units in Group R-2 and R-4 buildings shall comply with Items 1 through 3.

1. The volume of water stored in piping serving each dwelling unit shall not exceed 1.8 gallons (6.8 L).

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

2. Stored volume shall be determined in accordance with Section R403.2.4.3.

Renumber and modify Sections R403.2.4.3 and R403.2.4.3.1 as follows:

R403.2.4.3 ~~R408.2.3.1.1~~ Water volume determination. The water volume in the piping between a source of heated water and the termination of a fixture supply 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. The stored water volume shall be verified in accordance with either Section R403.2.4.3.1 or Section R403.2.4.3.2.

R403.2.4.3.1 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 R403.2.4.3~~R403.2.2.3.1~~. 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 R403.2.4.3 as follows:

TABLE R403.2.4.3—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 R403.2.4.3.2:

R403.2.4.3.2 Field verification method. The water volume in the piping between a source of heated water and the termination of a fixture 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:
   3.1 0.6 gallons (2.3 L) for one- and two-family dwellings and townhouses
   3.2 2.0 gallons (7.6 L) for Group R-2 and R-4 buildings

Renumber and modify Sections R403.2.5 and R403.5.1 as follows:

R403.2.4 Heated water circulation and temperature maintenance systems. Heated water circulation systems shall be in accordance with Section R403~~.5.1.1~~.2.5.1. Heat trace temperature maintenance systems shall be in accordance with Section R403~~.5.1.2~~2.5.2. *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 Circulation systems. Heated water circulation systems shall be provided with a

circulation pump. Gravity and thermosyphon circulation systems shall be prohibited. 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. ~~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 system return pipe shall be a dedicated return 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).~~

Renumber and modify Sections R403.2.5.1.1 and R403.2.5.1.2:

R403.2.5.1.1 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 through 3.

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. Controls shall consist of an occupant-controlled switch or an occupancy sensor. The system shall not be activated solely by a timer or temperature sensor.
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 R403.2.4.3.

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 central systems in Group R-2 and R-4 buildings. *Demand recirculation water systems* serving central systems in Group R-2 and R-4 buildings shall have controls that start the pump upon receiving a signal from the action of a user 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:

R403.2.4.2 Heat trace systems.

Renumber new Section R403.2.5:

R403.2.5 Low-flow bathroom faucets and showerheads. Bathroom sink faucets and showerheads shall meet or exceed the most recently published WaterSense specification at the time the equipment is purchased by the homebuilder/contractor or homeowner.

Renumber the following section:

R403.2.6 Drain water heat recovery units.

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

R403.~~6~~3 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.~~6~~3.1 Heat or energy recovery ventilation. *Dwelling units* shall be provided with a heat recovery or energy recovery *ventila- tion* 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 ≥ 60%, or Sensible Energy Recovery Ratio at the design minimum outdoor air rate ≥ 65%	AHRI 1060
4C, 5, 6, 7, 8	Cooling	Enthalpy Recovery Ratio at the design minimum outdoor air rate ≥ 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 ≥ 65% at 32°F (0°C) at an airflow not less than the design outdoor air rate	CAN/CSA-C439

R403.~~6~~3.2 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.~~6~~7.2 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:

TABLE R403.~~6~~3.2—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]	
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~~3.3 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: Where location within conditioned space is not feasible, *ductwork* shall be insulated to a minimum of R-8 and sealed in accordance with Section R403.1.5.7.

Renumber the following section:

R403.~~6.5~~3.6 Intermittent exhaust control for bathrooms and toilet rooms.

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.~~10~~4 Energy consumption of pools and spas. The energy consumption of pools and permanent spas shall be controlled by the requirements in Sections R403.~~9~~4.1 through R403.~~9.4~~4.5.

Renumber the following sections:

R403.~~10~~4.1 Heaters.

R403.~~10~~4.2 Time switches.

R403.~~10~~4.3 Covers.

R403.~~11~~4.4 Portable spas.

R403.~~12~~4.5 Residential pools and permanent residential spas.

R403.~~13~~5 Gas fireplaces.

R403.~~13~~5.1 Gas fireplace efficiency.

R404

Modify Section R404.1 and R 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. ~~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. Lamps with an efficacy of not less than 120 lumens per watt shall be permitted to be counted toward the 95 percent requirement.
5. 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).

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 Habitable spaces. All permanently installed luminaires in *habitable spaces* shall be controlled with 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 Specific locations. All permanently installed luminaires in rooms other than *habitable spaces*, bathrooms, and toilet rooms ~~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 controls shall not be required for safety or security lighting.

R404.2.2 Occupant sensor control function in corridors and interior exit stairways serving 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.

Exception: Corridors and stairways provided with less than two footcandles of illumination on the floor at the darkest point with all lights on.

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 within 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 Section R404.3.1 and 404.3.2.

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 *auto-matic* 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 facades, shall be provided with *time-switch controls* or shall be automatically turned off when daylight is present and satisfies the lighting needs.

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 on behalf of the property owner and retired. Compliance using off-site renewable energy systems or RECs derived from off-site generation shall not be permitted.

Exception: Compliance using off-site renewable energy shall be permitted for community solar and where the building is certified under a third-party program including PHIUS, LEED ZERO, Living Building Challenge Zero Carbon, and other third-party programs with renewable energy quality control provisions approved by the *building official*.

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 *Group R* 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 m^2), 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 m^2). 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 m^2) and 500 square feet (46.5 m^2), 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 Sections R404.6.3.2 and 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 energy management system configuration where applicable.

A completed copy of the U.S. Department of Energy Efficient New Homes (ENH) Version 2 checklist—Single-Family or Multifamily, as applicable, including the EV Ready requirement—shall be included in the construction documentation.

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* or *EV capable*.
    - 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.

R404.6.3.2 ~~RE101.2.2~~ EV capable spaces. Spaces required to be provided with *EV capable* infrastructure ~~Each EV capable space used to meet the requirements of Section RE101.2.1~~ shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between a suitable panelboard or other on-site electrical distribution equipment and an enclosure or outlet located within 6 feet (1828 mm) of the *EV capable space*.
2. The installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with Section ~~RE101.2.5~~ R404.6.4.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a two-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."

R404.6.4 ~~RE101.2.5~~ Electrical distribution system capacity. The branch circuits and electrical distribution system serving each *EV charging infrastructure* space ~~*EV capable, EV ready space* and *EVSE space*~~ used to comply with Sections R404.6.1 through R404.6.3 ~~Section RE101.2.1~~ shall comply with one of the following:

1. Electrical distribution system and branch circuits shall be ~~S~~sized for a calculated *EV* charging load of not less than ~~6.2~~ 7.2 kVA per *EVSE*, *EV ready,* or *EV capable space*. Where ~~a~~ circuits are shared or managed, ~~it~~ they shall be in accordance with NFPA 70.
2. The capacity of the electrical distribution system and each branch circuit serving multiple *EVSE* spaces or *EV ready* spaces ~~or *EV capable spaces*~~ designed to be controlled by an *advanced load management system* ~~energy management system~~ in accordance with NFPA 70 shall be sized for a calculated *EV* charging load of not less than 2.1 kVA per space. Where an *advanced load management system* ~~energy management system~~ is used to control *EV* charging loads for the purposes of this section, it shall maintain continuous availability of electrical power to *EVSE* spaces used to comply with Sections R404.6.1 through R404.6.3. ~~not be configured to turn off electrical power to EVSE or EV ready spaces used to comply with Section RE101.2.1.~~

Add new Sections R404.7 through R404.9:

R404.7 Heat Pump Water Heater Ready. Where liquid 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 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 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 R405.5 Photovoltaic (PV) ready and R404.6 Electric vehicle (EV) charging infrastructure.

Exception to R405.2.1.1: Where a project has achieved final PHIUS certification prior to permit issuance, the owner or designee shall provide a Final Certification Letter from PHIUS and verification of compliance with R405.5 Photovoltaic (PV) ready and R404.6 Electric vehicle (EV) charging infrastructure.

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 R404.5 Solar Photovoltaic (PV) Ready and R404.6 Electric vehicle (EV) charging infrastructure.

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 R405.5 Photovoltaic (PV) ready and R404.6 Electric vehicle (EV) charging infrastructure.

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 R404.5 Solar Photovoltaic (PV) Ready and R404.6 Electric vehicle (EV) charging infrastructure.

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 R404.5 Photovoltaic (PV) Ready and R404.6 Electric Vehicle (EV) charging infrastructure.

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 R404.5 Photovoltaic (PV) ready, and R404.6 Electric vehicle (EV) charging infrastructure

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 R404.5 Solar Photovoltaic (PV) Ready and R404.6 Electric Vehicle (EV) charging infrastructure.

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 R404.5 Photovoltaic (PV) ready and R404.6 Electric vehicle (EV) charging infrastructure.

R406

Modify Section R406.1 as follows:

R406.1 Scope. This section establishes criteria for compliance using an *Energy Rating Index (ERI)* analysis. Such analysis shall be limited to *dwelling units* and *sleeping units*. Spaces other than *dwelling units* and *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* 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* values indicated in Section ~~Table~~ R406.5.

Modify Table R406.2 as follows:

TABLE R406.2—REQUIREMENTS FOR ENERGY RATING INDEX	
SECTION[a]	**TITLE**
Mechanical	
R403.1, except Section R403.1.2	Heating and Cooling Systems
R403.~~5~~2, except Section R403.2.1	Service hot water systems
R403.~~6~~3	Mechanical ventilation systems and indoor air quality
~~R403.7, except Section R403.7.1~~	~~Equipment sizing and efficiency rating~~
R403.~~10~~4	Energy consumption of pools and spas
R403.~~13~~5	Gas fireplaces

Add the following rows to Table R406.2:

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 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.~~ Where complying with the total building thermal envelope thermal conductance (TC) of Section R402.1.5, adjustments to the TC calculation related to slab edge insulation details that are permitted by ENERGY STAR Single Family Homes Version 3.2 or 3.3 are permissible for use in meeting this requirement.

Exception: *Dwelling units* with a total building thermal envelope UA complying with the Section R402.1.5 of the 2021 International Energy Conservation Code.

R406.4 Energy Rating Index. The *Energy Rating Index* (*ERI*) shall be determined in accordance with ANSI/RESNET/ICC 301, without the inclusion of on-site power production (OPP). T~~he 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* or the *rated design*.

R406.5 ERI-based compliance. Compliance based on an *ERI* analysis requires that the *rated design* and each confirmed as-built *dwelling unit* be simulated without on-site power production (OPP) and shown to have an *ERI* less than or equal to the appropriate value from either section R406.5.1 or R406.5.2.

R406.5.1 Maximum Energy Rating Index. The maximum *energy rating index* shall be less than or equal to the value indicated in Table R406.5.1 where compared to the *ERI reference design* as follows:

1. Where *on-site solar photovoltaic* systems ~~renewables~~ are not installed, the values under "All electric" and "Mixed fuels" ~~ENERGY RATING INDEX NOT INCLUDING OPP~~ apply.
2. Where *on-site solar photovoltaic* systems of at least 5 kW for single-family and 2.5 kW per dwelling unit for R-2 and townhomes are installed, the higher values under "Dwelling Units with SOLAR PV" ~~*ENERGY RATING INDEX* WITH OPP~~ apply. The on-site power production associated with the on-site solar photovoltaic system shall not be used to determine the ERI.

Exception:

~~Where the *ERI* analysis excludes on-site power production (OPP), the values under ENERGY RATING INDEX NOT INCLUD- ING OPP shall be permitted to be applied.~~

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*, as calculated in accordance with ANSI/RESNET/ICC 301.

Renumber and modify Table R406.5.1:

TABLE R406.5.1—MAXIMUM ENERGY RATING INDEX NOT INCLUDING SOLAR

CLIMATE ZONE	MAXIMUM ENERGY RATING INDEX		
	All Electric[a, b]	Mixed Fuels[a]	Dwelling Units with Solar PV
0 and 1	45	42	48
2	45	42	48
3	45	42	48
4	45	42	48
5	45	42	48
6	45	42	48
7	45	42	48
8	45	42	48

a. All-electric includes no equipment/appliance that combusts fuel on site. Mixed fuels includes use of equipment/appliance that combusts fuel on site

including wood, natural gas, etc.
b. For homes and accessory dwelling units of 800 sq. ft. or less, the maximum ERI is 48.

Add new Section R406.5.2:

R406.5.2 Design-specific energy rating index[2]. The maximum *energy rating index* for a particular dwelling unit is the ENERGY STAR ERI Target, from ENERGY STAR Single Family New Homes, V3.2 OR V3.3 or from ENERGY STAR Multifamily New Construction, V1.2 OR 1.3, as applicable.

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* ~~has a~~ *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~~5~~ 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 $^1/_4$ 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.

R408

Modify Sections R408.1 and R408.2 as follows:

R408.1 Scope. This section provides additional efficiency measures and credits required to comply with Section R401.2.1.

[2] Compliance with Section R406.5.2 is required to obtain Energy Star certification.

R408.2 Additional energy efficiency credit requirements. *Residential building*s shall earn credits where required by this section. ~~not less than 10 credits from not less than two measures specified in Table R408.2. 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 R408.2.1c 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. Credits shall be required as follows:

1. *Dwelling units* with more than 4,000 square feet (465 m^2) of living space located above *grade plane* shall earn not less than five credits.
2. *Dwelling units* using heating, cooling, or service water heating equipment permitted by the exceptions to Sections R403.1.2 or R403.2.1 shall comply with Section R408.2.1.

R408.2.1 Additional offset credits for lower efficiency equipment. Dwelling units subject to Item 2 of Section R408.2 shall earn credits in accordance with this section. *Dwelling units* using cooling and heating equipment permitted by the exception to Section R403.1.2 shall earn the required number of credits in Table R408.2.1a and *buildings* using water heating equipment permitted by exception 2 in Section R403.2.1 shall earn the required number of credits in Table R408.2.1b. Credits shall be from measures specified in Table R408.2.1c.

Add new Tables R408.2.1a and R408.2.1b:

Table R408.2.1a Additional Energy Efficiency Credits Required When Using Cooling and Heating Equipment Permitted by Exception to Section R403.1.2

Climate Zone Type	Hot and Mixed Climates				Cold Climates				
2024 IECC Climate Zone	1	2	3	4	4C	5	6	7	8
Air conditioning	10	10	8	8	8	8	0	0	0
Gas furnace or boiler	0	0	2	5	5	5	7	8	9
Heat pump	11	11	9	11	8	9	9	9	11

Table R408.2.1b Additional Energy Efficiency Credits Required When Using Water Heating Equipment Permitted by Exception 2 to Section R403.2.1

Climate Zone Type	Hot and Mixed Climates				Cold Climates				
2024 IECC Climate Zone	1	2	3	4	4C	5	6	7	8
Gas water heater	7	7	8	6	9	5	4	4	3
Gas storage water heat UEF ≥ 0.86	6	7	8	6	8	5	4	3	3
Electric resistance water heater	6	6	6	5	7	5	4	3	3

Renumber and replace Table R408.2c in its entirety (next page):

TABLE R408.2.1c CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

MEASURE NUMBER	MEASURE DESCRIPTION	CREDIT VALUE								
		Climate Zone 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)	≥ 10% and < 20% reduction in total TC	0	1	2	3	4	4	5	5	6
R408.2.2.1(2)	≥ 20% and < 30% reduction in total TC	1	3	3	6	7	8	9	10	12
R408.2.2.1(3)	≥ 30% 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
R408.2.2.3(1)	Low slope roof solar reflectance per Table R408.2.1.3 (reflectance >= 0.65)	1	0	0	0	0	0	NA	NA	NA
R408.2.2.3(2)	Steep slope roof (any material) solar reflectance per Table R408.2.1.3 (reflectance >=0.60)	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)	Ground source heat pump	0	1	4	6	5	10	12	16	20
R408.2.3(2)	Improved performance cooling 18 SEER2	10	11	9	9	NA	NA	NA	NA	NA
R408.2.3(3)	High Performance Heat pump (Option 1 - CZs 1,2, 3, 4A, and 4B)	12	11	10	11	NA	NA	NA	NA	NA
R408.2.3(4)	VRF multi-split air-cooled heat pump	12	11	10	11	11	12	10	8	6
R408.2.3(5)	VRF multi-split water-cooled heat pump	1	1	1	1	1	1	1	1	1
R408.2.3(6)	Gas heat pump 130% AFUE (heating only)	NA	3	3	7	7	8	8	7	8
R408.2.4.1(1)	Electric water heater COP≥3.3 (Option 1)	6	7	7	6	8	6	4	4	4
R408.2.4.1(2)	Electric water heater > 12kW, COP >3.0 (Option 2)	10	9	9	7	6	4	3	3	2
R408.2.4.1(3)	Electric water heater ≥12kW, COP>4.3 (Option 3)	14	13	13	10	9	6	5	4	3
R408.2.4.1(4)	Gas heat pump water heater 1.30 UEF	12	11	10	7	2	4	7	8	5
R408.2.4.1(5)	Solar hot water heating system electric backup – 3.0 SUEF	13	13	13	9	8	5	4	4	3
R408.2.4.1(6)	Solar hot water heating system gas backup – 1.8 SUEF	10	9	9	6	7	6	5	4	3
R408.2.5	High Performance ERV or HRV installed (CZs 4C, 5, 6, 7, 8)	NA	NA	NA	NA	3	3	3	3	3
R408.2.6	On-site photovoltaic (PV) systems	39	38	38	25	24	22	18	15	10
R408.2.7	Electric vehicle supply equipment	1	1	1	1	1	1	1	1	1

Renumber the following sections:

R408.2.~~1~~2 Enhanced building thermal envelope options

R408.2.~~1~~2.1 Enhanced building thermal envelope performance

R408.2.~~1~~2.2 Improved fenestration.

Renumber and modify Table R408.2.2.2 as follows:

TABLE R408.2.~~1~~2.2—IMPROVED FENESTRATION			
CLIMATE ZONE	**U-FACTOR 10% IMPROVEMENT**	**U-FACTOR 20% IMPROVEMENT**	**SHGC**
0	0.27~~0.32~~	0.24	
1	0.27~~0.32~~	0.24	
2	0.27~~0.30~~	0.24	
3	0.25~~0.28~~	0.22	
4 except Marine 4	0.22~~0.25~~	0.20	NR~~0.40~~
5 and Marine 4	0.22~~0.25~~	0.20	
6	0.22~~0.25~~	0.20	
7 and 8	0.22~~0.25~~	0.20	
	NR = No Requirement.		

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

R408.2.~~1~~2.3 Roof solar reflectance index. High reflectance roofs ~~*Low slope* roofs in Climate Zones 0 through 2~~ shall earn credit for Table R408.2 measure numbers R408.2.1.3(1) and R408.2.1.3(2) where the 3-year-aged solar reflectance index (SRI) is greater than or equal to the values specified in Table R408.2.1.3 ~~75~~. To earn the full credit, the roof area meeting the high-reflectance requirement, after accounting for allowed exclusions, shall be at least 95 percent of the total roof area. If the area meeting the requirement is less than 95 percent, the earned credit shall be prorated as the ratio of the compliant roof area to 95 percent. The following portions of the roof are permitted to count toward the 5 percent allowed roof area exclusions. ~~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/m^2) or 23 psf (117 kg/m^2) 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 × ft^2 × °F (12 W/m^2 × 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.

R408.2.1~~1~~2.3.1 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-~~3~~4.

Equation 4-~~3~~4

R_{aged} = [0.2 + ~~0.7~~β($R_{initial}$ – 0.2)] 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.

β = 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], any material enhanced reflectance	0.60	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.~~1~~2.4 Reduced air leakage. ~~The *building* shall have a measured air leakage rate 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)].~~Three options are provided:

Option one: the *building* shall have a measured air leakage rate at least 10% lower than the values specified in R402.5.1.3.

Option two: the *building* shall have a measured air leakage rate at least 20% 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.

R408.2.2~~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.

HVAC options ~~applicable to all *climate zones*~~:

1. Water-to-air ground source heat pump applicable to all *climate zones*: Greater than or equal to 17.1 EER and 3.6 COP ground source heat pump.
2. High performance cooling 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(6).
3. High performance heat pump applicable to *climate zones* 1, 2, 3, 4A and 4B: Greater than or equal to 9.0 HSPF2 and 18 SEER2 with a capacity ratio ≥ 70 percent of heating capacity at 5°F (-15°C) versus rated

heating capacity at 47°F (8.3°C).

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

~~7. Cooling (Option 1): Greater than or equal to 15.2 SEER2 and 12.0 EER2 air conditioner.~~

~~8. Cooling (Option 2) applicable to Climate Zones 4, 5, 6, 7 and 8: : Greater than or equal to 16.0 SEER2 and 12.0 EER2 air conditioner.~~

~~9. Gas furnace or gas boiler (Option 1): Greater than or equal to 97 percent AFUE *fuel gas* furnace.~~

~~10. Gas furnace or gas boiler (Option 2) applicable to Climate Zones 1, 2, 3 and 4 except Marine: Greater than or equal to 95 percent AFUE *fuel gas* furnace. HVAC options applicable to Climate Zones 0, 1, 2 and 3:~~

~~11. Gas furnace or gas boiler (Option 3): Greater than or equal to 90 percent AFUE *fuel gas* furnace.~~

~~12. Gas furnace or gas boiler 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.~~

~~13. Gas furnace or gas boiler 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.~~

~~14. Gas furnace or gas boiler 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.~~

~~15. 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:~~

~~16. Gas furnace or gas boiler 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.~~

~~17. Gas furnace or gas boiler 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.~~

~~18. Gas furnace or gas boiler 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 ≥ 70 percent of heating capacity at 5°F (-15°C) versus rated heating capacity at 47°F (8.3°C).~~

~~6. Heat pump (Option 21) applicable to Climate Zones 4,5,6,7 and 8: Greater than or equal to 8.1 HSPF2 and 15.2 SEER2 air source heat pump capable of meeting a capacity ratio ≥ 70 percent of heating capacity at 5°F (-15°C) versus rated heating capacity at 47°F (8.3°C).~~

~~7. Gas heat pump: Greater than or equal to 140 percent AFUE.~~

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

~~a. Gas furnace or gas boiler 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.~~

~~b. Heat pump (Option 1): Greater than or equal to 7.8 HSPF2, 15.2 SEER2 and 11.7 EER2 air source heat pump.~~

Modify Section R408.2.4 as follows:

R408.2.3~~4~~ 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 following options in Section

R408.2.4.1.

Renumber and modify Section R408.2.4.1 as follows:

R408.2.4.1 More efficient service water heating. For measure numbers R408.2.~~3~~4 (1) through R408.2.~~3~~4(~~7~~6), the installed hot water system shall meet one of the Uniform Energy Factors (UEF) 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
R408.2.3.1(1)	Electric water heater (Option 1)	All storage volumes, low, medium, or high	Integrated or split-system HPWH	UEF ≥ 3.30
R408.2.3.1(2)	Electric water heater (Option 2)	Rated input capacity > 12 kW	–	COP ≥ 3.00
R408.2.3.1(3)	Electric water heater (Option 3)	Rated input capacity > 12 kW	–	COP ≥ 4.30
R408.2.3.1(4)	Gas heat pump water heater	All storage volumes, low, medium, or high	Integrated or split-system HPWH	UEF ≥ 1.30
R408.2.3.1(5)	Solar water heaters (electric backup)	All storage volumes, all draw patterns	Electric backup	SUEF ≥ 3.00
R408.2.3.1(6)	Solar water heaters (gas backup)	All storage volumes, all draw patterns	Gas backup	SUEF ≥ 1.80

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.

Renumber and modify Section R408.2.5 as follows:

R408.2.5 Improved ~~air sealing and~~ efficient ventilation system options. 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) is 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.~~

Equipment shall comply with the performance requirements listed in Table R408.2.5a and Table R408.2.5b. ~~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.

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 R408.2.4a for climate zones 1 through 4B.
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

and total recovery efficiency requirement of Table R408.2.5b. The equipment's sensible recovery efficiency and net moisture transfer ratio (NMTR) 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 to the requirement shall be demonstrated by a listing in Home Ventilating Institute's Certified Product Directory.

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

CLIMATE ZONES	TEST CONDITION	PERFORMANCE REQUIREMENTS	Test Standard
0, 1, 2, 3, 4A, 4B	Heating	Enthalpy Recovery Ratio or Sensible Energy Recovery Ratio at the design minimum outdoor air rate ≥ 60%, or Sensible Energy Recovery Ratio at the design minimum outdoor air rate ≥ 65%	AHRI 1060
0, 1, 2, 3, 4A, 4B	Cooling	Enthalpy Recovery Ratio at the design minimum outdoor air rate ≥ 50%	AHRI 1060

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

CLIMATE ZONES	PERFORMANCE REQUIREMENTS	Test Standard
0, 1, 2, 3, 4A, 4B	SRE ≥ 65% at 32°F (0°C) at an airflow rate not less than the design minimum outdoor air rate Total Recovery Efficiency rating at 95F shall not be less than 50% and where active humidification is provided, NMTR at 32F shall not be less than 0.40	CAN/CSA-C439
4C, 5, 6, 7, 8	SRE ≥ 75% at 32°F (0°C) at an airflow not less than the design outdoor air rate	CAN/CSA-C439

Delete Section R408.2.6 *Energy efficient appliances* in its entirety.

Renumber and modify Section R408.2.6 as follows:

R408.2.7~~6~~ ~~Renewable energy~~ On-site photovoltaic (PV) systems. ~~*Renewable energy resources*~~ A *photovoltaic system* shall be permanently installed where a *solar* zone exists and have the rated capacity to produce not less than 2.0~~1.0~~ watt of *on-site* ~~*renewable energy*~~*PV* per square foot of *conditioned floor area*. Photovoltaic systems shall be designed and installed in accordance with the manufacturer's installation instructions. Group-R occupancies shall comply with Section C405.15. ~~To qualify for this option, *renewable energy certificate* (REC) documentation shall meet the requirements of Section R404.4.~~

Add a new Section R408.2.7:

R408.2.7 Electric vehicle supply equipment. Where this credit is selected, spaces required to be provided with *EV charging infrastructure* by Section R404.6 shall be provided as *EVSE* spaces. *EVSE* spaces shall comply with Sections R404.6.4 and R404.6.5.

R408.2.7.1 Quantity. Spaces required to be provided with *EV charging infrastructure* by Section R404.6 shall be provided as *EVSE* spaces in accordance with the following:

1. One- and two-family dwellings and townhouses with private parking only: Not less than one *Level 2 EVSE* space for each *dwelling unit.*

2. Group R-2 and R-4 buildings, dormitories, and townhouses with common parking only: At least 20 percent of total parking spaces shall be *Level 2 EVSE* spaces.
3. Developments with a mix of private and common parking**:** Where a development includes both private parking and common parking, *EVSE* spaces shall be provided in accordance with all of the following:
   3.1 Private parking serving individual dwelling units shall comply with R408.2.7.1 Item 1.
   3.2 Common parking shall comply with R408.2.7.1 Item 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.

R408.2.7.1.1 Reduction for DC fast charging. Where DC fast *EVSE* are installed in parking areas serving dwelling units, 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* space is installed for each DC fast EVSE.