Draft Amendments for the Development of the 2024 IECC

COMMERCIAL

Code Change Title	Section Impacted	Summary
Efficiency		
Cool Roof Expansion	C402	Increases SRI requirement for Climate Zones 0-3 and establishes requirements for cool roofs in CZs 4 and 5.
Air Barrier Testing	C402	Increase building size threshold for testing to 250,000 ft2 and reduce allowable air leakage rate to 0.25 cfm/ft2.
Thermal Bridging	C402	Requires thermal bridging be documented and mitigated.
Dedicated Outdoor Air Systems (DOAS)	C403	Requires commercial buildings to install a DOAS system, separating ventilation from space conditioning.
Horticultural Dehumidification	C403	Increases the efficiency of dehumidification systems in horticultural applications.
Horticultural Lighting	C405	Increases stringency for lighting in horticultural applications.
Energy Monitoring	C405	Reduces size threshold for energy monitoring requirement to 10k sqft to align with common benchmarking policies.
Energy Monitoring for EVs	C405	Requires submetering for EVs where installed.
Commissioning	C408	Reduces thresholds for required commissioning of systems.
Multifamily Alignment	Multiple	Aligns requirements for multifamily buildings across commercial and residential provisions.

Code Change Title	Section Impacted	Summary
Renewable Energy		
Biomass	C202	Clarifies the type of biomass that counts as a renewable energy resource.
Onsite Renewable Energy	C405	Requires on-site renewable energy generation.
Renewables Definition	Appendix CC	Clarifies renewable energy terms in Appendix CC.
Electrification		
Commercial Decarbonization	C402	Requires all new construction be all-electric.
Grid Integration		
Grid integrated thermostats	C403	Requires grid-integrated controls on space heating and cooling systems that adjust temperature within 4-degrees.
Grid integrated water heating	C404	Requires grid-integrated controls on electric storage water heaters (37-120 gallons/ “residential style”).
Electric Vehicles	C405	Requires EV charging for all commercial building types.
Energy Storage Ready	C405	Requires commercial and multifamily energy storage readiness.
Solar and storage inverters	C405	Requires solar and energy storage systems be equipped with smart inverters for grid-integrated controls.
Grid Optimal credits	C406	Establishes credits for buildings to shed load during peak demand hours.
Existing Buildings		
Additional Efficiency Credits for Existing Buildings	C506	This proposal adds a requirement that additions and large alterations achieve a minimum level of points from C406 through the addition of a new Section C506.
Acceptance Testing for Alterations	C503	Requires acceptance testing of existing HVAC, SHW or lighting systems that serve alterations.
HVAC Control Upgrade in Alterations	C503	New HVAC equipment in alterations must have controls that comply with current code requirements.

Code Change Title	Section Impacted	Summary
Lighting Control Upgrades in Alterations	C503	New luminaires in alterations must have lighting controls that comply with current code requirements.
Duct Leakage Testing in Alterations	C502 C503	Ducts must be tested when equipment is replaced.
System Sizing in Commercial Alterations	C503	New equipment installed in alterations has to be right sized based on the alteration.
Testing of Gas Piping in Alterations	C502 C503	When new gas equipment is installed, the gas piping has to be leakage tested.

RESIDENTIAL

Code Change Title	Section Impacted	Summary
Efficiency		
Multifamily Alignment	Multiple	Aligns requirements for multifamily buildings across commercial and residential provisions.
Efficiency Credits	R408	Changes residential option packages to a credit-based structure similar to Commercial C406.
Renewables		
Biomass Waste Definition	R202	Adds definition of biomass waste and clarifies definition of renewable energy resources.
Solar Readiness	R404	Requires single- and two-family solar readiness. Requires multifamily to comply with a sister provision under commercial section of energy code.
Renewable Energy Credits	R404	Clarifies RECS definition and documentation requirements for RECS.
Electrification		
Residential Decarbonization	R402	Requires all new construction be all-electric.
Grid Integration		
Grid integrated water heating	R403	Requires grid-integrated controls on electric storage water heaters (37-120 gallons/ “residential style”).
Grid integrated thermostats	R403	Requires grid-integrated controls on space heating and cooling systems that adjust temperature within 4-degrees.
Solar and storage inverters	R404	Requires solar and energy storage systems be equipped with smart inverters for grid-integrated controls.
Electric Vehicles	R404	Requires single- and two-family EV charging. Requires multifamily to comply with a sister provision under commercial section of energy code.
Energy Storage Readiness	R404	Requires single- and two-family energy storage readiness.

Code Change Title	Section Impacted	Summary
Zero Energy Home		
Zero Energy Home Appendix Update	Appendix RC	Updates the Zero Energy Home Appendix with ERI targets based on a survey of Passive House scores
Zero Energy Home Appendix Decarbonization	Appendix RC	Updates the Zero Energy Home Appendix to require all-electric construction.
Zero Energy Home Appendix Renewable Definitions	Appendix RC	Clarifies renewable energy terminology used in the Zero Energy Home Appendix.
Existing Buildings		
Additional Efficiency Packages for Existing Buildings	R506	This proposal adds a requirement that large additions and large alterations include a package option from R408.
HVAC Control Upgrade in Alterations	R503	New HVAC equipment in alterations must have controls that comply with current code requirements.
Duct Leakage Testing in Alterations	R502 R503	Ducts must be tested when equipment is replaced.
System Sizing in Residential Alterations	R503	New equipment installed in alterations has to be right sized based on the alteration.
Testing of Gas Piping in Alterations	R502 R503	When new gas equipment is installed, the gas piping has to be leakage tested.

IECC - Commercial Provisions

Efficiency

Cool Roof Expansion

Revise text as follows:

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above ~~cooled~~ conditioned spaces ~~in Climate Zones 0 through 3~~ shall comply with one or more of the options in Table C402.3.

Revise table as follows:

Table C402.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]

Climate Zone	0-3	4-5	6-8
Three-year-aged solar reflectance[b]/3-year aged thermal emittance[c]	~~Three-year-aged solar reflectance index[b] of 55 and 3-year-aged thermal emittance[e] of~~ 0.63/0.75	0.55/0.75	NR
Three-year-aged solar reflectance index[d]	~~Three-year-aged solar reflectance index[d] of 64~~ 75	64	NR

Installing a cool roof is a relatively inexpensive energy conservation measure to passively reduce cooling load in buildings. Cool roofs strongly reflect sunlight and efficiently radiate heat away from the roof surface. Cool roofs also decrease the amount of heat transferred from the roof to the air, thus mitigating the urban heat island effect. Extreme heat is the number one weather-related killer in the U.S. In cities, this is a particular concern due to the urban heat island, where temperatures can be 9 to 16 degrees (Fahrenheit) higher than surrounding rural areas. Studies have shown that a 10-percentage point increase in urban surface reflectivity would reduce the number of deaths during heat events by an average of 6%. With 80% of the world's population projected to live in an urban area within the next 50 years, and in a warming climate with more extreme heat events, it is likely that even more lives could be saved if cool roofs were more widely installed.

Air Barrier Testing

Revise text as follows:

C402.5 Air leakage—thermal envelope. The *building thermal envelope* shall comply with Sections C402.5.1 through Section C402.5.11.1~~, or the building thermal envelope shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9~~.

Revise text as follows:

C402.5.1.2 Air barrier compliance. A continuous air barrier for the opaque building envelope shall ~~comply with the following:~~ meet the provisions of Section 402.5.3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5

1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.

   Exception: Buildings in Climate Zones 2B, 3C and 5C.

   Group R and Group I occupancies that meet the provisions of Section C402.5.2. Portions of buildings containing Group R or Group I occupancies that are not tested shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.2.

   Exceptions:

   1. Buildings in Climate Zones 2B, 3B, 3C and 5C.
   2. Buildings larger than 5,000 square feet (464.5 m2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.
   3. Buildings between 5,000 square feet (464.5 m2) and 50,000 square feet (4645 m2) floor area in Climate Zones 0A, 3A and 5B.

3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5

Revise text as follows:

C402.5.2 Dwelling and sleeping unit enclosure testing. The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed ~~0.30 cfm/ft2 (1.5 L/s m2)~~ 0.20 cfm/ft^2 (1.0 L/s m^2) of the dwelling or sleeping unit ~~testing unit~~ enclosure area at a pressure differential of 0.2-inch water gauge (50 Pa). Where multiple dwelling units or sleeping units ~~or other occupiable conditioned spaces~~ are contained within one building thermal envelope, ~~each unit shall be considered an~~

~~individual testing unit, and~~ the building air leakage shall be the weighted average of all test~~ing unit~~ results, area weighted by the enclosure area of each ~~testing~~ tested unit~~'s enclosure area~~. Units shall be tested without simultaneously testing adjacent units and shall be separately ~~with an unguarded blower door~~ tested as follows:

1. Where buildings have fewer than eight total dwelling or sleeping units ~~testing units~~, each ~~testing~~ unit shall be tested.
2. For buildings with eight or more dwelling or sleeping units ~~testing units~~, the greater of seven units or 20 percent of the ~~testing~~ units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest ~~testing unit~~ enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of ~~testing~~ unit types and locations.

Revise text as follows:

C402.5.3 Whole-Building thermal envelope testing. The building thermal envelope shall be tested in accordance with ASTM E779, ~~ANSI/RESNET/ICC 380~~, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed ~~0.40 cfm/ft2 (2.0 L/s × m2)~~ 0.25 cfm/ft^2 (1.25 L/s m^2) of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa).

Exceptions:

~~Alternatively,~~ 1. For buildings larger than 50,000 ft^2 (4,645 m^2), portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. ~~In the alternative approach,~~ tThe following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.
4. Portions of buildings containing Group R or Group I occupancies that are not tested shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

~~**Exception:** Where the measured air leakage rate exceeds 0.40 cfm/ft2 (2.0 L/s × m2) but does not exceed 0.60 cfm/ft2 (3.0 L/s × m2), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions~~

~~taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.~~

2. For buildings larger than 250,000 ft² (25,000 m^2), that do not include Group R or Group I occupancies, where an *approved* agency verifies the design and installation of the continuous air barrier in accordance with Section C402.5.1.5.

Revise text as follows:

C406.9 Reduced air infiltration. Air infiltration shall be verified by whole-building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air-leakage rate of the building envelope shall not exceed ~~0.25 cfm/ft2 (2.0 L/s × m2)~~ 0.17 cfm/ft^2 (0.85 L/s x m^2) under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exceptions:

1. For buildings having over 250,000 square feet (25,000 m2) of conditioned floor area, ~~air leakage testing need not be conducted on the whole building where~~ testing ~~is~~ shall be conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.
2. For buildings or portions of buildings containing Group R or Group I occupancies, where testing is conducted in accordance with C402.5.2 and the weighted average of all testing unit results does not exceed 0.13 cfm/ft^2 (0.65 L/s m^2) under a pressure differential of 0.2 inches water column (50 Pa).

Air leakage can be a significant source of energy waste in buildings, contributing to higher heating and cooling costs for building owners and occupants, and increasing risk related to comfort and durability. Air tightness testing can result in more attention to envelope assembly air barrier sealing and significantly reduced building leakage. Adequate control over air leakage can provide many benefits, including reduced HVAC equipment sizing, better building pressurization, and energy savings due to reduced heating and cooling of infiltrated outside air.

Thermal Bridging

Revise text as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

14. T*hermal bridges*, including type, dimension (area or length) and thermal transmittance.

Add new text as follows:

C103.2.2 Documentation of Thermal bridges. *Thermal bridges* shall be calculated and represented on the construction drawing in compliance with Sections C103.2.2.1 through C103.2.2.3.

C103.2.2.1 Clear field thermal bridges. Where otherwise not included in pre-calculated assembly *U-factors*, *C-factor*s, or *F-factors* outlined in Section C402.1.4, *clear field thermal bridges* in a wall, roof, or floor assembly shall be noted as such in the construction documents.

C103.2.2.2 Point thermal bridges. *Point thermal bridges* greater than or equal in area to 3in^2 (7,744 mm^2) and not associated with HVAC or electrical systems shall be noted as *thermal bridges* in the construction documents.

C103.2.2.3 Linear thermal bridges. Linear thermal bridges shall be calculated in accordance with Table C103.2.2.3 and documented in tabular format in the construction drawing including the following information.

1. *Linear thermal bridge* type.
2. Aggregate length of each type of *linear thermal bridge.*
3. Relevant detail in the construction documents showing a cross-section through the *thermal bridge*.
4. Thermal transmittance for each *thermal bridge* from Table C103.2.2.3.

   Exception: Where *linear thermal bridges* have been tested or modeled using methods approved by the code official, alternate values may be used.

Add new table as follows:

TABLE C103.2.2.3 AVERAGE THERMAL TRANSMITTANCE FOR UMITIGATED LINEAR THERMAL BRIDGES

Type of Thermal Bridge	Thermal transmittance[a] [Btu / hr ft °F]
Balcony	0.50
Floor Slab	0.44
Fenestration Perimeter Transition	0.32
Parapet	0.42
Shelf Angle	0.41

1. Thermal transmittance-values are derived from the BC Hydro Building Envelope Thermal Bridging Guide Version 1.2 –September 2018 and are based on poor performing details.
2. Fenestration Perimeter Transition is the thermal bridge between any fenestration frame and the typical wall, roof or floor assembly it abuts or is mounted within.

Add new definitions as follows:

THERMAL BRIDGE: An element that interrupts areas of uniform thermal resistance in the b*uilding thermal envelope*. For the purposes of documenting and calculating *thermal bridges* withing the *building thermal envelope*, thermal bridges are defined as follows:

CLEAR FIELD THERMAL BRIDGE: an area-based thermal transmittance associated with elements of a building envelope assembly which repeat at regular intervals. Examples of *clear field thermal bridges* include metal or wood stud, brick ties and cladding attachments such as z-girts.

LINEAR THERMAL BRIDGE: a length-based thermal transmittance associated with horizontal, vertical, or diagonal elements within the building envelope and with length measured along the exterior surface of the building envelope. Examples of *linear thermal bridges* include balconies or floor assemblies which penetrate walls in the building envelope, *fenestration* perimeter interfaces, parapets, and shelf angles. Linear thermal transmittance is heat flow divided by length and by the temperature difference between the interior and exterior sides of the assembly, in units Btu/hr• ft• °F.

POINT THERMAL BRIDGE: an element-based thermal transmittance associated with a discrete element that penetrates the building envelope. Examples of point *thermal bridges* include

a beam penetrating a wall, a column penetrating a roof or floor, and an anchor or connection used to attach an element to the building and not otherwise addressed as a *clear field thermal bridge* or *linear thermal bridge*.

Add new text as follows:

C402.2.2.1 Above-Grade Wall Thermal Bridges

Individual *point thermal bridges* and *linear thermal bridges* shall comply with equation C402.2.2.1

Exceptions:

1. Service penetrations, including mechanical, electrical, plumbing, telecommunications, and fire services that pass thru the *opaque building envelope*.
2. Insulated roof curbs and blocking.
3. *Clear field thermal bridges*
4. Individual *Point thermal bridges* that are less than the allowances in Table C402.2.2.

Add new table as follows:

Table C402.2.2.1 Allowable *point thermal bridge* cross sectional area

Allowable Area per *point thermal bridge* In^2 (mm^2)	**Common material name**
3 (1935)	Carbon Steel
9 (5800)	Stainless Steel
65 (41935)	Concrete and Masonry

Add equation as follows:

347 Btu · in./(ft^2·hr·°F) × 0.003% · *above grade* area of the *building envelope* ≥ (k_1 × A_1) + (k_2 × A_2) + (k_3 × A_3)… **(Equation C402.2.2)** I-P

50 W/(m·K) × 0.003% · *above grade* area of the *building envelope* ≥ (k_1 × A_1) + (k_2 × A_2) + (k_3 × A_3)… **(Equation C402.2.2)** S-I

where:

k_1, k_2 , k_3 … = the thermal conductivity of material 1, material 2, material 3, etc… expressed in Btu · in./(ft^2·hr·°F) (W/(m·K)) for point thermal bridge material 1, material 2, material 3, etc…(e.g. concrete, carbon steel, stainless steel, wood)

A_1, A_2, A_3,… = the total cross sectional area of *point thermal bridges* and *linear thermal bridges* of material 1, material 2, material 3, etc….expressed in ft^2 (m^2)

Revise table as follows:

Table C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION	TITLE
Envelope	
C402.5	Air Leakage-thermal envelope
C402.2.2	Thermal Bridging

Thermal bridges are created when a relatively high thermally conductive material "bridges" through the insulating materials in the thermal envelope. Whether they penetrate all the way from the exterior to the interior of the building or only partially through the thermal envelope, thermal bridges make it easier for heat to travel in or out of the building. The impact of thermal bridges has a greater energy impact than a simple weighted U-factor calculation would suggest. Weighted U-factor calculations assume that heat travels in parallel paths through an assembly. In reality, heat also moves laterally, resulting in additional heat transmission through the assembly. This proposal provides a common definition for the three most common types of thermal bridges, requires design teams to document them in their construction documents and mitigate certain thermal bridges that exceed a size threshold.

Dedicated Outdoor Air Systems (DOAS)

Revise text as follows:

C403.3 ~~Heating and cooling equipment efficiencies~~ Equipment selection. Heating and cooling equipment installed in mechanical systems shall be sized in accordance with Section C403.3.1 and shall be not less efficient in the use of energy than as specified in Section C403.3.2.

Add new text as follows:

C403.3.5 Dedicated outdoor air systems (DOAS). Outdoor air shall be provided to each occupied space by a dedicated outdoor air system (DOAS) which delivers 100 percent outdoor air without requiring operation of the heating and cooling system fans for ventilation air delivery, as required by Table C403.3.5. For DOAS having a total fan system motor nameplate hp less than 5 hp, total combined fan power shall not exceed 1 W/cfm of outdoor air. Total fan power limits of Section C403.8.1 shall apply to each outdoor air unit of the DOAS and shall not include the fan power associated with the zonal heating and cooling equipment.

Exceptions:

1. Use groups listed as exempted in Table C403.3.5
2. Occupied spaces that are solely ventilated by a natural ventilation system in accordance with Section 402 of the International Mechanical Code;
3. Buildings where the cooling and heating equipment exceeds the minimum efficiency requirements listed in the tables in Section C403.3.2 by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the rating requirement, including IEER, SEER and IPLV as applicable. This exception shall not be used as a substitution for the more efficient HVAC equipment credit option per C406.2.
4. Buildings with underfloor air systems

TABLE C403.3.5

Occupancy Classifications Requiring DOAS

OCCUPANCY CLASSIFICATIONS	COVERED USE GROUPS	EXEMPTED USE GROUPS
A-1	All occupancies	Television and radio studios
A-2	Casinos (gaming area)	All other use groups
A-3	Lecture halls, community halls, exhibition halls, gymnasiums, courtrooms, libraries, places of religious worship	All other use groups

A-4, A-5		All use groups
B	All use groups not specifically exempted	Food processing establishments including commercial kitchens, restaurants, cafeterias; laboratories for testing and research; data processing facilities and telephone exchanges; air traffic control towers; animal hospitals, kennels, pounds; ambulatory care facilities.
F, H, I, R, S, U		All use groups
E, M	All use groups	

C403.3.5.1 Heating/cooling system fan controls. Heating and cooling equipment fans, heating and cooling circulation pumps, and terminal unit fans shall cycle off and terminal unit primary cooling air shall be shut off when there is no call for heating or cooling in the zone.

Exception:

Fans used for heating and cooling using less than 0.12 watts per cfm may operate when space temperatures are within the set point dead band to provide destratification and air mixing in the space.

C403.3.5.2 Decoupled DOAS supply air. The DOAS supply air shall be delivered directly to the occupied space or downstream of the terminal heating and/or cooling units.

Exceptions:

1. Active chilled beam systems.
2. Sensible only cooling terminal units with pressure independent variable airflow regulating devices limiting the DOAS supply air to the greater of latent load or minimum ventilation requirements.
3. Terminal heating and/or cooling units that comply with the low fan power allowance requirements in the exception of Section C403.3.5.1.

Revise text as follows:

C403.7.4 Energy recovery systems. Energy recovery ventilation systems shall be provided as specified in Section C403.7.4.3 and either Section C403.7.4.1 or C403.7.4.2, as applicable.

Add new text as follows:

C403.7.4.3 Spaces with Dedicated Outdoor Air Systems (DOAS). Dedicated outdoor air systems (DOAS) shall include energy recovery ventilation in call cases and shall be in accordance with either Section C403.7.4.1 or C403.7.4.2, as applicable.

Exceptions: Systems installed for the sole purpose of providing makeup air for systems exhausting toxic, flammable, paint, or corrosive fumes or dust, dryer exhaust, or commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Revise text as follows:

C406.1 Additional energy efficiency credit requirements. New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406. Where a building contains multiple-use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

5. Where not required by Section C403.3.5, the p~~P~~rovision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.

The majority of commercial HVAC systems are based around a central air handling delivery system. This system typically provides heating, cooling and ventilation air from a single source. Since cooling is typically the largest instantaneous load, the fans must be sized large enough to deliver enough air to meet the peak cooling requirements. When the ventilation is integrated, these large fans must operate during all occupied hours to deliver ventilation effectively to the space. This leads to very high fan energy use. Through the use of a Dedicated Outdoor Air System (DOAS) ventilation can be separated from the heating and cooling delivery and the large heating/cooling fans can be shut off unless there is a call for heating or cooling and the much smaller ventilation-only fans can operate to deliver fresh air to the space. Furthermore, when the DOAS is combined with a Recovery Ventilation (ERV) the heating energy requirements associated with tempering the ventilation air are significantly reduced or eliminated.

Horticultural Dehumidification

Add new definitions as follows:

DESSICANT DEHUMIDIFICATION SYSTEM. A mechanical dehumidification technology that uses a solid or liquid material to remove moisture from the air.

INTEGRATED HVAC SYSTEM. An HVAC system designed to handle both sensible and latent heat removal. Integrated HVAC systems may include, but are not limited to HVAC systems with a sensible heat ratio of 0.65 or less and the capability of providing cooling, dedicated outdoor air systems, single package air conditioners with at least one refrigerant circuit providing hot gas reheat, and *dehumidifiers* modified to allow external heat rejection.

DEHUMIDIFIER. A self-contained, electrically operated, and mechanically encased product with the sole purpose of dehumidifying the space consisting of 1) a refrigerated surface (evaporator) that condenses moisture from the atmosphere, 2) a refrigerating system, including an electric motor, 3) an air-circulating fan, and 4) a means for collecting or disposing of the condensate. A dehumidifier does not include a portable air conditioner, room air conditioner, or packaged terminal air conditioner.

Add new text as follows:

C403.15 Dehumidification in spaces for plant growth and maintenance. Equipment that dehumidifies building spaces used for plant growth and maintenance shall comply with one of the following:

1. *Dehumidifiers* regulated under federal law in accordance with DOE 10 CFR 430 and tested in accordance with the test procedure listed in DOE 10 CFR 430 and DOE 10 CFR 430, Subpart B, Appendix X or X1 as applicable.
2. *Integrated HVAC system* with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat;
3. Chilled water system with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat; or
4. Solid or liquid *desiccant dehumidification system* for system designs that require dewpoint of 50°F or less.

Revise standard as follows:

DOE	US Department of Energy c/o Superintendent of Documents 1000 Independence Avenue SW Washington, DC 20585

Standard reference number	Title	Referenced in code section number
10 CFR, Part 430—2015	Energy Conservation Program for Consumer Products: Test Procedures and Certification and Enforcement Requirement for Plumbing Products; and Certification and Enforcement Requirements for Residential Appliances; Final Rule.	Table C403.3.2(1), Table C403.3.2(2), Table C403.3.2(5), Table C403.3.2(6), Table C403.3.2(14), Table C404.2, C403.15

Indoor agriculture energy usage is projected to grow significantly nationwide in this decade, driven in large part by state legalization of medical and recreational marijuana across the country. In 2017, a total of 20 million square feet of building space was dedicated to growing crops indoors. Energy use by HVAC systems in indoor horticulture facilities can account for 30 to 65% of energy use - primarily because these systems must maintain specific humidity and temperature levels to promote plant growth. Section 403 already requires HVAC systems meet a certain efficiency threshold but does not address the efficiency of dehumidification systems. The proposed language provides projects with a range of efficient dehumidification strategies. Indoor grow facilities can install dehumidifiers that meet federal minimum efficiency requirements. The proposal also provides options for solid or liquid desiccant dehumidification systems, for utilizing recovered energy in integrated HVAC systems, and for chilled water systems that can meet dehumidification reheat needs.

Horticultural Lighting

Revise definition as follows:

GREENHOUSE. A structure or a thermally isolated area of a building that maintains a specialized sunlit environment with a skylight roof ratio of 50% or more above the growing area exclusively used for, and essential to, the cultivation, protection or maintenance of plants. *Greenhouses* are those that are erected for a period of 180 days or more.

Add new definition as follows:

HORTICULTURAL LIGHTING. Electric lighting used for horticultural production, cultivation or maintenance.

PHOTOSYNTHETIC PHOTON EFFICACY (PPE). Photosynthetic photon flux emitted by a light source divided by its electrical input power in units of micromoles per second per watt, or micromoles per joule (µmol/J) between 400-700nm as defined by ANSI/ASABE S640.

Revise text as follows:

C405.4 ~~Lighting for plant growth and maintenance~~Horticultural Lighting. ~~Not less than 95 percent of the~~ pPermanently installed luminaires used ~~for plant growth and maintenance~~ shall have a ~~photon efficiency~~ *photosynthetic photon efficacy* of not less than 1.7 µmol/J for *horticultural lighting* in *greenhouses* and not less than ~~1.6~~ 1.9 µmol/J for all other *horticultural lighting*. Luminaires for *horticultural lighting* in *greenhouses* shall be controlled by a device that automatically turns off the luminaire when sufficient daylight is available. Luminaires for *horticultural lighting* shall be controlled by a device that automatically turns off the luminaire at specific programmed times.

Indoor agriculture energy usage is projected to grow substantially nationwide over the next several years, driven in large part (but not entirely) by the legalization of medical and recreational marijuana across the country. A total of 46 million square feet of grow area in the U.S. is lit by electric horticultural lighting, 58% of which was in supplemental greenhouses, 41% in non-stacked indoor farms, and 1% in vertical farms. Lighting in greenhouses operate on average 2,120 hours per year or 6 hours per day and lighting in non-stacked indoor operations were on 5,475 hours per year or 15 hours per day. Because of these long operating hours, lighting can account for 50 to 80% of a facilities energy use in indoor operations and 30% of energy use in greenhouses. Because sales of both recreational and medical marijuana are becoming legal across the country, it is critical to ensure these facilities are as efficient as possible.

Energy Monitoring

Revise text as follows:

C405.12 Energy monitoring. ~~New b~~Buildings ~~with a gross *conditioned floor area* of 25,000 square feet or larger~~ shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5.

Exceptions:

1. Buildings less than 10,000 square feet (929 m^2).
2. Existing buildings.
3. R-2 occupancies with less than 10,000 square feet (929 m^2) of common area
4. ~~i~~Individual tenant spaces ~~are not required to comply with this section provided that the space has its own utility services and meters and has~~ less than 5,000 square feet (464.5m^2) ~~of *conditioned floor area*.~~ with their own utility service and meter.

There are currently over 40 benchmarking regulations across the US (38 local jurisdictions and four states) – with size thresholds as low as 10,000 sf. These regulations require the reporting of energy use and are being used as a steppingstone toward regulation of building performance – either through audit and retro-commissioning requirements or building performance standards. Ensuring that buildings are equipped to comply with these policies is a critical function of the code.

Energy Monitoring for EVs

Add new definitions as follows:

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles.

Revise table as follows:

TABLE C405.12.2 ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers, and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	Any single load that is not included in HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment, and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads.
Building operations and other miscellaneous	The remaining loads not included in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

Commissioning

Revise text as follows:

C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements. [no change in text]

Exceptions: The following systems are exempt:

1. Buildings with less than 10,000 square feet and ~~Mechanical systems and service water heating systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h cooling capacity and 600,000 Btu/h~~ combined heating, cooling, and service water heating ~~and space heating~~ capacity of less than 960,000 Btu/h.

[remaining exceptions are unchanged…]

Changes to exception will expand the applicability of commissioning requirements in commercial buildings. This approach is based off the combined heating, cooling and hot water heating capacity from 90.1-2019, and further informed by the prevalence of city and state benchmarking, retro-commissioning and BPS policies that continue to target 10,000 square feet as a cut off for determining compliance. By ensuring that buildings of this size have completed commissioning at construction, owners and facility managers are better equipped to operate the building as intended and meet continuing performance requirements.

Multifamily Alignment

Add definition as follows:

> **CURTAIN WALL.** An external non-bearing wall intended to separate the exterior nonconditioned and interior conditioned spaces consisting of any combination of framing materials, fixed glazing, opaque glazing, operable windows, or other in-fill materials.

Revise text as follows:

> **C402.4.3 Maximum U-factor and SHGC.** [no change to base text]
>
> **Exception:** Curtain wall fenestration and fenestration products certified to meet the North American Fenestration Standard/Specification for an Architectural Window (AW) in Group R occupancies shall be permitted to use the U-factors for All Other.

Revise text as follows:

> **C405.1.1 Lighting for dwelling units.** ~~No less than 90 percent of the p~~ Permanently installed lighting serving *dwelling units*, excluding kitchen appliance lighting, shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W~~, or shall comply with Sections C405.2.4 and C405.3~~.
>
> **Exception:** Lighting that complies with C405.2.4 and C405.3.

This combination of proposals seeks to align the requirements of multifamily dwelling units across the two sides of the code. Currently there are large discrepancies in terms of system design, control and stringency between a 3-story MF building and a 4-story MF building. This leads to market confusion, enforcement inconsistencies, and large potential untapped energy savings. This revision and its companion seek to close these gaps and create a common set of requirements for multifamily buildings.

Revise table as follows:

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Vertical fenestration																
***U*-factor**																
	All other	**Group R**	**All other**	**Group R**	**All other**	**Group R**	**All other**	**Group R**	**All other**	**Group R**	**All other**	**Group R**	**All other**	**Group R**	**All other**	**Group R**
Fixed fenestration	0.50	0.4	0.45	0.3	0.42	0.27	0.36	0.25	0.36	0.25	0.34	0.25	0.29	0.25	0.26	0.25
Operable fenestration	0.62	0.4	0.60	0.3	0.54	0.27	0.45	0.25	0.45	0.25	0.42	0.25	0.36	0.25	0.32	0.25
Entrance doors	0.83		0.77		0.68		0.63		0.63		0.63		0.63		0.63	
SHGC																
	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable
PF < 0.2	0.23	0.21	0.25	0.23	0.25	0.23	0.36	0.33	0.38	0.33	0.38	0.34	0.40	0.36	0.40	0.36
0.2 ≤ PF < 0.5	0.28	0.25	0.30	0.28	0.30	0.28	0.43	0.40	0.46	0.40	0.46	0.41	0.48	0.43	0.48	0.43
PF ≥ 0.5	0.37	0.34	0.40	0.37	0.40	0.37	0.58	0.53	0.61	0.53	0.61	0.54	0.64	0.58	0.64	0.58
Skylights																
U-factor	0.70		0.65		0.55		0.50		0.50		0.50		0.44		0.41	
SHGC	0.30		0.30		0.30		0.40		0.40		0.40		NR		NR	

Electrification

Commercial Decarbonization

Add new definitions as follows:

ALL-ELECTRIC BUILDING. A *building* that contains no *combustion equipment*, or plumbing for *combustion equipment*, installed within the *building*, or *building site*.

APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

COMBUSTION EQUIPMENT. Any *equipment* or *appliance* used for space heating, *service water heating*, cooking, clothes drying, or lighting that uses *fuel gas* or *fuel oil*.

COMMERCIAL COOKING APPLIANCE. Appliances used in a commercial food service establishment for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a local exhaust ventilation system. Such appliances include deep fat fryers, upright broilers, griddles, broilers, steam-jacketed kettles, hot-top ranges, under-fired broilers (charbroilers), ovens, barbecues, rotisseries, and similar appliances. For the purpose of this definition, a food service establishment shall include any building or a portion thereof used for the preparation and serving of food.

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Revise text as follows:

C401.2 Application. Commercial buildings shall be *all-electric buildings* and shall comply with Section C401.2.1 or C401.2.2.

Revise text as follows:

C404.9.1 Heaters. The electric power to all heaters shall be controlled by an on-off switch that is an integral part of the heater, mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater in a location with ready access. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be ~~equipped with continuously burning ignition pilots~~ permitted.

Revise text as follows:

C405.4.3 Gas lighting. Gas-fired lighting appliances shall not be ~~equipped with continuously burning pilot ignition systems~~ permitted.

Revise tables as follows:

Table C406.1(1) Additional Energy Efficiency Credits for Group B Occupants

Climate Zone:	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
~~C406.7.3: Efficient fossil fuel water heater~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~

Table C406.1(2) Additional Energy Efficiency Credits for Group R and I Occupancies

Climate Zone:	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
~~C406.7.3: Efficient fossil fuel water heater~~	~~5~~	~~5~~	~~6~~	~~6~~	~~8~~	~~7~~	~~8~~	~~8~~	~~8~~	~~9~~	~~9~~	~~9~~	~~10~~	~~10~~	~~9~~	~~10~~	~~11~~

Table C406.1(3) Additional Energy Efficiency Credits for Group E Occupancies

Climate Zone:	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
~~C406.7.3: Efficient fossil fuel water heater~~	~~NA~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~2~~	~~2~~	~~3~~	~~2~~	~~3~~	~~2~~	~~3~~	~~3~~	~~3~~	~~5~~

Table C406.1(4) Additional Energy Efficiency Credits for Group M Occupancies

Climate Zone:	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
~~C406.7.3: Efficient fossil fuel water heater~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~

Table C406.1(5) Additional Energy Efficiency Credits for Other* Occupancies

Climate Zone:	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
~~C406.7.3: Efficient fossil fuel water heater~~	~~5~~	~~5~~	~~6~~	~~6~~	~~8~~	~~7~~	~~8~~	~~8~~	~~8~~	~~9~~	~~9~~	~~9~~	~~10~~	~~10~~	~~9~~	~~10~~	~~11~~

Delete section without substitution:

> ~~**C406.7.3 Efficient fossil fuel water heater.** The combined input-capacity-weighted-average equipment rating of all fossil fuel water-heating equipment in the building shall be not less than 95 percent Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with Section C404.2.1.~~

In order to meet President Biden's 2050 goal of reducing greenhouse gas emissions in half by 2030 and achieving net zero carbon emissions by 2050, the United States must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. In 2020, combustion equipment in commercial and residential buildings accounted for 36% of the United States energy-related greenhouse gas emissions. To meet President Biden's goal, it is crucial that new buildings built today are all-electric so that emissions from these buildings are not "locked-in" by gas-dependent building infrastructure.

Requiring all-electric construction as described above will result in new construction that is less expensive to construct than a building constructed with gas appliances and in the long term will result in fewer retrofit costs for building owners to meet future policy goals to eliminate all carbon emissions in the U.S. by 2050.

Renewable Energy

Biomass Definition

Delete definition as follows:

~~**BIOMASS.** Nonfossilized and biodegradable organic material originating from plants, animals and/or microorganisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the nonfossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of nonfossilized and biodegradable.~~

Add new definition as follows:

BIOMASS WASTE. Organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and biogases; but excludes wood and wood-derived fuels (including black liquor), biofuel, feedstock, biodiesel, and fuel ethanol.

Revise definition as follows:

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, ~~landfill gas, biogas,~~ biomass waste or extracted from hot fluid or steam heated within the earth.

The existing definition for biomass in the IECC dates to the 2012 IECC. It was proposed by the team of New Buildings Institute, US Department of Energy and American Institute of Architects. It was one clause in a comprehensive overhaul of the 2009 IECC. When it was written in 2010, it was the first time that renewable energy had been defined in an I-code, and it reflected a very early understanding of a much less mature industry. It has not been significantly revised since.

This proposal updates the language by further refining biomass energy sources with terms that were not available at the time it was drafted in 2010. The revision also limits the biomass sources that count as renewable energy resources to those that are specified as waste products. There are many flavors of biomass energy, but this proposal ensures that virgin material of unknown origin does not count as a renewable energy resource, which in the provisions of C406 is a trade-off for energy efficiency features of the building. Without an available standard to cite in the IECC for sustainable biomass, it is critical to ensure that biomass used in compliance with the IECC is derived from waste products or byproducts. The definition of biomass waste is from the glossary of the Energy Information Administration. A similar amendment has been submitted to amend the residential IECC to ensure the definition of renewable energy resources is consistent between the two codes.

Mandatory On-site Renewable Energy

Revise as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documented are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment herein governed. Details shall include the following as applicable:

14. Location of pathways for routing of raceways or cable from the on-site renewable energy system to the electrical service panel.

Revise definition as follows:

RENEWABLE ENERGY CERTIFICATE (REC): A market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with *renewable energy resources*; also known as "energy attribute" and "energy attribute certificate" (EAC).

Add new definitions as follows:

COMMUNITY RENEWABLE ENERGY FACILITY. A facility that produces energy harvested from *renewable energy resources* and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

FINANCIAL RENEWAWABLE ENERGY POWER PURHASE AGREEMENT. A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT. A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

Revise text as follows:

C405.1 General. Lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption and generation shall comply with this section. Sleeping units shall comply with Section C405.2.4 and C405.1.1 or C405.3. General lighting shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with C405.2.4.

Add new text as follows:

C405.13 Renewable energy systems. Each *building site* shall have equipment for on-site renewable energy with a rated capacity of not less than 1.5 W/ft² (16.1 W/m²) multiplied by the sum of the gross conditioned floor area of the three largest floors.

Exception: Where the *building site* cannot meet the requirement, either in part or in full, with an o*n-site renewable energy system*, the *building site* shall procure and be credited for an amount of renewable energy not less than otherwise required by this section with one or more of the following:

1. A *physical renewable energy power purchase agreement.*
2. A *financial renewable energy power purchase agreement.*
3. A *community renewable energy facility.*

The renewable energy shall be delivered or credited to the *building site* under an energy contract with a duration of not less than 15 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.

C405.13.1 Additional efficiency package options. The PV capacity required in this section shall not be used for compliance with the on-site renewable energy option of Section C406.5.

C405.13.2 Total building performance. Where the total building performance of Section C407 is used for compliance, the PV capacity required in this section shall be the same in the *standard reference design* and the *proposed design.*

C405.13.3 Renewable energy certificate documentation. The property owner or owner's authorized agent shall demonstrate that any RECs or EACs associated with on-site and off-site renewable energy comply with the following:

1. Are retained and retired by or on behalf of the property owner or tenant for a period of not less than 15 years;
2. Are created within a 12-month period of the use of the REC; and
3. Are from a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.

Revise text as follows:

C406.5 On-site renewable energy.

Building~~s~~ sites shall comply with C405.13.3 and with Section C406.5.1 or C406.5.2.

Revise text as follows:

CC103.3.2 Requirements for all procurement methods.

The following requirements shall apply to all off-site renewable energy procurement methods:

1. RECS and other environmental attributes associated with the procured off-site renewable energy shall ~~be assigned to the building project for the duration of the contract~~ comply with Section C405.13.3.

This code proposal change is based on approved ASHRAE addenda by, ck, and cp to Standard 90.1-2019 which will be published in ASHRAE Standard 90.1-2022 and a recent technical brief developed by PNNL in support of further revisions to 90.1. Proposed definitions clarify renewable energy requirements for community renewable energy facility, financial renewable power purchase agreement, physical power purchase agreement and renewable energy credits. The proposal more closely aligns these definitions with language under consideration both in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance, and in ASHRAE Standard 189.1, which will be the basis of the 2024 IgCC.

Aligning Renewables Definitions for Appendix CC

SECTION CC102

DEFINITIONS

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY. A facility that produces energy from *renewable energy systems* and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

FINANCIAL RENEWAWABLE ENERGY POWER PURHASE AGREEMENT. A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."

Revise definition as follows:

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system ~~not~~ located ~~on the building project~~ outside of the site boundary.

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system~~s~~ on the ~~building project~~ *building site*.

Add new definition as follows:

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT. A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

RENEWABLE ENERGY CERTIFICATE (REC). A-market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with *renewable energy systems*; also known as an energy attribute and energy attribute certificate (EAC).

Revise Section as follows:

CC103.3.1 Qualifying off-site procurement methods. The following are considered qualifying off-site renewable energy procurement methods:

1. *Community renewable energy facility*~~Community renewables: an off-site renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers~~.

2. *Renewable energy investment fund:* an entity that installs renewable energy capacity on behalf of the owner.

3. *Financial renewable energy power purchase agreement*~~Virtual power purchase agreement: a power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output at a fixed price schedule.~~

4. Direct ownership: an *off-site renewable energy system* owned by the building project owner.

5. Direct access to wholesale market: an agreement by ~~between~~ the owner ~~and a renewable energy developer~~ to purchase renewable energy from the wholesale market.

6. Green retail tariffs: a program by the retail electricity provider to provide 100-percent renewable energy to the owner.

7. Unbundled *Renewable Energy Certificates (RECs)*~~Renewable Energy Certificates (RECs): certificates purchased by the owner representing the environmental benefits of renewable energy generation that are sold separately from the electric power.~~

8. *Physical renewable energy power purchase agreement*

Revise Table as follows:

TABLE CC103.3.3 DEFAULT OFF-SITE RENEWABLE ENERGY PROCUREMENT METHODS, CLASSES AND COEFFICIENTS

CLASS	PROCUREMENT FACTOR (PF)	PROCUREMENT OPTIONS	ADDITIONAL REQUIREMENTS (see also Section CC103.3.2)
1	0.75	~~Community solar~~ *Community renewable energy facility*	-
		REIFs	Entity must be managed to prevent fraud or misuse of funds
		~~*Virtual PPA*~~ *Financial PPA or Physical PPA*	-
		Self-owned off-site	Provisions shall prevent the generation from being sold separately from the building
3	0.55	Green retail tariffs	The offering shall not include the purchase of unbundled RECS

		Direct access	The offering shall not include the purchase of unbundled RECS
3	0.20	Unbundled RECS	The vintage of the RECS shall align with building energy use.

This proposal clarifies renewable energy terminology and requirements by removing the definition of terms out of the body of the appendix in CC103.3.1 and moving those terms and their definitions to Section CC102. The proposed definitions clarifies and aligns off-site renewable energy requirements with other codes by aligning community renewable energy facility, financial renewable power purchase agreement, off-site and on-site renewable energy systems, physical power purchase agreement and renewable energy credits with language under consideration both in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance, and in ASHRAE Standard 189.1, which will be the basis of the 2024 IgCC. The proposed definition for renewable energy investment fund is unchanged from the original definition in the Appendix.

Grid Integration

Grid Integrated Thermostats

Add new definition as follows:

> **GRID-INTEGRATED CONTROL.** An automatic control that can receive, automatically respond to demand response requests from and send information back to a utility, electrical system operator, or third-party demand response program provider.

Add new text as follows:

> **C403.4.1.6 Grid-integrated controls.** All thermostatic controls shall be provided with *grid-integrated controls* capable of the following:
>
> 1. *Automatically increasing the zone operating cooling set point by a minimum of* 4°F (2.2°C)
> 2. *Automatically decreasing the zone operating heating set point by a minimum of* 4°F (2.2°C)
> 3. *Automatically decreasing the zone operating cooling set point by a minimum of* 2°F (1.1°C)
> 4. Automatically increasing the zone operation heating set point by a minimum of 2°F (1.1°C)
> 5. *Both ramp-up and ramp-down logic to prevent the building peak demand from exceeding that expected without the DR implementation.*
>
> The thermostatic controls shall be capable of performing all other functions provided by the control when the *grid-integrated controls* are not available. Systems with direct digital control of individual zones reporting to a central control panel shall be capable of remotely complying.
>
> **Exception:** Health care and assisted living facilities.

Grid-integrated controls for thermostats are added based on language from California Title 24 and ASHRAE Standard 189.1. The controls allow for dialing back heating and cooling, as well as to accept additional heating or cooling when renewable energy generation is high or energy prices are low, and both ramp up and down requirements in relationship to the utility/grid operator/third party aggregator signal to prevent rebound issues on the grid after the signal is released. DR programs continue to rely deeply on thermostat control strategies, but the need for such controls is fast growing. As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend.

Grid Integrated Water Heating

Add new definition as follows:

GRID-INTEGRATED CONTROL. An automatic control that can receive, automatically respond to demand response requests from and send information back to a utility, electrical system operator, or third-party demand response program provider.

Add new text as follows:

C404.11 Grid-integrated water heating. Electric storage water heaters with a storage tank capacity between 37 and 120 gallons shall be provided with *grid-integrated controls* that comply with ANSI/CTA-2045-B Level 2.

Exceptions:

1. Water heaters that provide a hot water delivery temperature of 180°F (82°C) or greater
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code
3. Water heaters that use 3-phase electric power

Add new standard as follows:

CTA

Consumer Technology Association
1919 S. Eads Street
Arlington, VA 22202

Standard reference number	Title	Referenced in code section number
ANSI/CTA-2045-B	Modular Communications Interface for Energy Management	. . . . . C404.11

With increasing penetrations of intermittent renewable energy, volatile wholesale power prices, and subsequent growth in dynamic rates/demand response programs, grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services.

As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend. Water heaters offer an unparalleled opportunity for load shifting: tanks full of hot water are inherently energy storage devices. Including the controls necessary to take advantage of this opportunity is relatively simple and affordable in new construction. Compared to other energy storage technologies such as batteries, smart, grid-integrated water heater controls can deliver substantial dispatchable (that is, reliable to the grid operator) energy flexibility. The controls specified by ANSI/CTA-2045-B ensure negligible risk of occupant disruption (that is, the hot water will

not run out). Water heaters provide a particularly attractive option as they have inherent thermal storage that allows energy consumption to be shifted with little to no impact to the end user. This capability has been demonstrated in several contexts, most recently through regional demonstrations conducted by EPRI and BPA.

Electric Vehicles

Add new definitions as follows:

AUTOMOBILE PARKING SPACE (APS). A space within a building or public parking lot, exclusive of driveways, ramps, columns, office and work areas, for the parking of an automobile.

AUTOMATIC LOAD MANAGEMENT SYSTEM (ALMS). A system designed to manage load across one or more electric vehicle supply equipment (*EVSE*) to share electrical capacity and/or automatically manage power at each connection point.

ELECTRIC VEHICLE (EV). An automobile for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles for this code.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the *electric vehicle* connectors, attachment plugs, personnel protection system, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.

EV CAPABLE SPACE. An *automobile parking space* that is provided with infrastructure, such as, but not limited to, raceways, cables, electrical capacity, and panel space, necessary for the future installation of an *EVSE*,

EV READY SPACE. An *automobile parking space* that is provided with an electrical circuit that will support an installed *EVSE*.

ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED (EVSE) SPACE. An *automobile parking space* that is provided with a dedicated *EVSE*.

Add new sections as follows:

C405.14 Electric vehicle charging infrastructure. New parking facilities shall be provided with electric vehicle charging infrastructure in accordance with this section and Table C405.14 based on the total number of parking spaces and rounded up to the nearest whole number. *EVSE spaces*, *EV ready spaces* and *EV capable spaces* may be counted toward meeting minimum parking requirements. *EVSE spaces* may be used to meet requirements for *EV ready spaces* and *EV capable spaces. EV ready spaces* may be used to meet requirements for *EV capable spaces.* Each *EVSE space* capable of delivering not less than 150kW to an electric vehicle shall be permitted to reduce the total number of *EV spaces* required by this section by five. Where more than one

parking facility is provided on a building site, the number of parking spaces required shall be calculated separately for each parking facility.

TABLE C405.14

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE REQUIREMENTS [c]

OCCUPANCY	***EVSE SPACES***	***EV READY SPACES***	***EV CAPABLE SPACES***
Group B Occupancies	20%	NA	30%
Group M Occupancies	10%	NA	10%
R-2 Occupancy[a]	25%	NA	75%
All other Occupancies[b]	10%	NA	10%

a. Where *EV ready spaces* are provided in accordance with Section C405.14.3, the requirement for *EVSE spaces* and *EV Capable spaces* shall be permitted to be reduced to 0%.

b. Group U, H, S occupancies provided with not less than one *EVSE* space.

c. Where staff parking is designated, quantities shall be proportionally distributed between public and staff EV charging.

C405.14.1 Electric Vehicle Charging Stations and Systems. Where provided, electric vehicle charging systems shall be installed in accordance with NFPA 70. Electric vehicle charging system equipment shall be listed and labeled in accordance with UL 2202. *EVSE* shall be listed and labeled in accordance with UL 2594. Accessibility to *EVSE* shall be provided in accordance with IBC Section 1108. Electric vehicle charging infrastructure shall be in accordance with C405.14.

C405.14.2 EV Capable Spaces. *EV Capable Spaces* shall be provided with electrical infrastructure that conforms to the following requirements:

1. A raceway or cable that is continuous between a junction box or outlet located within 3 feet (914 mm) of the parking space and connected by continuous conduit to an electrical panel serving the area of the parking space
2. The raceway or cable shall be sized and rated to accommodate a minimum 40-amp, 208/240-volt branch circuit, and the raceway shall have a minimum nominal trade size of 1 inch.
3. The electrical panel shall have sufficient load capacity for the design load, or shall be managed by an approved ALMS or building load management program. Design load assumptions shall be documented on the construction documents.
4. The electrical panel to which the raceway or cable ~~conduit~~ connects shall have sufficient dedicated physical space for a 2-pole breaker.
5. The electrical junction box and the electrical panel directory entry for the dedicated space in the electrical panel shall have labels stating "For future *electric vehicle* charging."

Exception: In parking garages, the raceway or cable required for *EV capable spaces* may be omitted provided the parking garage electrical service has no less than 1.8 kVA of additional reserved capacity per *EV capable space.*

C405.14.3 EV Ready Spaces. Where permitted by Table C405.14, one *EV ready space* shall be provided per *dwelling unit.* The branch circuit serving *EV Ready Spaces* shall conform to the following requirements:

1. Conductors or cables capable of supporting a 40-amp, 208/240-volt circuit,
2. Terminates at a receptacle outlet located within 3 feet (914 mm) of the parking space,
3. A minimum load capacity of 1.8 kVA,
4. The electrical panel directory shall designate the branch circuit as "For electric vehicle charging" and the junction box or receptacle shall be labelled "For *electric vehicle* charging."

Exception: Where 100% of *automobile parking spaces* are *EV ready spaces* or *EVSE spaces.*

C405.14.4 EVSE Spaces. The *EVSE* serving *EVSE spaces* shall be rated to supply not less than 6.2 kW to an electric vehicle and shall be located within 3 feet (914 mm) of the parking space. An *EVSE* with multiple vehicle connections shall be permitted to serve multiple *EVSE spaces* provided each connection meets the requirements of this section for power delivery and location. An *ALMS* may be used to reduce the total electrical capacity required by *EVSE spaces* provided that all *EVSE spaces* are capable of simultaneously charging at a minimum rate of 1.8 kW.

C405.14.5 Electric Vehicle Charging Loads. The load calculated for Electric Vehicle Charging Loads per Table C405.12.2 Energy Use Categories may be reduced by 50% for installed EVSE equipped with the capability of programing the charging to occur during utility established off-peak hours.

The adoption rate of electric vehicles is on a steep upward climb, creating the need for electric vehicle charging now and in the near future. The cost of retrofitting parking lots with electric vehicle charging infrastructure (EVCI) is far higher than the cost of installing it as new construction or providing parking spaces with raceways and other low-cost provisions to add EVCI in the future (EV Capable). This proposal includes requirements for EV chargers for some spaces to meet current EV charging needs and requirements for EV capable spaces to provide for cost-effective EV charging retrofits in the future to meet future EV charging needs.

Energy Storage Ready

Revise text as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documented are permitted to be submitted when approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment herein governed. Details shall include the following as applicable:

14. Location of pathways for routing of raceways or cable from the renewable energy system to the electrical service panel and electrical energy storage system area.

15. Location and layout of a designated area for electrical energy storage system.

Revise text as follows:

C105.2.5 Electrical system. Inspection shall verify lighting system controls, components, and meters as required by the code, approved plans and specifications. Where an electrical energy storage system area is required, inspections shall verify space availability and pathways to electrical service.

Add new text as follows:

C405.15 Energy storage infrastructure. Each building site shall be provided with a location for on-site energy storage not less than 2 feet (610 mm) in one dimension and 4 feet (1219 mm) in another dimension and located in accordance with Section 1206.2.8 of the International Fire Code and Section 110.26 of the NFPA 70.

Exception: Where an onsite electrical energy system storage system is installed.

C405.15.1 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a two-pole circuit breaker for future electrical energy storage system installation This space shall be labeled "For Future Electric Storage." The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

Energy storage will soon become critical to achieving President Biden's goal of a carbon-free power sector by 2035. In 2020, 21% of the United States' electricity is sourced from renewable energy, primarily wind, an intermittent source of energy. As the U.S. increases the amount of electricity generated from renewables, buildings must be prepared to aid in this transition by storing energy to match grid demands. Energy storage is expected to grow by over 40% each year until 2025 and the U.S., because of its manufacturing background and experience in battery-storage technology for cars is becoming a clear leader in this market.

In 2020, DOE found that an average household in the United States goes without power for 8 hours in a year. Because of extreme weather events caused by climate change, those outages are increasing. These

outages are estimated to cost the U.S. economy between $25 billion to $70 billion annually. Requiring buildings to be storage-ready will ensure communities are more resilient by allowing buildings to cost effectively install storage which can operate for a short-period of time without relying on the electricity grid.

Grid Integrated Solar and Energy Storage Inverters

Add new text as follows:

> **C405.13 Inverters.** Direct-current-to-alternating-current inverters serving *on-site renewable energy* systems or electrical energy storage systems shall be compliant with IEEE 1547-2018a and UL 1741.

Add new reference standard as follows:

IEEE Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, 17th Floor
New York, NY 10016-5997

Standard reference number	Title	Referenced in code section number
1547-2018a	IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.	. . . . . C405.13

Add new reference standard as follows:

UL UL, LLC.
1285 Walt Whitman Road
Melville, NY 11747-3081

Standard reference number	Title	Referenced in code section number
1741	UL Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.	. . . . . C405.13

IEEE 1547-2018a governs requirements for the interconnection of distributed energy resources that operate in parallel to the electric grid. This standard (and its implementation at the device level through (UL 1741) ensure that these resources can support and potentially enhance grid stability, thereby improving reliability, reducing curtailments, stabilizing voltage, and maintaining power quality. The National Association of Regulatory Utilities Commissioners (NARUC) has already recommended that state utility commissions require implementation of IEEE1547-2018a as a part of their interconnection requirements. While the primary purpose of smart inverter functionality is grid stability, there are several additional benefits to the grid and its stakeholders. When operating in volt-VAR mode supporting reactive power, these inverters can actually provide energy savings, particularly when operating within distribution networks already operating conservation voltage reduction schemes. Additionally, smart inverters can help to increase DER hosting capacity of distribution networks, enabling greater access to renewable energy systems while maintaining safety and reliability.

Grid Optimal Credits

Add new definitions as follows:

GRID-INTEGRATED CONTROL. An automatic control that can receive, automatically respond to demand response requests from and send information back to a utility, electrical system operator, or third-party demand response program provider.

BUILDING PEAK ELECTRIC DEMAND. The annual highest whole-building electrical power demand, net of on-site renewables, measured in kW.

Add new text as follows:

C406.1 Additional energy efficiency credit requirements. [no base text change]

12. Grid Integration Controls in accordance with Section C406.13.1 or Section C406.13.2.

Revise tables as follows:

Table C406.1(1) Additional Energy Efficiency Credits for Group B Occupants

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13.1 Grid integration controls	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.13.2 Enhanced Grid integration controls	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1

Table C406.1(2) Additional Energy Efficiency Credits for Group R and I Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13.1 Grid integration controls	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
C406.13.2 Enhanced Grid integration controls	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table C406.1(3) Additional Energy Efficiency Credits for Group E Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13.1 Grid integration controls	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
C406.13.2 Enhanced Grid integration controls	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	1

Table C406.1(4) Additional Energy Efficiency Credits for Group M Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13.1 Grid integration controls	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.13.2 Enhanced Grid integration controls	1	2	2	2	2	2	2	2	2	2	1	2	1	1	2	1	1

Table C406.1(5) Additional Energy Efficiency Credits for Other* Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.13.1 Grid integration controls	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
C406.13.2 Enhanced Grid integration controls	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Revise text as follows:

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options from Tables C406.1(1) through C406.1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6, C406.7 or C406.10. Where the entire building complies using credits from Section C406.5, C406.8, ~~or~~ C406.9, or C406.13 tenant spaces shall be deemed to comply with this section.

Add new text as follows:

C406.13.1 Grid integration controls. The building shall contain *grid-integrated controls* that can automatically reduce *building peak electric demand* by an average of 10% over the single hour coincident with the *building peak electric demand*.

C406.13.2 Enhanced Grid integration controls. The building shall contain *grid-integrated controls* that can automatically reduce *building peak electric demand* by an average of 20% over the single hour coincident with the *building peak electric demand*.

Existing Buildings

Additional Efficiency Credits for Existing Buildings

Add new text as follows:

C502.2.7.1 Additional energy efficiency credits. *Additions* shall achieve a total of 10 credits in accordance with Section C506. *Alterations* to the existing building that are not part of an *addition*, but permitted with an *addition*, may be used to achieve the required credits.

Exceptions:

1. *Buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H
2. *Additions* less than 1,000 ft^2 and less than 50% of existing floor area.
3. *Additions* that do not include the addition or replacement of equipment covered in Section C403.3 or C404.2 that achieve a total of 5 credits.
4. *Additions* that do not contain *conditioned space* that achieve a total of 5 credits.
5. *Buildings* in Residential Group R and Institutional Groups I in climate zones 3C, 4B, 4C, 5C that achieve a total of 5 credits
6. Where the *addition* alone or the existing building and *addition* together comply with Section C407

Add new text as follows:

C503.7 Additional energy efficiency credits. *Alterations* shall achieve a total of 5 credits in accordance with Section C506.

Exceptions:

1. A*lterations* that require compliance with only one of: C402.1, C403.3, C404.2, or C405.3.
2. *Alterations* that are part of an *addition* complying with section C502.
3. *Alterations* that comply with Section C407.

Add new text as follows:

C506.1 General. Where required in Section C502 or C503, credits shall be achieved from Tables C406.1 (1) through C406.1 (5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables of calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.

2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Where not required by Section C405.12, include an energy monitoring system in accordance with Section C406.10.
10. Where not required by Section C403.2.3, include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.
11. Efficient kitchen equipment in accordance with Section C406.12.

Section C406 does not currently apply to additions and alterations to existing buildings. This is a significant missed opportunity, particularly in light of the emergence of Building Performance Standards. This proposal creates a new Section C506 that allows the additional efficiency credits from C406 to be applied to additions and alterations.

Acceptance Testing in Alterations

Add new text as follows:

C503.4.2 Mechanical system acceptance testing. Where an *alteration* requires compliance with Section C403 or any of its subsections, mechanical systems that serve the *alteration* shall comply with Sections C408.2.2, C408.2.3 and C408.2.5.

Exceptions:

1. Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.5 that serve individual *dwelling units* and *sleeping units*.

Add new text as follows:

C503.5.1 Service hot water system acceptance testing. Where an *alteration* requires compliance with Section C404 or any of its subsections, service hot water systems that serve the *alteration* shall comply with Sections C408.2.3 and C408.2.5.

Exceptions:

1. Service water heater systems in buildings where the total mechanical equipment capacity is less than 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units.

Add new text as follows:

C503.6.1 Lighting acceptance testing. Where an *alteration* requires compliance with Section C405 or any of its subsections, lighting systems that serve the *alteration* shall comply with Section C408.3.

The IECC does not require acceptance testing of the whole HVAC, hot water or lighting system when components of the system are replaced. Acceptance testing is even more critical in existing systems than new construction as they have had the opportunity for configurations and alterations to deviate from original installation. This proposal requires that the acceptance testing requirements of C408 that are relevant to existing buildings are applied to existing systems that undergo alteration.

HVAC Control Upgrade in Alterations

Add new text follows:

C503.3.2 Controls. New heating and cooling equipment that are part of the *alteration* shall be provided with controls that comply with Section C403.4.

Exception: Systems with direct digital control of individual zones reporting to a central control panel

The IECC only requires altered portions of heating and cooling systems to meet current code requirements. This means that new heating and cooling equipment can be installed and then controlled by old, even obsolete controls. This proposal requires that new heating and cooling equipment have controls that meet current code requirements to ensure effective and efficient operation.

Lighting Control Upgrades in Alterations

Add new text as follows:

C503.5.1 Controls. New luminaires that are part of the *alteration* shall be provided with controls that comply with Section C405.2.

Exceptions:

1. *Alterations* that replace less than 10 percent of the luminaires operated by a common lighting control device.
2. Luminaires controlled by *luminaire* level lighting controls in compliance with C405.2(2).

The IECC only requires altered portions of lighting systems to meet current code requirements. This means that new luminaires can be installed and then controlled by old, even obsolete controls. This proposal requires that luminaires have controls that meet current code requirements to ensure effective and efficient operation.

Duct Leakage Testing in Alterations

Add new text as follows:

> **C502.3.3.1 Duct Testing.** Where the extension of existing ducts into an *addition* results in an increase of total duct volume in the *building* of more than 20 percent, the ducts that serve the *addition* shall be tested in accordance with the SMACNA HVAC Air Duct Leakage Test manual. Documentation of the test results shall be provided to the *code official* and the owner.

Add new text as follows:

> **C503.3.1 Duct Testing.** Ducts and plenums that serve new heating, cooling or ventilation equipment in an *alteration* shall be tested in accordance with the SMACNA HVAC Air Duct Leakage Test manual. Documentation of the test results shall be provided to the *code official* and the owner.

The requirements for duct construction and sealing in the IECC have developed substantially over recent code cycles. This proposal requires duct testing during equipment replacement to provide information about duct performance to inform the equipment replacement and future efficiency retrofits.

System Sizing in Commercial Alterations

Add new text as follows:

> **C503.3.2 System sizing.** New heating and cooling equipment that is part of an *alteration* shall be sized in accordance with Section C403.1.1 based on the existing *building* features as modified by the *alteration.*
>
> > **Exception:** Where is has been demonstrated to the *code official* that compliance with this section would result in heating or cooling equipment that is incompatible with the rest of the heating or cooling system.

Historically, HVAC equipment has been routinely oversized, yet the sizing for many equipment replacements is based on the size of the old equipment. This oversized equipment is less efficient and less effective, resulting in higher costs and worse performance. This proposal requires that replacement equipment in alterations be based on the existing building loads as modified by any alterations that accompany the equipment replacement.

Testing of Gas Piping in Alterations

Add new definition as follows:

FUEL GAS. A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

Add new text as follows:

C502.3.3.1 Fuel gas pipe testing. Where new *fuel gas* equipment or a new *fuel gas* appliance is installed as part of an *addition*, all *fuel gas* piping that serves the equipment or appliance shall be tested and meet the requirements for leakage of Section 406 of the *International Fuel Gas Code.*

Exception: Where it has been demonstrated to the code official that the *fuel gas* piping has been tested and met the requirements of this section within the previous five years.

Add new text as follows:

C503.1.1 Fuel gas pipe testing. Where new *fuel gas* equipment or a *new fuel* gas appliance is installed as part of an *alteration*, all *fuel gas* piping that serves the equipment or appliance shall be tested and meet the requirements for leakage of Section 406 of the *International Fuel Gas Code.*

Exception: Where it has been demonstrated to the code official that the *fuel gas* piping has been tested and met the requirements of this section within the previous five years.

Gas piping degrades over time and leaks can go undetected for many reasons. In addition to the life-safety and emissions impact of leaking gas pipes, they also represent lost energy in buildings. This proposal requires that existing fuel gas piping that serves new gas equipment be tested for leakage and leaks be repaired in accordance with the International Fuel Gas Code.

IECC – Residential Provisions

Efficiency

Multifamily Alignment

Add new definitions as follows:

> **COMMON AREA.** All portions of *Group R occupancies* that are not *dwelling units* or *sleeping units*.

Revise text as follows:

> **R403.1 General.** Systems serving individual *dwelling units* shall comply with Section R403. Systems serving *common areas or* two or more *dwelling units* shall comply with Sections C403 and C404 of the International Energy Conservation Code – Commercial Provisions instead of Section R403.
>
> **R403.~~1~~2 Controls.** [no text change]
>
> … [renumber subsequent sections]

Revise text as follows:

> **R403.6.1 Heat or energy recovery ventilation.** *Dwelling units* shall be provided with a heat recovery or energy recovery ventilation system ~~in Climate Zones 7 and 8~~. The system shall be balanced with a minimum sensible heat recovery efficiency of 65 percent at 32°F at a flow greater than or equal to the design airflow.
>
> **Exceptions:**
>
> 1. Dwelling units in single and two-family buildings in Climate Zones 0-6.
> 2. Dwelling units in Group-R occupancies that comply with Section C403.7.4.1.

Delete without substitution:

> ~~**R403.8 Systems serving multiple dwelling units.** Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the International Energy Conservation Code – Commercial Provisions instead of Section R403.~~

Revise text as follows:

> **R404.2 Interior lighting controls.** Lighting serving individual *dwelling units* shall comply with Section R404.2.1. Lighting serving *common areas* shall comply with Sections C405.2 of the International Energy Conservation Code – Commercial Provisions instead of Section R404.2.1.

R404.2.1 Controls for individual dwelling units. Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupancy sensor control or other control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the following:

1. Bathrooms.

2. Hallways.

~~3. Exterior lighting fixtures.~~

3 4. Lighting designed for safety or security.

Revise text as follows:

R404.3 Exterior lighting controls. Exterior lighting controlled from within individual *dwelling units* shall comply with Section R404.3.1. Controls for all other exterior lighting shall comply with Sections C405.2.7 of the International Energy Conservation Code – Commercial Provisions instead of Section R404.3.1.

R404.3.1 Controls 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 shut-off actions.

~~**Exception:** Lighting serving multiple dwelling units.~~

[remainder of subsection unchanged…]

Add new text as follows:

R404.4 Electrical Power Systems. Group R occupancies shall comply with Sections C405.6 through C405.12.

This combination of proposals seeks to align the requirements of multifamily dwelling units across the two sides of the code. Currently there are large discrepancies in terms of system design, control and stringency between a 3-story MF building and a 4-story MF building. This leads to market confusion, enforcement inconsistencies, and large potential untapped energy savings. This revision and its companion seek to close these gaps and create a common set of requirements for multifamily buildings.

Residential Efficiency Credits

Revise text as follows:

R401.2.1 Prescriptive Compliance Option. The prescriptive compliance option requires compliance with Sections R401 through R404 and R408.

R401.2.2 Total Building Performance Option. The total building performance option requires compliance with Section R405 and one of the following:

1. Section R408 without including such measures in the proposed design under Section R405.
2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 90 percent of the annual energy cost of the standard reference design.

R401.2.3 Energy Rating Index Option. The total building performance option requires compliance with Section R406 and one of the following:

1. Section R408 without including such measures in the proposed design under Section R405.
2. The Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.

Delete without substitution:

~~**R401.2.5 Additional energy efficiency.** This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.~~

~~1. For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2~~

~~2. For buildings complying with Section R401.2.2, the building shall meet one of the following:~~

~~2.1. One of the additional efficiency package options in Section R408.2 shall be installed, without including such measures in the proposed design under Section R405; or~~

~~2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.~~

~~3. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.~~

~~The option selected for compliance shall be identified in the certificate required by Section R401.3.~~

Delete without substitution:

~~**R408.1 Scope.** This section establishes additional efficiency package options to achieve additional energy efficiency in accordance with Section R401.2.5.~~

Revise and renumber text as follows:

R408.~~2~~1 Additional energy efficiency credit requirements ~~package options~~. ~~Additional efficiency package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.~~ New buildings shall achieve a total of 10 credits from Table R408.2. Each measure chosen shall meet the relevant subsections of Section R408 and receive credit for the credits as indicated in the Table for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

[renumber remaining sections and subsections…]

Revise text as follows:

R408.2.1 Enhanced envelope performance UA options. The total *building thermal envelope* UA of the *building thermal envelope* as designed shall be one of the following and the sum of U-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the U-factors in Table R402.1.2 by the same assembly area as in the proposed building. in accordance with Section R402.1.5: The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table R402.1.2.

1. Not less than 2.5% below the total UA of the *building thermal envelope*.
2. Not less than 5% below the total UA of the *building thermal envelope*.
3. Not less than 7.5% below the total UA of the *building thermal envelope*.

R408.2.2 Improved fenestration options. Vertical fenestration shall meet one of the following:

1. 20% reduction in glazed area-weighted average SHGC.
2. Have a U-factor equal to or less than 0.22

R408.2.~~3~~2 More efficient HVAC equipment performance options. Heating and cooling equipment shall meet one of the following efficiencies:

1. Greater than or equal to ~~95 AFUE natural gas furnace and 16~~ 18 SEER and 14 EER air conditioner.
2. Greater than or equal to 10 HSPF/16 SEER air source heat pump.
3. Greater than or equal to 3.5 COP ground source heat pump.
4. Greater than or equal to 96 AFUE natural gas furnace

For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design

load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

R408.2.43 Reduced energy use in service water-heating options. The hot water system shall meet one of the following efficiencies:

1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to 2.0 2.9 UEF electric service water-heating system.
3. Greater than or equal to 0.4 solar fraction solar water-heating system.

R408.2.54 More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the *building thermal envelope*.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the *building thermal envelope*.
3. 100 percent of duct thermal distribution system located in *conditioned space* as defined by Section R403.3.2.

R408.2.65 Improved air sealing and efficient ventilation system option. The measured air leakage rate shall be one of the following:

1. lLess than or equal to 32.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed.
2. Less than equal to 1.0 ACH50, with either an ERV or HRV installed.

Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/ Moisture Transfer (LRMT).

This proposal builds on the additional efficiency options in the 2021 IECC by converting those package options into a points-based system similar to the "Additional Efficiency Credits" system in C406 of the commercial section of the energy code. The purpose of this code change proposal is to improve overall residential building efficiency (heating, cooling and water heating energy) by roughly 10% and to create a scalable, flexible means of improving residential building efficiency for future IECC updates. Instead of requiring efficiency improvements to specific building components, the new "credits" approach in Section R408 provides a multitude of options for builders to achieve the efficiency requirements of the IECC.

Add new table as follows:

TABLE R408.2

CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		CZ 0 & 1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
R408.2.1 (1)	≥ 2.5% reduction in total UA	1	1	2	2	2	2	3	4	4
R408.2.1 (2)	≥ 5% reduction in total UA	3	3	3	3	3	4	5	5	5
R408.2.1 (3)	> 7.5% reduction in total UA	5	5	5	5	5	6	7	8	8
R408.2.2 (1)	20% reduction SHGC	4	1	NA	NA	NA	NA	NA	NA	NA
R408.2.2 (2)	0.22 U-factor windows	NA	NA	2	2	2	2	2	3	3
R408.2.3 (1)	High performance cooling system	9	7	3	2	NA	NA	NA	NA	NA
R408.2.3 (2)	High performance gas furnace	NA	2	6	9	10	10	11	12	14
R408.2.3 (3)	High performance heat pump system	NA	NA	3	4	4	5	4	3	3
R408.2.3 (4)	Ground source heat pump	NA	2	4	6	6	8	7	6	5
R408.2.4 (1)	Fossil fuel service water heating system	7	5	4	3	2	2	2	1	1
R408.2.4 (2)	High performance heat pump water heating system	5	5	5	5	5	5	5	5	5
R408.2.4 (3)	Solar hot water heating system	8	9	9	7	9	6	5	4	3
R408.2.5 (1)	More efficient distribution system	8	8	9	11	8	12	15	17	17
R408.2.5 (2)	100% of ducts in conditioned space	8	8	9	11	8	12	15	17	17
R408.2.6 (1)	2 ACH50 air leakage rate with ERV or HRV installed	2	5	NA	NA	NA	NA	NA	NA	NA
R408.2.6 (2)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	7	9	9	9	10	11	11

Electrification

Residential Decarbonization

Add new definitions as follows:

ALL-ELECTRIC BUILDING. A *building* that contains no *combustion equipment*, or plumbing for *combustion equipment*, installed within the *building*, or *building site*.

APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

COMBUSTION EQUIPMENT. Any *equipment* or *appliance* used for space heating, *service water heating*, cooking, clothes drying, or lighting that uses *fuel gas* or *fuel oil*.

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Revise text as follows:

R401.2 Application. Residential buildings shall be *all-electric buildings* and shall comply with Section R401.2.~~5~~4 and either Sections R401.2.1, R401.2.2, or R401.2.3 ~~or R401.2.4~~.

Revise text as follows:

R401.3 Certificate. A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certification shall indicate the following:

4. The types, sizes, and efficiencies of heating, cooling and service water heating equipment. Where a ~~gas-fired unvented room heater,~~ electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate ~~"gas-fired unvented room heater,"~~ "electric 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.

Delete section without substitution:

~~**R402.4.4 Rooms containing fuel burning appliances.**~~

Revise text as follows:

R404.1.1 Fuel gas lighting equipment. Fuel gas lighting systems shall not ~~have continuously burning pilot lights~~ be installed.

Revise text as follows:

R408.2.2 More efficient HVAC equipment. Heating and cooling *equipment* shall meet one of the following efficiencies:

~~1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.~~

~~2~~1. Greater than or equal to 10 HSPF/16 SEER air source heat pump.

~~3~~2. Greater than or equal to 3.5 COP ground source heat pump.

Revise text as follows:

R408.2.3 Reduced energy use in service water-heating option. The hot water system shall meet one of the following efficiencies:

~~1. Greater than or equal to 82 EF fossil fuel service water-heating system.~~

~~2~~1. Greater than or equal to 2.0 EF electric service water-heating system.

~~3~~2. Greater than or equal to 0.4 solar fraction solar water-heating system.

In order to reduce greenhouse gas emissions by half by 2030 and achieve net zero carbon emissions by 2050, the United States must not only reduce energy use through energy efficiency and move to renewable energy, but also transition away from using combustion equipment in buildings that run on fossil fuels. In 2020, combustion equipment in commercial and residential buildings accounted for 36% of the United States energy-related greenhouse gas emissions. To meet our climate goals, it is crucial that new homes built today are all-electric so that emissions from these buildings are not "locked-in" by gas-dependent building infrastructure.

Renewable Energy

Biomass Waste Definition

Add new definition as follows:

> **BIOMASS WASTE.** Organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and biogases; but excludes wood and wood-derived fuels (including black liquor), biofuel, feedstock, biodiesel, and fuel ethanol.

Revise definition as follows:

> **RENEWABLE ENERGY RESOURCES.** Energy derived from solar radiation, wind, waves, tides, ~~landfill gas, biogas,~~ *biomass waste* or extracted from hot fluid or steam heated within the earth.

There is currently no definition for biomass in the residential IECC even though biomass was recently listed as a potential renewable energy resource. Because there are many flavors of biomass, it is important for the IECC to clarify which forms of biomass energy count towards reducing a residential buildings' ERI score. The revision limits the biomass sources that count as renewable energy resources to those that are specified as waste products and ensures that virgin material of unknown origin does not count as a steady source of renewable energy. Without an available standard to cite in the IECC for sustainable biomass, it is critical to ensure that biomass used in compliance with the IECC is derived from waste products or byproducts. The definition of biomass waste is taken from the glossary of the Energy Information Administration. A similar amendment has been submitted to amend the commercial IECC to ensure the definition of renewable energy resources is consistent between the two codes.

Solar Ready

Add new text as follows:

> **R103.2.3 Solar-ready system.** The construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from *solar-ready zone* to electrical service panel or plumbing from *solar-ready zone* to *service water heating* system for the *solar-ready zone* shall be represented on the construction documents.

Revise text as follows:

> **R105.2.3 Plumbing rough-in inspection.** Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection and required controls. Where the solar-ready zone is installed for solar water heating, inspections shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

Add new text as follows:

> **R105.2.5 Electrical rough-in inspection.** Inspections at electrical rough-in shall verify compliance as required by the code and the approved plans and specifications as to the locations, distribution, and capacity of the electrical system. Where the solar-ready zone is installed for electricity generation, inspections shall verify conduit or pre-wiring from solar-ready zone to electrical panel.

Revise numbering as follows:

> ~~**R105.2.5**~~ **R105.2.6 Final inspection.**

Add new definition as follows:

> **SOLAR-READY ZONE.** A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Revise text as follows:

> **R401.3 Certificate.** A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certification shall indicate the following:
>
> 8. Where a *solar-ready zone* is provided, the certificate shall indicate the location, dimensions, and capacity reserved on the electrical service panel.

Add new text as follows:

R404.4 Renewable energy infrastructure. The building shall comply with the requirements of R404.4.1 or R404.4.2

R404.4.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses shall comply with Sections R404.4.1.1 through R404.4.1.4.

Exceptions:

1. A *building* with a permanently installed on-site renewable energy system.
2. A *building* with a solar-ready zone area that is less than 600 square feet (55 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
3. A *building* with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually.

R404.4.1.1 Solar-ready zone area. The total area of the *solar-ready zone* shall not be less than 300 square feet (28 m^2) and shall be composed of areas not less than 5.5 feet (1676 mm) in width and not less than 80 square feet (7.4 m^2) exclusive of access or set back areas as required by the International Fire Code.

Exception: Townhouses three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (186 m^2) per dwelling shall be permitted to have a solar-ready zone area of not less than 150 square feet (14 m^2).

R404.4.1.2 Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R404.4.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled "For Future Solar Electric." The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

R404.4.1.4 Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the *solar ready zone* by one of the following:

1. Minimum ¾-inch nonflexible conduit
2. Minimum #10 Metal copper 3-wire

Where the interconnection terminates in the attic, location shall be no less than 12" (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Solar Electric".

R404.4.2 Group R occupancies. Buildings in Group R-2, R-3 and R-4 shall comply with Section C405.13.

Revise table as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Renewable energy infrastructure

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Renewable energy infrastructure
R406.3	Building thermal envelope

In order to cost-effectively achieve Biden's goal to create a carbon-free power sector by 2035, we must make sure our buildings are capable of cost effectively installing renewable energy now. According to a recent study entitled "A New Roadmap for the Lowest Cost Grid", the least expensive grid involves a combination of centralized renewables and distributed renewables located on building sites. New residential buildings must be solar-ready to achieve a 100% carbon-free electricity goal by 2035 in the most cost-effective manner. Installing renewables on-site will also allow homeowners to economically benefit from the transition towards a low-carbon economy and benefit from additional resiliency during disruptions in centrally supplied power. The proposed revisions and additions to the code have been moved from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code.

Renewable Energy Credits

Revise definition as follows:

RENEWABLE ENERGY CERTIFICATE (REC): A~~n~~ market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with renewable energy resources ~~energy~~; also known as an energy attribute and energy attribute certificate (EAC).

Revise as follows:

SECTION R404

ELECTRICAL POWER, ~~AND~~LIGHTING, AND RENEWABLE ENERGY SYSTEMS

Add new text as follows:

R404.5 Renewable energy certificate (REC) documentation. Where on-site renewable energy generation is required by this code the property owner or owner's authorized agent shall demonstrate that any RECs or EACs associated with on-site renewable energy are retained, or retired, on behalf of the property owner.

Revise text as follows:

R406.7.3 Renewable energy certificate (REC) documentation. Where onsite renewable energy is included in the calculation of an ERI, documentation shall comply with Section R404.5. ~~one of the following forms of documentation shall be provided to the *code official*:~~

1. ~~Substantiation that the *RECs* associated with the onsite renewable energy are owned by, or retired on behalf of, the homeowner.~~
2. ~~A contract that conveys to the homeowner the *RECs* associated with the onsite renewable energy, or conveys to the homeowner an equivalent quantity of *RECs* associated with other renewable energy.~~

Add new text as follows:

RC102.3 Renewable energy certificate (REC) documentation. Documentation shall comply with Section R404.5

During the 2021 IECC process the Solar Energy Industry Association (SEIA) assisted NBI in drafting revisions to the original proposal during the public comment period. Because of the rules of the ICC process, the public comment was put up for the online vote. This proposal brings back the public comment language for consideration into the 2024 IECC. This proposal also seeks to clarify the term renewable energy certificate. The proposal more closely aligns the definition with language under consideration both in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance, and in ASHRAE Standard 189.1, which will be the basis of the IgCC.

Grid Integration

Grid-Integrated Thermostats

Add new definitions as follows:

GRID-INTEGRATED CONTROL. An automatic control that can receive, automatically respond to demand response requests from and send information back to a utility, electrical system operator, or third-party demand response program provider.

Add new text as follows:

R403.1.1.1 Grid-integrated thermostat controls. The thermostats shall be provided with *grid-integrated controls* that comply with AHRI 1380 capable of the following:

1. Automatically increasing the zone operating cooling set points by a minimum of 4°F (2.2°C)
2. Automatically decreasing the zone operating heating set points by a minimum of 4°F (2.2°C)
3. Automatically decreasing the zone operating cooling set points by a minimum of 2°F (1.1°C)
4. Automatically increasing the zone operation heating set points by a minimum of 2°F (1.1°C)
5. Both ramp-up and ramp-down logic to prevent the building peak demand from exceeding that expected without the DR implementation.

The thermostat shall be capable of performing all other functions provided by the control when the *grid-integrated controls* are not available.

Exception: Assisted living facilities.

Revise text 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 and is controlled by a thermostat in accordance with Section R403.1.1.

Add new standard as follows:

ANSI

American National Standards Institute (ANSI)
25 West 43rd Street
New York, NY 20036, United States
1-212-642-4900; www.ansi.org

Standard	Title	Referenced

reference number		in code section number
AHRI 1380	Demand Response through Variable Capacity HVAC Systems in Residential and Small Commercial Applications	R403.1.1.1

According to a new report from the National Association of Home Builders (NAHB), in 2021, homeowners will be seeking out features for their homes that improve comfort, wellness and efficiency. One of these common home features homeowners are seeking out are ways to improve their overall home energy use. To help lower energy bills, home builders install a smart thermostat to regulate temperatures and install ENERGY STAR appliances. Major builders D.R. Horton and Toll Brothers are both partners with smart home technology which are installed in the homes they build (these include smart thermostats).
Grid-integrated controls for thermostats are added based on language from California Title 24 and integrated into the current requirement for thermostats. Any thermostat listed as "Title 24 compliant" would meet this requirement, and are available directly through major retailers.

Grid-Integrated Water Heating

Add new definitions as follows:

GRID-INTEGRATED CONTROL. An automatic control that can receive, automatically respond to demand response requests from and send information back to a utility, electrical system operator, or third-party demand response program provider.

Add new text as follows:

R403.5.4 Grid-integrated water heating. Electric storage water heaters with a storage tank capacity greater than 37 gallons (140 L) shall be provided with *grid-integrated controls* that comply with ANSI/CTA-2045-B, Level 2.

Revise table as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION	TITLE
Mechanical	
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water circulation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Mechanical	
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water circulation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~

Revise text as follows:

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

3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating controlled in accordance with Section R403.5.4.

Add new standard as follows:

CTA	Consumer Technology Association 1919 S. Eads Street Arlington, VA 22202	
Standard reference number	*Title*	*Referenced in code section number*
ANSI/CTA-2045-B	Modular Communications Interface for Energy Management	. . . . . R403.5.4

Electric Vehicles

Add new definitions as follows:

ELECTRIC VEHICLE (EV). An automobile for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles for this code.

EV READY SPACE. An *automobile parking space* that is provided with an electrical circuit capable of supporting an installed *EVSE*.

ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED (EVSE) SPACE. An *automobile parking space* that is provided with a dedicated *EVSE*.

Add new text as follows:

R404.5 Electric vehicle charging infrastructure. Electric infrastructure for the charging of *electric vehicles* shall be installed in accordance with this section. *EV ready spaces* are permitted to be counted toward meeting minimum parking requirements.

R404.5.1 One- and two- family dwellings and townhouses. New One- and two-family dwellings and townhouses with a dedicated attached or detached garage or on-site parking spaces and new detached garages shall be provided with one *EV-ready space* per *dwelling unit.* The branch circuit shall terminate in a receptacle outlet and shall comply with the following requirements:

1. Panel capacity for a 40-amp, 208/240-volt circuit with a minimum capacity of 9.6 kVA.
2. Terminates at a receptacle outlet or an EVSE, located within 3 feet (914 mm) of the parking space.
3. The electrical panel directory shall designate the branch circuit as “For electric vehicle charging” and the junction box or receptacle shall be labelled “For electric vehicle charging”.

R404.5.2 Group R occupancies. New Parking facilities serving all other Group R occupancies shall comply with Section C405.15 of the International Energy Conservation Code – Commercial Provisions.

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION [a]	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.5	Electric vehicle charging infrastructure
R406.3	Building thermal envelope

The adoption rate of electric vehicles is on a steep upward climb, creating the need for electric vehicle charging now and in the near future. While the cost of adding electric vehicle charging infrastructure (EVCI) to single-family homes is minimal, the cost of retrofitting EVCI to existing homes can be substantial. This proposal requires a low-cost branch circuit to support an EV charger in single family homes.

Energy Storage Ready

Add new text as follows:

R103.2.4 Energy storage-ready system. The construction documents shall provide the location of pathways for routing of raceways or cable from the energy storage system area to the electrical service panel and the location and layout of a designated area for electrical energy storage system.

Add new text as follows:

R105.2.5 Electrical rough-in inspection. Inspections at electrical rough-in shall verify compliance as required by the code and the approved plans and specifications as to the locations, distribution, and capacity of the electrical system. Where the energy storage system area is not in the same space as the electrical panel, inspections shall verify conduit or pre-wiring from the energy storage ready zone to the electrical panel.

Revise numbering as follows:

~~**R105.2.5**~~ **R105.2.6 Final inspection.**

Add new text as follows:

R404.6 Energy storage infrastructure. Each *building site* shall have a dedicated location for the installation of future on-site energy storage in accordance with this section.

Exception: Where an onsite electrical energy system storage system is installed.

R404.6.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses shall be provided with an energy storage ready area in accordance with the following:

1. Floor area not less than 2 feet (610 mm) in one dimension and 4 feet (1219 mm) in another dimension and located in accordance with Section 1207 of the International Fire Code and Section 110.26 of the NFPA 70.
2. The main electrical service panel shall have a reserved space to allow installation of a two-pole circuit breaker for future electrical energy storage system installation. This space shall be labeled “For Future Electric Storage.” The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

R404.6.2 Group R occupancies. Buildings with Group R-2, R-3 and R-4 occupancies shall comply with Section C405.15.

Revise table as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.6	Energy storage infrastructure

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.6	Energy storage infrastructure
R406.3	Building thermal envelope

Energy storage will soon become critical to achieving President Biden's goal of a carbon-free power sector by 2035. In 2020, 21% of the United States' electricity is sourced from renewable energy, primarily wind, an intermittent source of energy. As the U.S. increases the amount of electricity generated from renewables, buildings must be prepared to aid in this transition by storing energy to match grid demands. Energy storage is expected to grow by over 40% each year until 2025 and the U.S., because of its manufacturing background and experience in battery-storage technology for cars is becoming a clear leader in this market.

In 2020, DOE found that an average household in the United States goes without power for 8 hours in a year. Because of extreme weather events caused by climate change, those outages are increasing. These outages are estimated to cost the U.S. economy between $25 billion to $70 billion annually. Requiring homes to be storage-ready will ensure communities are more resilient by allowing buildings to cost effectively install storage which can operate for a short-period of time without relying on the electricity grid.

Grid Integrated Solar and Energy Storage Inverters

Add new text as follows:

R404.4 Solar and energy storage inverters. Direct-current-to-alternating-current inverters serving *on-site renewable energy* systems or electrical energy storage systems shall be compliant with IEEE 1547-2018a and UL 1741.

Revise table as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.4	Solar and energy storage inverters

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.4	Solar and energy storage inverters

Revise text as follows:

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

12. Where buildings have installed direct current-to-alternating current inverters serving *on-site renewable energy* systems, or electrical energy storage systems, the building is compliant with Section R404.4.

Add new standards as follows:

IEEE

Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, 17th Floor
New York, NY 10016-5997

Standard reference number	Title	Referenced in code section number
1547-2018	IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces	R404.4

UL	UL, LLC. 1285 Walt Whitman Road Melville, NY 11747-3081	
Standard reference number	Title	Referenced in code section number
1741	UL Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources	R404.4

IEEE 1547-2018a governs requirements for the interconnection of distributed energy resources that operate in parallel to the electric grid. This standard (and its implementation at the device level through (UL 1741) ensure that these resources can support and potentially enhance grid stability, thereby improving reliability, reducing curtailments, stabilizing voltage, and maintaining power quality. The National Association of Regulatory Utilities Commissioners (NARUC) has already recommended that state utility commissions require implementation of IEEE1547-2018a as a part of their interconnection requirements.

While the primary purpose of smart inverter functionality is grid stability, there are several additional benefits to the grid and its stakeholders. When operating in volt-VAR mode supporting reactive power, these inverters can actually provide energy savings, particularly when operating within distribution networks already operating conservation voltage reduction schemes. Additionally, smart inverters can help to increase DER hosting capacity of distribution networks, enabling greater access to renewable energy systems while maintaining safety and reliability.

Zero Energy Home

Zero Energy Home Appendix Update

Revise table as follows:

TABLE RC102.2
MAXIMUM ENERGY RATING INDEX [a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
0	34	0
1	~~43~~ 34	0
2	~~45~~ 34	0
3	~~47~~ 38	0
4	~~47~~ 38	0
5	~~47~~ 34	0
6	~~46~~ 34	0
7	~~46~~ 34	0
8	~~46~~ 34	0

The adoption of the Zero Home Appendix into the 2021 IECC has garnered a lot of attention and questions from cities and states looking to understand its energy impact and alignment with energy reduction and climate goals. The 2021 IECC provided scores that are in line with ASHRAE Standard 90.2 – which is more efficient than the base 2021, but less efficient than we know can be built. To truly embody the goal of a zero energy home, a building cannot just offset its energy, it also needs to use less energy. Targets presented for consideration here are based on a scan of PHIUS certified projects in the US.

Zero Energy Home Appendix Decarbonization

Revise text as follows:

Section RC102

~~ZERO ENERGY RESIDENTIAL BUILDINGS~~ GENERAL DEFINITIONS

Add definition as follows:

ALL-ELECTRIC BUILDING. A *building* that contains no *combustion equipment*, or plumbing for *combustion equipment*, installed within the *building*, or *building site*.

Revise text as follows:

Section RC103

ZERO ENERGY RESIDENTIAL BUILDINGS

Renumber and revise text as follows:

RC10~~2~~3.1 General. New *residential buildings* shall be *all-electric buildings* and comply with Section RC102.2.

RC10~~2~~3.2 Energy Rating Index zero energy score.

Table RC10~~2~~3.2

[remainder of text and content remains unchanged] …

The adoption of the Zero Home Appendix into the 2021 IECC has garnered a lot of attention and questions from cities and states looking to understand its energy impact and alignment with energy reduction and climate goals. The 2021 IECC version of the appendix does not address onsite carbon emissions, a request that has been made by jurisdictions seeking to set carbon targets in addition to energy reductions via energy code and stretch codes. This amendment would place the Appendix in line with the ICC's stated goals on carbon and energy reductions by requiring buildings be all-electric in addition to energy efficient.

Zero Energy Home Appendix Renewable Definitions

Add new definitions as follows:

COMMUNITY RENEWABLE ENERGY FACILITY. A facility that produces energy harvested from *renewable energy resources* and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

FINANCIAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT. A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project's renewable generation. Also known as a "financial power purchase agreement" and "virtual power purchase agreement."

PHYSICAL RENEWABLE ENERGY POWER PURCHASE AGREEMENT. A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

Revise text as follows:

RC102.1 General. New *residential buildings* shall comply with Section RC102.2.

RC102.2 Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.
2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

Adjusted OPP = OPP + CREF + ~~REPC~~ PPPA + FPPA **(Equation RC-1)**

where:

CREF = Community Renewable Energy Facility power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a ~~community renewable energy facility~~ *community renewable energy facility* ~~that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.~~

PPPA ~~REPC~~ = Physical Renewable Energy ~~Purchase Contract~~ Power Purchase Agreement power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from ~~an energy facility~~ a *physical renewable energy power purchase agreement* ~~that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems,~~ and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

FPPA = Financial Renewable Energy Power Purchase Agreement power production – the yearly energy, in kilowatt hour equivalent (kWheq) contracted through a *financial renewable energy power purchase agreement* with a duration of not less than 15 years.

This amendment clarifies and aligns off-site renewable energy definitions with other codes. The amendment changes the name of a "renewable energy purchase contract" to the more common name "physical renewable energy power purchase agreement." The amendment clarifies the definition of a community renewable energy facility and allows financial renewable energy power purchase agreements to be counted towards a buildings ERI zero energy score. Finally, this amendment aligns the nomenclature and definitions in this Appendix with the nomenclature and definitions used in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance which is currently under development and addenda under consideration in ASHRAE Standard 189.1.

Existing Buildings

Additional Efficiency Packages for Existing Buildings

Revise text as follows:

R502.3 Prescriptive compliance. Additions shall comply with Sections R502.3.1 through ~~R502.3.4~~ R502.3.5.

R502.3.5 Additional Efficiency Packages. *Additions* shall comply with Section R506. *Alterations* to the existing building that are not part of the *addition*, but permitted with the *addition*, may be used to achieve this requirement.

Exceptions:

1. *Additions* that increase the *building*'s total *conditioned floor area* by less than 25 percent.
2. *Additions* that do not include the addition or replacement of equipment covered in Sections R403.5 or R403.7.
3. *Additions* that do not contain *conditioned space*.
4. Where the *addition* alone or the existing building and *addition* together comply with Section R405 or R406.

Revise text as follows:

R503.1 General. Alterations to any building or structure shall comply with the requirements of the code for new construction, without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing building or structure was prior to the alteration.

Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations shall be such that the existing building or structure does not use more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Sections R503.1.1 through ~~R503.1.4~~ R503.1.5.

Add new text as follows:

R503.1.5 Additional Efficiency Packages. *Alterations* shall comply with Section R506.

Exceptions:

1. *Alterations* only requiring compliance with one of Sections R402.1, R403.5, or R403.7.
2. *Alterations* that are part of an addition complying with section R502.3.5.
3. *Alterations* that comply with Section R405 or R406.

Add new text as follows:

SECTION R506
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

C506.1 General. Where required in Section R502 or R503, the *building* shall comply with one or more additional efficiency package options in accordance with the following:

1. Enhanced envelope performance in accordance with Section R408.2.1.
2. More efficient HVAC equipment performance in accordance with R408.2.2
3. Reduced energy use in service water-heating in accordance with R408.2.3
4. More efficient duct thermal distribution system in accordance with R408.2.4
5. Improved air sealing and efficient ventilation system in accordance with R408.2.5

Section R408 requires homes to include an additional efficiency option to achieve greater efficiency. There is one significant gap in R408, it does not apply to additions or alterations. The exclusion from R408 is a significant loophole. Additions and substantial alterations are prime opportunities for achieving greater energy efficiency utilizing R408. This proposal creates a framework to apply R408 to large additions and substantial alterations.

HVAC Control Upgrade in Alterations

Add new text as follows:

> **R503.1.2.1 Controls.** New heating and cooling equipment that are part of the *alteration* shall be provided with controls that comply with Section R403.1.

The IECC only requires altered portions of heating and cooling systems to meet current code requirements. This means that new heating and cooling equipment can be installed and then controlled by old, even obsolete controls. This proposal requires that new heating and cooling equipment have controls that meet current code requirements to ensure effective and efficient operation.

Duct Leakage Testing in Alterations

Revise text as follows:

R502.3.2 Heating and cooling systems. HVAC ducts newly installed as part of an addition shall comply with Section R403 and R502.3.2.1.

Exception: Where the extension of ducts from an existing heating and cooling system ~~are extended to~~ into an addition results in an increase of total duct volume in the *building* of less than 20 percent.

Add new text as follows:

R502.3.2.1 Duct Testing. Ducts that serve the *addition* shall be tested in accordance with Section R403.3.5. The report required by Section R403.3.5 shall be provided to the owner in addition to the *code official.*

Revise text as follows:

R503.1.2 Heating and cooling systems. New heating and cooling and duct systems that are part of the alteration ~~HVAC ducts newly installed as part of an alteration~~ shall comply with Section R403.

Exception: Where ducts from an existing heating and cooling system are extended to an addition.

Add new text as follows:

R503.1.2 Duct testing. Ducts and plenums that serve new heating or cooling equipment in an alteration shall be tested in accordance with Section R403.3.5. The report required by Section R403.3.5 shall be provided to the owner in addition to the *code official.*

The requirements for duct construction and sealing in the IECC have developed substantially over recent code cycles. This proposal requires duct testing during equipment replacement to provide information about duct performance to inform the equipment replacement and future efficiency retrofits.

System Sizing in Residential Alterations

Revise text as follows:

R503.1.2 Heating and cooling systems. New heating and cooling and duct systems that are part of the alteration shall comply with Section R403 and this section.

R503.1.2.1 Ducts. HVAC ducts newly installed as part of an alteration shall comply with Section R403.

Exception: Where ducts from an existing heating and cooling system are extended to an addition.

Add new text as follows:

R503.1.2.2 System Sizing. New heating and cooling equipment that is part of an *alteration* shall be sized in accordance with Section R403.7 based on the existing *building* features as modified by the *alteration.*

Exception: Where it has been demonstrated to the *code official* that compliance with this section would result in heating or cooling equipment that is incompatible with the remaining portions of the existing heating or cooling system.

Historically, HVAC equipment has been routinely oversized, yet the sizing for many equipment replacements is based on the size of the old equipment. This oversized equipment is less efficient and less effective, resulting in higher costs and worse performance. This proposal requires that replacement equipment in alterations be based on the existing building loads as modified by any alterations that accompany the equipment replacement.

Testing of Gas Piping in Alterations

Add new definition as follows:

FUEL GAS. A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

Add new text as follows:

R502.1.1 Fuel gas pipe testing. Where new *fuel gas* equipment or a new *fuel gas* appliance is installed as part of an *addition*, all *fuel gas* piping that serves the equipment or appliance shall be tested and meet the requirements for leakage of Section 406 of the *International Fuel Gas Code* or Section G2417 of the *International Residential Code.*

Exception: Where it has been demonstrated to the code official that the *fuel gas* piping has been tested and met the requirements of this section within the previous five years.

Add new text as follows:

R503.1.1 Fuel gas pipe testing. Where new gas equipment or a new *fuel gas* appliance is installed as part of an *alteration*, all *fuel gas* piping that serves the equipment or appliance shall be tested and meet the requirements for leakage of Section 406 of the *International Fuel Gas Code.*

Exception: Where it has been demonstrated to the code official that the *fuel gas* piping has been tested and met the requirements of this section within the previous five years.

Gas piping degrades over time, creating the possibility of natural gas leakage. Leaking natural gas represents a loss in energy, and even small leaks can add up over long periods of time. Natural gas is also a potent Green House Gas, with over 86 times the global warming potential of CO2 on a short-term basis. The installation of new gas equipment provides an ideal time to test gas pipe leakage. This proposal creates a requirement that the gas piping that serves newly installed gas equipment or appliances in additions and alterations be tested in accordance with the IFGC or fuel gas section of the IRC.

