Energy Sub-Workgroup
March 24, 2022
9:00 a.m.
Virtual Meeting: https://vadhcd.adobeconnect.com/va2021cdc/

AGENDA

1) Welcome
2) Introductions
3) Overview of VA Code Development Process
4) Background
5) Proposals

    a. EC1301.1.1.1-21
    b. EC-C407.6-21
    c. REC-R402.1.2(1)-21
    d. REC-R402.1.2(2)-21
    e. REC-R402.2-21
    f. REC-R402.4-21
    g. REC-R402.4.1.2-21
    h. REC-R403.1.2-21
    i. REC-R403.3.3-21
    j. REC-R404.2-21
    k. REC-R401.2-21
    l. REC-R401.2.5-21
    m. REC-R403.1.1.1-21
    n. REC-R403.5.4-21
    o. REC-R404.4-21
    p. EC-C401.2-21
    q. EC-C403.3-21
    r. EC-C403.4.1.6-21
    s. EC-C403.15-21
    t. EC-C404.11-21
    u. EC-C405.4-21
    v. EC-C405.13-21
    w. EC-C405.16-21

6) Assignments and Next Steps
7) Next meeting

EC1301.1.1.1-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Construction Code

Delete without substitution:

~~**1301.1.1.1 Changes to the International Energy Conservation Code (IECC).** The following changes shall be made to the IECC:~~

1. ~~Add Sections C402.1.4.2, C402.1.4.2.1, C402.1.4.2.2, C402.1.4.2.3, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5 and Change Section C402.2.1.1 to read:~~

    ~~**C402.1.4.2 Roof/ceiling assembly.** The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on *construction* materials used in the roof/ceiling assembly.~~

    ~~**C402.1.4.2.1 Tapered, above-deck insulation based on thickness.** Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) for *U*-factor compliance as prescribed in Section C402.1.4.~~
    ~~**C402.1.4.2.2 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling *construction*.~~
    ~~**C402.1.4.2.3 Multiple layers and staggered joints.** Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.~~

    ~~**C402.2.1 Roof assembly** The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on *construction* materials used in the *roof assembly*.~~

    ~~**C402.2.1.1 Tapered, above-deck insulation based on thickness.** Where used as a component of a roof/ceiling assembly *R*-value calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) for *R*-value compliance as prescribed in Section C402.1.3.~~
    ~~**C402.2.1.2 Minimum thickness, lowest point.** The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).~~
    ~~**C402.2.1.3 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling *construction*.~~
    ~~**C402.2.1.4 Multiple layers and staggered joints.** Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.~~
    ~~**C402.2.1.5 Skylight curbs.** Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.~~

    ~~**Exception:** Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.~~

2. ~~Change the SHGC for Climate Zone 4 (Except Marine) of Table C402.4 to read:~~

3. ~~Delete Section C402.4.1.2, change Sections C402.4.2, C402.4.2.1, C402.4.2.2 and C402.4.3.~~

~~**C402.4.2 Skylight area with daylight response controls.** The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones under skylights.~~

~~**C402.4.2.1 Daylight Zone Controls under skylights.** Daylight responsive controls complying with Section C405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.~~
~~**C402.4.2.2 Haze factor.** Skylights that are installed in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.~~

~~**Exception:** Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.~~

~~**C402.4.3 Maximum *U*-factor and SHGC.** The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.~~

~~The window projection factor shall be determined in accordance with Equation 4-5.~~

$$PF = A/B \quad \text{(Equation 4-5)}$$

~~where:~~

~~PF = Projection factor (decimal).~~

~~A = Distance measured horizontally from the farthest continuous extremity of any overhand, eave, or permanently attached shading device to the vertical surface of the glazing.~~

~~B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.~~
~~Where different windows or glass doors have different PF values, they shall each be evaluated separately.~~

~~Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.20, the required maximum SHGC from Table C402.4 shall be adjusted by multiplying the required maximum SHGC by the multiplier specified in Table C402.4.3 corresponding with the orientation of the fenestration product and the projection factor.~~

4. ~~Add Table C402.4.3 to read:~~

5. ~~Add an exception to the first paragraph of Section 403.7.7 to read:~~

~~**Exception:** Any grease duct serving a Type I hood installed in accordance with the *International Mechanical Code* (IMC) Section 506.3 shall not be required to have a motorized or gravity damper.~~

6. ~~Add Section C403.2.2.1 to read:~~

~~**C403.2.2.1 Dwelling unit mechanical ventilation.** Mechanical ventilation shall be provided for *dwelling units* in accordance with the IMC.~~

7. ~~Delete Section C403.7.5 and Table C403.7.5.~~
8. ~~Delete Sections C404.5 through C404.5.2.1, including Tables.~~
9. ~~Change Section C405.4 to read:~~

~~**C405.4 Exterior lighting (Mandatory).** All exterior lighting, other than low-voltage landscape lighting, shall comply with Section C405.4.1.~~

~~**Exception:** Where *approved* because of historical, safety, signage, or emergency considerations.~~

10. ~~Change Section C502.1 to read:~~

~~**C502.1 General.** Additions to an existing building, building system or portion thereof shall conform to the provisions of Section 805 of the *Virginia Existing Building Code* (VEBC).~~

~~11. Delete Sections C502.2 through C502.2.6.2.~~

~~12. Change Section C503.1 to read:~~

> ~~**C503.1 General.** Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.~~

~~13. Delete Sections C503.2 through C503.6.~~

~~14. Change Section C504.1 to read:~~

> ~~**C504.1 General.** *Buildings* and *structures*, and parts thereof, shall be repaired in compliance with Section 510 of the VEBC.~~

~~15. Delete Section C504.2.~~

~~16. Change Section R401.2 to read:~~

> ~~**R401.2 Compliance.** Projects shall comply with all provisions of Chapter 4 labeled "Mandatory" and one of the following:~~
>
> ~~1. Sections R401 through R404.~~
> ~~2. Section R405.~~
> ~~3. Section R406.~~
> ~~4. The most recent version of REScheck, keyed to the 2018 IECC.~~

~~17. Change Section R401.3 to read:~~

> ~~**R401.3** 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. Where *approved*, certificates for multifamily *dwelling units* shall be permitted to be located off-site at an identified location. The certificate shall indicate the predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces; *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results from any required duct system and *building* envelope air leakage testing performed on the *building*. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types 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.~~

~~18. Change the wood frame wall *R*-value categories for Climate Zone 4 (Except Marine) in Table R402.1.2 to read:~~

~~19. Change the frame wall *U*-factor categories for Climate Zone 4 (Except Marine) in Table R402.1.4 to read:~~

~~20. Change Section R402.2.4 to read:~~

> ~~**R402.2.4 Access hatches and doors.** Access doors from conditioned spaces to unconditioned spaces (e.g., *attics* and crawl spaces) shall be weatherstripped and insulated in accordance with the following values:~~
>
> ~~1. Hinged vertical doors shall have a minimum overall R-5 insulation value;~~
> ~~2. Hatches and scuttle hole covers shall be insulated to a level equivalent to the insulation on the surrounding surfaces; and~~
> ~~3. Pull down stairs shall have a minimum of 75 percent of the panel area having R-5 rigid insulation.~~
>
> ~~Access shall be provided to all *equipment* that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.~~

21. ~~Change Sections R402.4 and R402.4.1.1 to read:~~

> ~~**R402.4 Air leakage.** The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.~~
>
> > ~~**R402.4.1.1 Installation (Mandatory).** The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction*. Where required by the code official, an *approved* third party shall inspect all components and verify compliance.~~

22. ~~Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:~~

23. ~~Change Section R402.4.1.2 to read:~~

> ~~**R402.4.1.2 Testing.** The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official*. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.~~
>
> ~~**Note:** Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.~~
>
> ~~During testing:~~
>
> 1. ~~Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;~~
> 2. ~~Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;~~
> 3. ~~Interior doors, if installed at the time of the test, shall be open;~~
> 4. ~~Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;~~
> 5. ~~Heating and cooling systems, if installed at the time of the test, shall be turned off; and~~
> 6. ~~Supply and return registers, if installed at the time of the test, shall be fully open.~~

24. ~~Change Section R403.3.3 to read:~~

> ~~**R403.3.3 Duct testing (Mandatory).** Ducts shall be pressure tested to determine air leakage by one of the following methods:~~
>
> 1. ~~Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.~~
> 2. ~~Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.~~
>
> > ~~**Exception:** A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.~~

~~A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.~~

25. ~~Delete Section R403.3.5.~~

~~26. Change Section R403.7 to read:~~

> ~~**R403.7 Equipment and appliance sizing.** Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S or other *approved* sizing methodologies based on *building* loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.~~
>
> ~~**Exception:** Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other *approved* sizing methodologies where any of the following conditions apply:~~
>
> 1. ~~The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the *approved* heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.~~
> 2. ~~The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the *approved* heating and cooling methodology and the next larger standard size unit is specified.~~
> 3. ~~The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer.~~

~~27. Change footnote "a" in Table R406.4 to read:~~

~~a. When onsite renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2 and the building thermal envelope shall be greater than or equal to levels of energy efficiency and solar heat gain coefficient in Table R402.1.2, with a ceiling *R*-value of 49 and a wood frame wall *R*-value of 20 or 13 + 5, or Table R402.1.4, with a ceiling *U*-factor of 0.026 and a frame wall *U*-factor of 0.060.~~

~~28. Change Section R501.1 to read:~~

> ~~**R501.1 Scope.** The provisions of the *Virginia Existing Building Code* (VEBC) shall control the alteration, repair, addition and change of occupancy of existing *buildings* and *structures*.~~

~~29. Delete Sections R501.1.1 through R501.6.~~

~~30. Change Section R502.1 to read:~~

> ~~**R502.1 General.** Additions to an existing *building*, *building* system or portion thereof shall conform to the provisions of Section 811 of the VEBC.~~

~~31. Delete Sections R502.1.1 through R502.1.2.~~

~~32. Change Section R503.1 to read:~~

> ~~**R503.1 General.** Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.~~

~~33. Delete Sections R503.1.1 through R503.2~~

~~34. Change Section R504.1 to read:~~

> ~~**R504.1 General.** *Buildings*, structures and parts thereof shall be repaired in compliance with Section 510 of the VEBC.~~

~~35. Delete Section R504.2.~~

2018 Virginia Energy Conservation Code

Delete without substitution:

~~**TABLE C402.4 BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS**~~

~~**CLIMATE ZONE**~~	~~**1**~~	~~**2**~~	~~**3**~~	~~**4 EXCEPT MARINE**~~	~~**5 AND MARINE 4**~~	~~**6**~~	~~**7**~~	~~**8**~~
~~**Vertical fenestration**~~								
~~**U-factor**~~								
~~Fixed fenestration~~	~~0.50~~	~~0.50~~	~~0.46~~	~~0.38~~	~~0.38~~	~~0.36~~	~~0.29~~	~~0.29~~
~~Operable fenestration~~	~~0.65~~	~~0.65~~	~~0.60~~	~~0.45~~	~~0.45~~	~~0.43~~	~~0.37~~	~~0.37~~
~~Entrance doors~~	~~1.10~~	~~0.83~~	~~0.77~~	~~0.77~~	~~0.77~~	~~0.77~~	~~0.77~~	~~0.77~~
~~**SHGC**~~								
~~**SHGC**~~	~~0.25~~	~~0.25~~	~~0.25~~	~~0.36~~	~~0.40~~	~~0.40~~	~~0.45~~	~~0.45~~
~~**Skylights**~~								
~~U-factor~~	~~0.75~~	~~0.65~~	~~0.55~~	~~0.50~~	~~0.50~~	~~0.50~~	~~0.50~~	~~0.50~~
~~SHGC~~	~~0.35~~	~~0.35~~	~~0.35~~	~~0.40~~	~~0.40~~	~~0.40~~	~~NR~~	~~NR~~

~~NR = No Requirement~~

Revise as follows:

~~**TABLE C402.4.3 SHGC ADJUSTMENT MULTIPLIERS**~~

~~PROJECTION FACTOR~~	~~ORIENTED WITHIN 45 DEGREES OF TRUE NORTH~~	~~ALL OTHER ORIENTATIONS~~
~~0.2 ≤ PF < 0.5~~	~~1.1~~	~~1.2~~
~~PF ≥ 0.5~~	~~1.2~~	~~1.6~~

~~TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT~~ ~~[a]~~

CLIMATE ~~ZONE~~	~~FENESTRATION *U*-FACTOR~~ ~~[b]~~	~~SKYLIGHT [b] *U*-FACTOR~~	~~GLAZED FENESTRATION SHGC [b, e]~~	~~CEILING *R*-VALUE~~	~~WOOD FRAME WALL *R*-VALUE~~	~~MASS WALL *R*-VALUE~~ ~~[i]~~	~~FLOOR *R*-VALUE~~	~~BASEMENT [c] WALL *R*-VALUE~~	~~SLAB [d] *R*-VALUE & DEPTH~~	~~CRAWL SPACE [c] WALL *R* VALUE~~
~~1~~	~~NR~~	~~0.75~~	~~0.25~~	~~30~~	~~13~~	~~3/4~~	~~13~~	~~0~~	~~0~~	~~0~~
~~2~~	~~0.40~~	~~0.65~~	~~0.25~~	~~38~~	~~13~~	~~4/6~~	~~13~~	~~0~~	~~0~~	~~0~~
~~3~~	~~0.32~~	~~0.55~~	~~0.25~~	~~38~~	~~20 or 13+5~~ ~~[h]~~	~~8/13~~	~~19~~	~~5/13~~ ~~[f]~~	~~0~~	~~5/13~~
~~4 except Marine~~	~~0.32~~	~~0.55~~	~~0.40~~	~~49~~	~~15 or 13+1~~ ~~[h]~~	~~8/13~~	~~19~~	~~10 /13~~	~~10, 2 ft~~	~~10/13~~
~~5 and Marine 4~~	~~0.30~~	~~0.55~~	~~NR~~	~~49~~	~~20 or 13+5~~ ~~[h]~~	~~13/17~~	~~30~~ ~~[g]~~	~~15/19~~	~~10, 2 ft~~	~~15/19~~
~~6~~	~~0.30~~	~~0.55~~	~~NR~~	~~49~~	~~20+5~~ ~~[h]~~ ~~or 13+10~~ ~~[h]~~	~~15/20~~	~~30~~ ~~[g]~~	~~15/19~~	~~10, 4 ft~~	~~15/19~~
~~7 and 8~~	~~0.30~~	~~0.55~~	~~NR~~	~~49~~	~~20+5~~ ~~[h]~~ ~~or 13+10~~ ~~[h]~~	~~19/21~~	~~38~~ ~~[g]~~	~~15/19~~	~~10, 4 ft~~	~~15/19~~

NR = Not Required.

For SI: 1 foot = 304.8 mm.

- ~~a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.~~
- ~~b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.~~

  ~~**Exception:** In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.~~
- ~~c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall.~~

  ~~"15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.~~
- ~~d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs. as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.~~
- ~~e. There are no SHGC requirements in the Marine Zone.~~
- ~~f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.~~
- ~~g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.~~
- ~~h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.~~
- ~~i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.~~

Delete without substitution:

~~TABLE R402.1.4 EQUIVALENT U-FACTORS~~ [a]

~~CLIMATE ZONE~~	~~FENESTRATION *U*-FACTOR~~	~~SKYLIGHT *U*-FACTOR~~	~~CEILING *U*-FACTOR~~	~~FRAME WALL *U*-FACTOR~~	~~MASS WALL *U*-FACTOR~~ [b]	~~FLOOR *U*-FACTOR~~	~~BASEMENT WALL *U*-FACTOR~~	~~CRAWL SPACE WALL *U*-FACTOR~~
~~1~~	~~0.50~~	~~0.75~~	~~0.035~~	~~0.084~~	~~0.197~~	~~0.064~~	~~0.360~~	~~0.477~~
~~2~~	~~0.40~~	~~0.65~~	~~0.030~~	~~0.084~~	~~0.165~~	~~0.064~~	~~0.360~~	~~0.477~~
~~3~~	~~0.32~~	~~0.55~~	~~0.030~~	~~0.060~~	~~0.098~~	~~0.047~~	~~0.091~~ [c]	~~0.136~~
~~4 except Marine~~	~~0.32~~	~~0.55~~	~~0.026~~	~~0.079~~	~~0.098~~	~~0.047~~	~~0.059~~	~~0.065~~
~~5 and Marine 4~~	~~0.30~~	~~0.55~~	~~0.026~~	~~0.060~~	~~0.082~~	~~0.033~~	~~0.050~~	~~0.055~~
~~6~~	~~0.30~~	~~0.55~~	~~0.026~~	~~0.045~~	~~0.060~~	~~0.033~~	~~0.050~~	~~0.055~~
~~7 and 8~~	~~0.30~~	~~0.55~~	~~0.026~~	~~0.045~~	~~0.057~~	~~0.028~~	~~0.050~~	~~0.055~~

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

~~COMPONENT~~	~~AIR BARRIER CRITERIA~~	~~INSULATION INSTALLATION CRITERIA~~ [b]
~~General requirements~~	~~A continuous air barrier shall be installed in the building envelope.~~ ~~The exterior thermal envelope contains a continuous air barrier.~~ ~~Breaks or joints in the air barrier shall be sealed.~~	~~Air-permeable insulation shall not be used as a sealing material.~~
~~Ceiling/attic~~	~~The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed.~~ ~~Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.~~	~~The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.~~
~~Walls~~	~~The junction of the foundation and sill plate shall be sealed.~~ ~~The junction of the top plate and the top of exterior walls shall be sealed.~~ ~~Knee walls shall be sealed.~~	~~Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch.~~ ~~Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.~~
~~Windows, skylights and doors~~	~~The space between framing and skylights, and the jambs of windows and doors, shall be sealed.~~	~~—~~
~~Rim joists~~	~~Rim joists shall include the air barrier.~~	~~Rim joists shall be insulated.~~
~~Floors, including cantilevered floors and floors above garages~~	~~The air barrier shall be installed at any exposed edge of insulation.~~	~~Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.~~
~~Crawl space walls~~	~~Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.~~	~~Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.~~
~~Shafts, penetrations~~	~~Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.~~	~~—~~
~~Narrow cavities~~	~~—~~	~~Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.~~
~~Garage separation~~	~~Air sealing shall be provided between the garage and conditioned spaces.~~	~~—~~
~~Recessed lighting~~	~~Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.~~	~~Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.~~
~~Plumbing and wiring~~	~~—~~	~~In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.~~
~~Shower/tub on exterior wall~~ [c]	~~The air barrier installed at exterior walls adjacent to showers and tubs shall be installed on the interior side and separate the exterior walls from the showers and tubs.~~	~~Exterior walls adjacent to showers and tubs shall be insulated.~~
~~Electrical/phone box on exterior walls~~	~~The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.~~	~~—~~
~~HVAC register boots~~	~~HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.~~	~~—~~

~~COMPONENT~~	~~AIR BARRIER CRITERIA~~	~~INSULATION INSTALLATION CRITERIA~~
~~Concealed sprinklers~~	~~Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.~~	—

Reason Statement: This proposal is intended to fully adopt and implement the 2021 IECC by eliminating exceptions that the Base Document would cause to displace language in the 2021 IECC. Full adoption of the 2021 IECC will carry out Virginia law and protect both residents and the public generally.

The BHCD's NOIRA published November 22, 2021, https://townhall.virginia.gov/L/viewstage.cfm?stageid=9475 states:

> "The 2021 editions of the International Codes are now completed and available from ICC. *The use of the newest available model codes and standards in the USBC assures that the statutory mandate is met to base the regulation on the latest editions of nationally recognized model codes to assure the protection of the health, safety and welfare of the residents of Virginia and that buildings and structures are constructed and maintained at the least possible cost.*"

The BHCD's NOIRA also states: "As the basis for Virginia's building code it is important to stay in sync with the national model codes." These statements are consistent with Section 36-99A of the Virginia Code has long prescribed that the purposes of the USBC are to protect the public and implement recognized standards of energy conservation and water conservation:

> "The provisions of the Building Code and modifications thereof shall be such as *to protect the health, safety and welfare of the residents of the Commonwealth*, provided that buildings and structures should be permitted to be constructed, rehabilitated and maintained at the least possible cost *consistent with recognized standards of health, safety, energy conservation and water conservation*…."

Legislation (H2227), enacted by the General Assembly and signed by the Governor in 2021, supplements the pre-existing law's commitment to protecting residents and the public "consistent with recognized standards of … energy conservation" by specifically endorsing adoption of energy standards "at least as stringent as" the latest IECC when the benefits "over time" to residents and the public exceed the incremental costs of construction.

In view of the NOIRA and applicable law, Virginia should adopt the full 2021 IECC. More stringent standards and non-weakening amendments may be proposed, but the expectation is that the code should be "at least as stringent" as the 2021 IECC. Adopting such standards would perform the important function of keeping Virginia's building code "in sync with the national model codes," except where more stringent standards are feasible and beneficial to residents and the public.

In further support of benefits residents and the public will gain from full implementation of the 2021 IECC, we note:

- The ICC process that produced the IECC was a multi-year effort that carefully vetted the amendments that were eventually adopted.

- DOE and the Pacific Northwest National Laboratory (PNNL) have already published findings demonstrating that the net savings to Virginia residents and to the public from implementing the full 2021 IECC exceed the incremental costs of construction. https://www.energycodes.gov/technical-assistance/publications?page=29

- DOE/PNNL has reached the same conclusion on a national basis. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31437.pdf

- The DOE/PNNL studies show that the public will benefit from reductions of air and climate pollution as measured by the Social Cost of Carbon.

- DOE/PNNL has previously found that earlier IECC updates dated 2012, 2015 and 2018 produced savings and benefits greater than construction costs. Consequently, moving implementation the 2021 IECC from pre-2012 standards that still apply to wall insulation and air leakage will result in net benefits and savings.

- Remaining more than a decade out of date in key areas, such as wall insulation and air leakage, is plainly inconsistent with Virginia law and the economic and health interests of residents and the public.

- Improved insulation, reduced air leakage and more efficient equipment will improve residents' comfort and health, reduce residents' problems of utility bill fluctuations, and improve their resiliency to low and high temperatures during power outages. Measures to reduce air leakage will have the added benefit of reducing access to dwellings by rodents and insects, which is a distinct concern identified in the Virginia Code.

Cost Impact: The code change proposal will increase the cost of construction
The code change proposal will increase the cost of construction, but lower the cost of occupancy.

As documented by DOE/PNNL, the cost savings to residents from fully implementing the 2021 IECC exceed the increased cost of construction on both a life-cycle and simple payback basis. Their analysis also shows that the public savings even more greatly exceed the incremental costs of construction.

- https://www.energycodes.gov/technical-assistance/publications?page=29
- https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31437.pdf

In addition to saving residents money and energy, adoption and implementation will create added benefits including greater comfort, less exposure to pests, and greater resiliency.

Resiliency Impact Statement: This proposal will increase Resiliency
This proposal will increase resiliency in multiple ways, including:

- Local and regional power outages are a recurring problem that will get worse as climate impacts (storms, floods, rising seas, higher temperatures) make power outages more frequent and consequential. Better insulated houses with lower air leakage will continue to provide comfort to residents for longer periods during power outages.
- Better insulated houses with lower air leakage will better protect residents from the economic consequences of rate and bill increases due to energy price increases and fluctuations. This enhanced economic resiliency is very important. High utility bills and energy consumption can result in residents falling behind on mortgages and rents, potentially resulting in eviction or loss of homes. Evictions have adverse impacts to people, especially seniors, parents and children, that extend beyond a need to change dwellings.
- Landlords, lenders and surrounding communities will indirectly benefit from energy conservation measures that reduce risks of customer defaults.
- By reducing health impacts from air pollution, temperature impacts of power outages or cost-driven reductions of heating or cooling, and evictions, conservation measures will improve health resiliency for residents and communities.

Workgroup Recommendation

Public Comments for: EC1301.1.1.1-21

This proposal doesn't have any public comments.

EC-C407.6-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Energy Conservation Code

Add new text as follows:

C407.6 Zero Energy Commercial Construction. Any Commercial building constructed or rehabilitated and sold, leased, advertised or otherwise held out to be a “zero energy” building or “net zero energy building” or made subject to an equivalent claim must satisfy the standards set forth in Appendix CC Zero Energy Commercial Building Provisions, in addition to any other energy efficiency and renewable energy standards that are applicable to such building. A building inspection and independent confirmation of compliance with Appendix CC must be conducted and supporting documentation must be submitted to demonstrate full compliance with Appendix CC. The building code official may require additional information, as appropriate, to demonstrate compliance.

R406.8 Zero Energy Residential Construction. Any residential building constructed or rehabilitated and sold, leased, advertised or otherwise held out to be as “zero energy” building or “net zero energy” or made subject to an equivalent claim must satisfy the standards set forth in Appendix RC Zero Energy Residential Building Provisions in addition to any other energy efficiency and renewable energy standards applicable to such construction or rehabilitation. Inspection and independent confirmation of compliance with Appendix RC must be conducted and documentation provided, consistent with the provisions of R406, R407 (including R407.1-R407.6) to confirm compliance with Appendix RC Zero Energy Residential Building Provisions. The building code official may require additional information, as appropriate, to demonstrate compliance.

N1106.8 Zero Energy Residential Construction.
Any residential building constructed or rehabilitated and sold, leased, advertised or otherwise held out to be as “zero energy” building or “net zero energy” or made subject to an equivalent claim must satisfy the standards set forth in Appendix RC Zero Energy Residential Building Provisions in addition to any other energy efficiency and renewable energy standards applicable to such construction or rehabilitation. Inspection and independent confirmation of compliance with Appendix RC must be conducted and documentation provided, consistent with the provisions of N1106, N1107 (including N1107.1-N407.6) to confirm compliance with Appendix RC Zero Energy Residential Building Provisions. The building code official may require additional information, as appropriate, to demonstrate compliance.

Reason Statement: The 2021 IECC adds two appendices specifying the requirements for "zero energy" construction: "Appendix CC Zero Energy Commercial Building Provisions" and "Appendix RC Zero Energy Residential Building Provisions".

The purpose of this proposal is to activate the standards set forth in these two appendices by making them applicable and mandatory for any buildings constructed and sold or leased as being "zero energy" or "net zero energy" or equivalent labels. It does not require builders to go beyond the generally applicable terms of the 2021 IECC, but it protects buyers, residents and competing "zero energy" builders by assuring that buildings claimed to be "zero energy" actually meet recognized "zero energy" energy conservation standards. The appendices are new and will be incorporated into Virginia's 2021 building code update.

Zero energy buildings are hugely valuable for residents and landlords because they eliminate energy costs of occupancy, over time, through a combination of enhanced energy efficiency and renewable energy. Such buildings are becoming increasingly popular, particularly since they cut both occupancy costs and pollution driving climate change. In reality, a shift to zero energy (net zero energy) housing will be critical to keeping global temperatures at levels that will prevent catastrophic climate harms. Given that new housing will operate for 70 or more years, it is vital that quality zero carbon construction begin sooner rather than later. Even though it does not mandate zero carbon construction, this proposal will at least establish minimum standards for such construction.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal does not require construction of zero energy buildings. It merely assures that buildings meet basic standards of construction and truth in advertising if they are built and sold or leased as "zero energy" buildings.

Resiliency Impact Statement: This proposal will increase Resiliency
This proposal will increase resiliency in several ways. Individual zero energy buildings and their occupants will be more resilient because they will (a) consume less energy, (b) produce zero-carbon renewable energy equal to or in excess of their energy needs, (c) retain heat or cooling during periods of utility outages, (d) be more capable of self-supplying energy during periods of utility outages, and (e) less exposed to economic harm from fluctuating energy prices. These are large resiliency benefits for residents in zero energy dwellings and their lenders or landlords.

This proposal will also increase resiliency for the public by reducing greenhouse gas emissions, reducing demands on utilities during critical supply and price periods and reducing risks of loan and lease defaults attributable to fluctuating energy prices.

Workgroup Recommendation

Public Comments for: EC-C407.6-21

This proposal doesn't have any public comments.

Proposal # 996

REC-R402.1.2 (1)-21

Proponents: Laura Baker (laura@reca-codes.com); Eric Lacey (eric@reca-codes.com)

2018 Virginia Energy Conservation Code

Revise as follows:

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT [a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR [b]	SKYLIGHT [b] *U*-FACTOR	GLAZED FENESTRATION SHGC [b, e]	CEILING R-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE [i]	FLOOR *R*-VALUE	BASEMENT [c] WALL *R*-VALUE	SLAB [d] *R*-VALUE & DEPTH	CRAWL SPACE [c] WALL *R* VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.30	0.55	0.25	38	20 or 13 + 5 ci or 0 + 15ci [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	30 or 20 + 5ci or 13 + 10ci or 0 + 20ci ~~15 or 13+1~~ [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	30 or 20 + 5ci or 13 + 5 ci or 0 + 20ci [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20+5 [h] or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20+5 [h] or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

NR = Not Required.

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall.

"15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs. as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE R402.1.4 EQUIVALENT U-FACTORS [a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR [b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091 [c]	0.136
4 except Marine	0.32	0.55	0.026	0.0~~79~~ 45	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.0~~60~~ 45	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

2018 Virgina Residential Code

Revise as follows:

TABLE N1102.1.2 (R402.1.2) INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	¾	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32	0.55	0.25	38	20 or 13 + 5ci[h] or 0 + 15ci	8/13	19	5/13[f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	30 or 20 + 5ci or 13 + 10ci or 0 + 20ci ~~15 or 13 + 1~~[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	30 or 20 + 5ci or 13 + 10ci or 0 + 20ci~~5~~[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20 + 5[h] or 13 + 10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20 + 5[h] or 13 + 10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

NR = Not Required.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall be not less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

    Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation on the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs. as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation shall not be required in warm-humid locations as defined by Figure N1101.7 and Table N1101.7.

g. Alternatively, insulation sufficient to fill the framing cavity providing not less than an *R*-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section N1102.2.5. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE N1102.1.4 (R402.1.4) EQUIVALENT U-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*- FACTOR	SKYLIGHT *U*- FACTOR	CEILING *U*- FACTOR	FRAME WALL *U*- FACTOR	MASS WALL *U*- FACTOR[b]	FLOOR *U*- FACTOR	BASEMENT WALL *U*- FACTOR	CRAWL SPACE WALL *U*- FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.32	0.55	0.026	~~0.079~~ 0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	~~0.060~~ 0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. Mass walls shall be in accordance with Section N1102.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure N1101.7 and Table N1101.7, the basement wall *U*-factor shall not exceed 0.360.

2018 Virginia Construction Code

Revise as follows:

1301.1.1.1 Changes to the International Energy Conservation Code (IECC). The following changes shall be made to the IECC:

1. Add Sections C402.1.4.2, C402.1.4.2.1, C402.1.4.2.2, C402.1.4.2.3, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5 and Change Section C402.2.1.1 to read:

C402.1.4.2 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on *construction* materials used in the roof/ceiling assembly.

C402.1.4.2.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) for *U*-factor compliance as prescribed in Section C402.1.4.
C402.1.4.2.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling *construction*.
C402.1.4.2.3 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.

C402.2.1 Roof assembly The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on *construction* materials used in the *roof assembly*.

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) for *R*-value compliance as prescribed in Section C402.1.3.
C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).
C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling *construction*.
C402.2.1.4 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.
C402.2.1.5 Skylight curbs. Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.

Exception: Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

2. Change the SHGC for Climate Zone 4 (Except Marine) of Table C402.4 to read:

3. Delete Section C402.4.1.2, change Sections C402.4.2, C402.4.2.1, C402.4.2.2 and C402.4.3.

C402.4.2 Skylight area with daylight response controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones under skylights.

C402.4.2.1 Daylight Zone Controls under skylights. Daylight responsive controls complying with Section C405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.

C402.4.2.2 Haze factor. Skylights that are installed in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.

C402.4.3 Maximum *U*-factor and SHGC. The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Equation 4-5.

$$PF = A/B \qquad \textbf{(Equation 4-5)}$$

Where different windows or glass doors have different PF values, they shall each be evaluated separately.

Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.20, the required maximum SHGC from Table C402.4 shall be adjusted by multiplying the required maximum SHGC by the multiplier specified in Table C402.4.3 corresponding with the orientation of the fenestration product and the projection factor.
where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the farthest continuous extremity of any overhand, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

4. Add Table C402.4.3 to read:

5. Add an exception to the first paragraph of Section 403.7.7 to read:

Exception: Any grease duct serving a Type I hood installed in accordance with the *International Mechanical Code* (IMC) Section 506.3 shall not be required to have a motorized or gravity damper.

6. Add Section C403.2.2.1 to read:

C403.2.2.1 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for *dwelling units* in accordance with the IMC.

7. Delete Section C403.7.5 and Table C403.7.5.

8. Delete Sections C404.5 through C404.5.2.1, including Tables.

9. Change Section C405.4 to read:

C405.4 Exterior lighting (Mandatory). All exterior lighting, other than low-voltage landscape lighting, shall comply with Section C405.4.1.

Exception: Where *approved* because of historical, safety, signage, or emergency considerations.

10. Change Section C502.1 to read:

C502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of Section 805 of the *Virginia Existing Building Code* (VEBC).

11. Delete Sections C502.2 through C502.2.6.2.
12. Change Section C503.1 to read:

    C503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

13. Delete Sections C503.2 through C503.6.
14. Change Section C504.1 to read:

    C504.1 General. *Buildings* and *structures*, and parts thereof, shall be repaired in compliance with Section 510 of the VEBC.

15. Delete Section C504.2.
16. Change Section R401.2 to read:

    R401.2 Compliance. Projects shall comply with all provisions of Chapter 4 labeled “Mandatory” and one of the following:

    1. Sections R401 through R404.
    2. Section R405.
    3. Section R406.
    4. The most recent version of REScheck, keyed to the 2018 IECC.

17. Change Section R401.3 to read:

    R401.3 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. Where *approved*, certificates for multifamily *dwelling units* shall be permitted to be located off-site at an identified location. The certificate shall indicate the predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces; *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results from any required duct system and *building* envelope air leakage testing performed on the *building.* Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types 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.

18. ~~Change the wood frame wall *R*-value categories for Climate Zone 4 (Except Marine) in Table R402.1.2 to read:~~

19. ~~Change the frame wall *U*-factor categories for Climate Zone 4 (Except Marine) in Table R402.1.4 to read:~~

20. Change Section R402.2.4 to read:

    R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces (e.g., *attics* and crawl spaces) shall be weatherstripped and insulated in accordance with the following values:

    1. Hinged vertical doors shall have a minimum overall R-5 insulation value;
    2. Hatches and scuttle hole covers shall be insulated to a level equivalent to the insulation on the surrounding surfaces; and
    3. Pull down stairs shall have a minimum of 75 percent of the panel area having R-5 rigid insulation.

    Access shall be provided to all *equipment* that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

21. Change Sections R402.4 and R402.4.1.1 to read:

> **R402.4 Air leakage.** The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.
>
> > **R402.4.1.1 Installation (Mandatory).** The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction*. Where required by the code official, an *approved* third party shall inspect all components and verify compliance.

22. Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:

23. Change Section R402.4.1.2 to read:

> **R402.4.1.2 Testing.** The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official.* Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.
>
> **Note:** Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.
>
> During testing:
>
> 1. Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
> 2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
> 3. Interior doors, if installed at the time of the test, shall be open;
> 4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
> 5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
> 6. Supply and return registers, if installed at the time of the test, shall be fully open.

24. Change Section R403.3.3 to read:

> **R403.3.3 Duct testing (Mandatory).** Ducts shall be pressure tested to determine air leakage by one of the following methods:
>
> 1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
> 2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.
>
> > **Exception:** A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.

25. Delete Section R403.3.5.

26. Change Section R403.7 to read:

> **R403.7 Equipment and appliance sizing.** Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S or other *approved* sizing methodologies based on *building* loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.
>
> **Exception:** Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other *approved* sizing methodologies where any of the following conditions apply:
>
> 1. The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the *approved* heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.
> 2. The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the *approved* heating and cooling methodology and the next larger standard size unit is specified.
> 3. The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer.

27. Change footnote "a" in Table R406.4 to read:

    a. When onsite renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2 and the building thermal envelope shall be greater than or equal to levels of energy efficiency and solar heat gain coefficient in Table R402.1.2, with a ceiling *R*-value of 49 and a wood frame wall *R*-value of 20 or 13 + 5, or Table R402.1.4, with a ceiling *U*-factor of 0.026 and a frame wall *U*-factor of 0.060.

28. Change Section R501.1 to read:

> **R501.1 Scope.** The provisions of the *Virginia Existing Building Code* (VEBC) shall control the alteration, repair, addition and change of occupancy of existing *buildings* and *structures*.

29. Delete Sections R501.1.1 through R501.6.
30. Change Section R502.1 to read:

> **R502.1 General.** Additions to an existing *building*, *building* system or portion thereof shall conform to the provisions of Section 811 of the VEBC.

31. Delete Sections R502.1.1 through R502.1.2.
32. Change Section R503.1 to read:

> **R503.1 General.** Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

33. Delete Sections R503.1.1 through R503.2
34. Change Section R504.1 to read:

> **R504.1 General.** *Buildings*, structures and parts thereof shall be repaired in compliance with Section 510 of the VEBC.

35. Delete Section R504.2.

~~**TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**~~[a]

~~**CLIMATE ZONE**~~	~~**WOOD FRAME WALL *R*-VALUE**~~
~~4 except Marine~~	~~15 or 13 + 1~~[h]

~~TABLE R402.1.4 EQUIVALENT U-FACTORS~~~~[a]~~

~~CLIMATE ZONE~~	~~FRAME WALL *U*-FACTOR~~
~~4 except Marine~~	~~0.079~~

Reason Statement: This proposal improves the comfort, efficiency, and resiliency of Virginia homes by improving the wall insulation requirements. It will also make Virginia's energy code consistent with the 2021 IECC requirements for wall insulation. The U.S. DOE found the 2021 IECC to be cost-effective for Virginia (*see* https://www.energycodes.gov/sites/default/files/2021-07/VirginiaResidentialCostEffectiveness_2021.pdf), and improvements to the thermal building envelope are important to the long-term efficiency and cost-effectiveness of new buildings. Using the U.S. Department of Energy methodology for reviewing code change proposals, and using BEopt modeling software, our analysis found that an improvement from R-15 to R-20+5 in wall insulation will result in a 13.1% improvement in efficiency, and a simple payback period of less than 5 years. Wall insulation is easiest (and most cost-effective) to install during construction. Given that there may only be limited opportunities to upgrade the walls in the future, it is important to construct well-insulated walls from the very beginning. Better-insulated buildings are clearly an investment in Virginia's energy future. We recommend maintaining consistency with the 2021 IECC requirements.
The wall insulation R-values in the 2021 IECC do not require the use of any specific product and can be achieved with either 2X4 or 2X6 wall construction. The values in the prescriptive R-value table are only a few of many different options. For additional wall insulation options, builders can use one of several compliance paths, each of which provides multiple options and combinations for meeting the code requirements:

- The U-factor alternative table (R402.1.2)
- The Total UA Alternative (R402.1.5)
- U.S. DOE's REScheck software (www.energycodes.gov)
- The Simulated Performance Alternative (R405)
- The Energy Rating Index (R406)

This proposal also updates the equivalent U-factors to be consistent with the 2021 IRC/IECC, which is important for builders and design professionals who intend to use DOE's free REScheck compliance software or other energy rating programs. We recommend that Virginia adopt equivalent U-factor values that will be consistent with the latest version of the IECC, both to maximize cost-effective energy efficiency and to improve the resiliency of every new home built in the Commonwealth.

Cost Impact: The code change proposal will increase the cost of construction
The improvement in wall insulation will increase initial construction cost, but is clearly cost-effective to the homeowner. Using the U.S. Department of Energy methodology for evaluating code change proposals, and using BEopt modeling software, we estimated that the average incremental increase in cost for climate zone 4 is $735.00. The average improvement in energy cost savings is 13.1%, which means simple payback is achieved within 4.4 years, on average. Obviously, results will vary based on which compliance option is selected by the builder, unique characteristics of each building, and so on. But given that walls are unlikely to be altered over the expected 70-100 year useful lifetime of the building, wall insulation is a vitally important measure to incorporate at the time of construction.

Resiliency Impact Statement: This proposal will increase Resiliency
This proposal will increase resiliency in Virginia's residential buildings. The International Code Council published a white paper titled *The Important Role of Energy Codes in Achieving Resilience* regarding the role of energy efficiency in resiliency. *See* https://www.iccsafe.org/wp-content/uploads/19-18078_GR_ANCR_IECC_Resilience_White_Paper_BRO_Final_midres.pdf. Specifically, the ICC found that increased insulation requirements support passive survivability and reduce energy burdens on low-income families, grid impacts by reducing energy demand, ice-dams, and condensation, limiting mold and mildew.

Workgroup Recommendation

Public Comments for: REC-R402.1.2 (1)-21

Discussion by Ross Shearer
Feb 9, 2022 20:31 UTC

Virginia is now two iterations behind the IECC residential model for wall R values. Walls comprise a majority share of the above grade exposed surface of residential buildings.
Comment by Ross Shearer
Feb 9, 2022 22:31 UTC

Virginia is currently at the 2009 code for walls: R-13 insulation in the cavities of a 3 by 5 stud wall structure. This framing and insulating approach has been the custom since the 70s with the R-13 rating since 1990. (A change in the process of manufacturing fiberglass increased from R-11 to R-

13 the resistance to heat movement in 3.5 inches of fiberglass.) Builders did not have to change their wall structures or insulation practices in 1990 or in 2009 when Virginia adopted the 2009 IECC model. It appears they have not had to change their practices since the mid 70s. After nearly one-half century's passage, change is way overdue, and Virginians deserve full adoption of the 2021 IECC residential wall model.

Laura Baker and Eric Lacey have provided information from a study showing that adoption of the IECC model wall provisions will yield at least 13% in energy savings, capable of recouping the added construction costs of meeting this requirement within less than 5 years, a return on investment rate that is significantly better than the long term average of securities markets. Denying these savings to future homeowners (and tenants) over the period of homeownership (and the 70 to 100 year life of houses) should be unacceptable to all. In addition to these material benefits, full adoption of this efficiency standard offers other less tangible, but valuable benefits including increased resiliency during lengthy utility outages and lower mortgage default rates. All these factors contribute to stabilization of families and neighborhoods during utility outages and economic recessions.

For those who have reservations about the results of a study obtained by those advocating for responsible energy codes, the DHCD should request a similar analysis from the Pacific Northwest National Lab. If requested by DHCD, **PNNL will run its data to compare Virginia's current residential code to Virginia adopting only the 2021 requirements for above grade walls as proposed.** PNNL indicated to me that "We would be able to analyze the codes in any form as they are adopted/modified. We typically analyze the entire code and not just portions of the code. So we would compare any stock code year to a modified code, wall changes only, or any change."

I urge all stakeholders to support this highly cost effective code change. For any stakeholders harboring reservations about the effectiveness claimed, I ask those stakeholders support a request by DHCD for a specific wall insulation analysis by PNNL, as I state above in bold.

Proposal # 926

REC-R402.1.2 (2)-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Energy Conservation Code

Revise as follows:

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT [a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR [b]	SKYLIGHT [b] *U*-FACTOR	GLAZED FENESTRATION SHGC [b, e]	CEILING R-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE [i]	FLOOR *R*-VALUE	BASEMENT [c] WALL *R*-VALUE	SLAB [d] *R*-VALUE & DEPTH	CRAWL SPACE [c] WALL *R* VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32	0.55	0.25	38	20 or 13+5 or 0+15ci [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	~~15 or 13+1~~ 30 or 20+5ci or 13+10ci or 20ci [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	~~20 or 13+5~~30 or 20+5ci 13+10ci or 20ci [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20+5 [h] or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20+5 [h] or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

NR = Not Required.

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

   Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall.

   "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs. as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE R402.1.4 EQUIVALENT U-FACTORS [a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR [b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091 [c]	0.136
4 except Marine	0.32	0.55	0.026	~~0.079~~ 0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	~~0.060~~ 0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

Reason Statement: The purpose of this proposal is to have Virginia adopt the full wall insulation efficiency requirements of the 2021 IECC. These updates are critical since Virginia is still implementing the 2009 wall insulation standards, making it a *more than a decade* behind the IECC. Continuing to lag years behind the IECC is inconsistent with Virginia law governing building codes. Sections 36-99A and 36-99B of the Virginia Code require the USBC to protect the public, to adhere to recognized standards of energy conservation and water conservation, and to reduce construction and rehabilitation costs only to the extent the results are consistent with the recognized code standards. ("The provisions of the Building Code and modifications thereof shall be such as to protect the health, safety and welfare of the residents of the Commonwealth, provided that buildings and structures should be permitted to be constructed, rehabilitated and maintained at the least possible cost consistent with recognized standards of health, safety, energy conservation and water conservation….") H2227, which was enacted in 2021, specifically calls for efficiency standards Virginia's code to be "at least as stringent" as the most current IECC.

Residents' welfare is plainly harmed by failing to adopt the 2021 IECC building efficiency standards. The incremental costs of construction are more than outweighed by the energy cost savings and other benefits to residents from tighter, more energy-efficient construction. The 2021 IECC incorporates wall insulation changes in addition to those made in the 2012 IECC. DOE/PNNL found, years ago, that the 2012 IECC would save residents money every year compared to the 2009 standards even considering the impacts of construction costs on residents' full occupancy costs.[1] In 2021, it found that updating to the 2021 IECC would save residents money compared to the 2012 IECC standards. Its findings support 2021 IECC compliance both nationally and for Virginia.[2] DOE/PNNL's lifecycle cost-benefit analysis considered all the costs of ownership, including the mortgage and tax impacts attributable to incremental construction costs and the savings from reduced energy usage.

Structural energy efficiency measures, including wall insulation, are extremely important in dwellings that have an expected life of 70 years or more.[3] They will benefit all residents whether owners or tenants. The ongoing burden of inefficient construction harms everyone, but it particularly harms low-income and moderate-income residents.[4]

Other benefits to residents from implementing the 2021 IECC envelope insulation (and leakage) standards include (a) health benefits, (b) added comfort, (c) greater resilience, and (d) avoidance of future need for more costly wall retrofits. The general public would also benefit from implementing the 2021 IECC envelope standards by (i) reducing climate harms from carbon pollution, (ii) reducing other health impacts from fossil fuel pollution, (iii) reducing overall utility bills by avoiding peak and annual fuel costs and minimizing facility construction costs.

It is vital to implement the IECC's envelope insulation standards during initial construction. The cost of *retrofitting* insulation in walls is much higher because it would require removing, replacing and refinishing walls. As a result, retrofitting to achieve the 2021 requirements for new construction is less likely to be undertaken. Indeed, the Base Document would continue a practice of not requiring any insulation upgrades unless walls are opened for some other purpose. Thus, residents and the public would suffer long-term harm from continuing to permit builders to under-insulate walls.

To make matters worse, the public and utility customers are paying for efficiency upgrades of some dwellings in order to offset poor efficiency in existing buildings. Virginia is on-course to spend over $1 billion, this decade, on improving energy efficiency primarily in existing dwellings--vastly more than it would have cost to build the housing well in the first place. There is no basis for assuming that utilities will continue to spend ratepayer money to make up for construction practices that are not "at least as stringent" as those in the latest IECC.

In sum, it would harm both residents and the public to continue implementing outdated building code standards that results from construction standards that are not at least as stringent as the 2021 IECC.

[1] DOE/PNNL, *National Energy Cost Savings for New Single and Multifamily Homes, A Comparison of the 2006, 2009, and 2012 Editions of the IECC*, https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf

[2] https://www.energycodes.gov/national-and-state-analysis

[3] Alliance to Save Energy, https://www.ase.org/buildings

[4] The VA Poverty Law Center reports that "On average Virginia households experience an already higher than average electricity burden of 3.1%, compared to a national average of 2.7%. 'Electricity burden' is the percentage amount of your household income that is spent on electricity costs. Financial advisors agree that an average of 6% for your entire energy burden is 'affordable.' Virginian's higher than average electricity burden is unaffordable for over 75% of Virginia's households." https://vplc.org/electricity-burden-and-the-myth-of-virginias-rate-utopia/

Cost Impact: The code change proposal will increase the cost of construction
Adopting these long-overdue energy saving measures will add marginally to construction costs, but will provide greater long-term savings to residents and mitigate costs to the public generally, as outlined in the Reason and Resliency Statements. DOE/PNNL calculate that implementing the 2021 IECC will save Virginia residents $8,376 on a lifecycle basis, with positive cash flow to residents annually. DOE/PNNL, *Cost-Effectiveness of the 2021 IECC for Residential Buildings in Virginia* (July 2021), https://www.energycodes.gov/national-and-state-analysis DOE/PNNL analysis showed that the 2012-2018 IECC standards, including for wall insulation, also would save residents thousands of dollars -- if Virginia had adopted them on a timely basis. DOE/PNNL, *National Energy Cost Savings for New Single and Multifamily Homes, A Comparison of the 2006, 2009, and 2012 Editions of the IECC*, https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf

In other words, residents will experience net annual and monthly costs savings for many years compared to living in dwellings built based on pre-2012 IECC standards. Since the benefits to residents from full compliance with the 2021 IECC clearly outweigh the incremental construction costs, the statutory standards to adopt standards "at least as stringent" as the 2021 IECC have been more than satisfied. (Although the data published by DOE/PNNL amply demonstrates that full compliance satisfies the statutory standards, more detailed data and analysis can be requested by DHCD from PNNL, if desired.)

Resiliency Impact Statement: This proposal will increase Resiliency
The proposed measures will help to enhance resiliency by protecting residents, reducing energy demand, helping to mitigate climate impacts and preparing Virginia's buildings and economy for a future that requires the least energy usage and energy-driven pollution possible.
Improving envelope efficiency will help residents and communities to withstand power outages from storms or other causes. During power outages, buildings with tighter, better insulated envelopes remain comfortable much longer because more efficient envelopes better maintain indoor heat in cold periods and indoor coolness in warm periods. Reducing demand through greater building efficiency will reduce burdens on utilities. That will help utilities to hold down operating and capital costs, in addition to helping them better cope with storms and other difficulties. All rate payers and the entire community benefits from this greater resilience and lower costs.

Reduced demand for energy will also mitigate climate change impacts. Climate change is already harming Virginia, and the harms will get much worse if we do not sharply reduce GHG emissions (particularly CO2 and methane). Growing climate dangers include harms to communities, infrastructure, people, property and the economy from rising seas, worsening storms and more severe rainfall events. These harms extend well beyond coastal communities. Growing dangers also include rising atmospheric and water temperatures that threaten worsening heat-related illnesses, limits on economic activity, agriculture, fisheries, and our natural heritage. The likelihood of mitigating and of recovering from those harms declines the longer we delay maximizing energy savings and minimizing GHG pollution. Sensible investments now in energy conserving measures will reduce future rehabilitation and adaptation costs, as well as future harms.

Workgroup Recommendation

Public Comments for: REC-R402.1.2 (2)-21

This proposal doesn't have any public comments.

Proposal # 995

REC-R402.2-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Energy Conservation Code

Add new text as follows:

R202 General Definitions. SECTION R202 GENERAL DEFINITIONS
ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, electric motorcycles and the like, which is primarily powered by an electric motor that draws current from a rechargeable storage battery. A "plug-in hybrid" is a type of electric vehicle which relies on a combination of a rechargeable storage battery and another source of motive power.

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

EV CAPABLE SPACE. A designated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for EVSE, and with an adequately-sized raceway from the panel to a clearly identified location within three feet of the parking space, to support future EVSE.

EV READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit and adequate electric panel capacity and space to electrify EVSE. The circuit shall terminate in a suitable termination point, such as a receptacle, junction box, or an EVSE, located within three feet of the parking space.

R402.2 (N1104.2) Electric Vehicle (EV) charging for new residential construction. . New construction shall provide and facilitate future installation and use of Electric Vehicle Supply Equipment (EVSE) in accordance with the National Electrical Code (NFPA 70). **Exception:** EV supportive spaces are not required where no parking spaces are provided to residents.

R404.2.1 (N1104.2.1) One- and two-family dwellings and townhouses. .
For each dwelling unit, provide at least one EV Ready Space in a garage or outdoor parking area. The branch circuit shall be identified as "EV Ready" in the service panel or subpanel directory, and the termination location shall be marked as "EV Ready". The conduit for an outdoor EV Ready Space shall be located underground and be protected from water.

R404.2.2 (N1104.2.2) Multifamily dwellings (three or more units). EVSE Installed Spaces, EV Ready Spaces and EV Capable Spaces shall be provided in accordance with Table R404.2.2, so that the total number of such spaces equals the number of dwelling units for which parking spaces are made available to residents. Where the calculation of percentages of spaces to be served results in a fractional parking space, it shall round up to the next whole number. If a multifamily project is built in phases, the minimum number of required spaces shall be determined separately for each phase. EVSE shall be installed as residents of dwelling units acquire EVs and request EV charging facilities. Raceways to outdoor parking spaces shall be located underground and protected from water.

R404.2.3 (N1104.2.3) Identification. .

The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as "EVSE Installed," "EV Capable" or "EV Ready" and shall be updated as EVSE Installed Spaces are created. The raceway location shall be permanently and visibly marked as "EV Capable". Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information on amperage of future EVSE, raceway methods, wiring schematics and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the EVSE.

Table R404.2.2 Minimum EVSE Installed, EV Ready and EV Capable Spaces. Table R404.2.2
Minimum EVSE Installed, EV Ready and EV Capable Spaces

Type of space	Minimum number of EV spaces installed at completion of construction or phase of construction
EVSE Installed Spaces	Greater of 1 or 15% of total number of dwelling units offered parking
EV Ready Spaces	Greater of 1 or 15% of total number of dwelling units offered parking
EV Capable Spaces	Total number of dwelling units minus the sum of (EVSE Installed Spaces plus EV Ready spaces)

N202 General Definitions. ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, electric motorcycles and the like, which is primarily powered by an electric motor that draws current from a rechargeable storage battery. A "plug-in hybrid" is a type of electric vehicle which relies on a combination of a rechargeable storage battery and another source of motive power.
ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the Electric Vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or charging apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle.

EV CAPABLE SPACE. A designated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for EVSE, and with an adequately-sized raceway from the panel to a clearly identified location within three feet of the parking space, to support future EVSE.

EV READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit and adequate electric panel capacity and space to electrify EVSE. The circuit shall terminate in a suitable termination point, such as a receptacle, junction box, or an EVSE, located within three feet of the parking space.

N1104.2 Electric Vehicle (EV) charging for new residential construction. . New construction shall provide and facilitate future installation and use of Electric Vehicle Supply Equipment (EVSE) in accordance with the National Electrical Code (NFPA 70). **Exception:** EV Ready Spaces are not required where no parking spaces are provided to residents.

N1104.2.1 One- and two-family dwellings and townhouses.. For each dwelling unit, provide at least one EV Ready Space in a garage or outdoor parking area. The branch circuit shall be identified as "EV Ready" in the service panel or subpanel directory, and the termination location shall be marked as "EV Ready". The conduit for an outdoor EV Ready Space shall be located underground and be protected from water.

Exception: EV Ready Spaces are not required where no parking spaces are provided to residents.

N1104.2.2 Multifamily dwellings (three or more units).. EVSE Installed Spaces, EV Ready Spaces and EV Capable Spaces shall be provided in accordance with Table R404.2.2, so that the total number of such spaces equals the number of dwelling units for which parking spaces are made available to residents. Where the calculation of percentages of spaces to be served results in a fractional parking space, it shall round up to the next whole number. If a multifamily project is built in phases, the minimum number of required spaces shall be determined separately for each phase. EVSE shall be installed as residents of dwelling units acquire EVs and request EV charging facilities. Raceways to outdoor parking spaces shall be located underground and protected from water.

N1104.2.3 Identification. . The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as "EVSE Installed," "EV Capable" or "EV Ready" and shall be updated as EVSE Installed Spaces are created. The raceway location shall be permanently and visibly marked as "EV Capable". Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information on amperage of future EVSE, raceway methods, wiring schematics and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the EVSE.

Table N1104.2.2 Minimum EVSE Installed, EV Ready and EV Capable Spaces. Table N1104.2.2
Minimum EVSE Installed, EV Ready and EV Capable Spaces

Type of space	**Minimum number of EV spaces installed at completion of construction or phase of construction**
EVSE Installed Spaces	Greater of 1 or 15% of total number of dwelling units offered parking
EV Ready Spaces	Greater of 1 or 15% of total number of dwelling units offerred parking
EV Capable Spaces	Total number of dwelling units minus the sum of (EVSE Installed Spaces plus EV Ready spaces)

SECTION C202 DEFINITIONS. ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, electric motorcycles and the like, which is primarily powered by an electric motor that draws current from a rechargeable storage battery. A "plug-in hybrid" is a type of electric vehicle which relies on a combination of a rechargeable storage battery and another source of motive power.
ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the Electric Vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or charging apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle.

EV CAPABLE SPACE. A designated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for EVSE, and with an adequately-sized raceway from the panel to a clearly identified location within three feet of the parking space, to support future EVSE.

EV READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit and adequate electric panel capacity and space to electrify EVSE. The circuit shall terminate in a suitable termination point, such as a receptacle, junction box, or an EVSE, located within three feet of the parking space.

C405.10 . Electric Vehicle (EV) charging readiness. New construction shall provide and facilitate future installation and use of Electric Vehicle Supply Equipment (EVSE) in accordance with the National Electrical Code (NFPA 70). **Exception:** EV Ready Spaces are not required where no parking spaces are provided to residents.

C405.10.1 Multifamily Dwellings. Multifamily buildings not covered by R404.2 **(N1104.2)** shall provide EVSE Installed Spaces, EV Ready Spaces and EV Capable Spaces in accordance with Table C405.10.1, such that the total number of such EV supporting spaces at least equals the number of dwelling units for which parking spaces are made available to residents. Where the calculation of percentages of spaces to be served results in a fractional parking space, it shall round up to the next whole number. If a multifamily project is built in phases, the minimum number of required spaces shall be determined separately for each phase. EVSE shall be installed as residents of dwelling units acquire EVs and request EV charging facilities. Raceways to outdoor parking spaces shall be located underground and protected from water.

Table C405.10,1 Minimum EVSE Installed, EV Ready and EV Capable Parking Spaces.

Type of space	**Minimum number of EV spaces installed at completion of construction or phase of construction**
EVSE Installed Spaces	Greater of 1 or 15% of total number of dwelling units offered parking
EV Ready Spaces	Greater of 1 or 15% of total number of dwelling units offered parking
EV Capable Spaces	Total number of dwelling units minus the sum of (EVSE Installed Spaces plus EV Ready spaces)

Reason Statement: This provision is designed to provide electric charging readiness for the growing use of electric vehicles (EVs) and to meet the essential need to offer at-home charging to residents many of whom own EVs or will own EVs in the next few years. It is designed to minimize costs through phasing of EV development, with an emphasis on installing infrastructure during initial construction. One and two family dwellings and townhouses only require the basic wiring and panel capacity. The owner can add the charger or outlet when he or she has an EV. In the case of multifamily construction, the proposal requires defined numbers of initial EV Installed, EV Ready spaces and EV Capable Spaces. The total of the three categories is tied to the number of dwelling units which are eligible for parking so that all residents have an opportunity to charge an EV when one is acquired. The intent is to provide a modest number of EV Installed and EV Ready Spaces from the outset, with EV Capable Spaces for the remainder up to the number of dwelling units for which parking is provided. Buildings that house individuals receiving medical or other care may not provide parking to serve residents of all dwelling units. The proposal will benefit residents and the public, saving money and cutting pollution.

Providing access to home charging is important as a matter of equity. Although the purchase cost of EVs is currently higher than the low end of vehicles with combustion engines, the purchase price is falling as competition grows and, more importantly, the EV savings in fuel and maintenance costs more than pay for the initial price difference. Also, air pollution from traditional vehicles is particularly harmful to low-income residents of Virginia.

EVs are growing in importance and will continue to grow in importance as climate risks compel shifting to vehicles that do not emit pollution and as more people recognize the potential value of owning or leasing EVs. EVs will save EV users up to $1900 per year in operating expenses compared to traditional vehicles (based on prices when those reviews were done).[1] Those operating savings will encourage EV sales growth and will greatly exceed the costs of pre-wiring garages and installing other necessary infrastructure during construction. Installing during construction is much cheaper than doing so by retrofit.

Vehicles are Virginia's largest source of carbon-dioxide emissions from fossil fuel combustion.[2] Even based on today's mix of generation in Virginia, DOE estimates that EVs would reduce CO2 emissions by roughly two-thirds compared to vehicles combusting gasoline.[3] Emissions from generation that supplies EVs will decline more as utilities' zero-carbon renewable energy replaces fossil-fuel generation. EVs' direct emissions are non-existent, which also has substantial health and pollution benefits compared to gasoline or diesel vehicles. Furthermore, in addition to the EV user's savings on annual operating costs (energy and maintenance), EV charging during off-peak periods can lead to a reduction of electric rates to all utility customers.[4]

There is a national goal to have 50% of new vehicles to be EVs by 2030.[5] Major vehicle manufacturers have committed to shift production to EVs over the next 10 years with a number of manufactures committing to shift to 100% EV production in the next 5-10 years.[6]At-home charging in conjunction with single or multifamily parking is particularly important to meeting the needs of EV owners and to encourage charging during utilities' off-peak periods. According to research by JD Power, "80% of EV charging is done at home—almost always overnight—or while a car is parked during the workday" and EV users strongly prefer Level 2 (220/240V) charging. [7] The capability for at-home charging will substantially reduce barriers to EV adoption that arise from the inconveniences that EV charging is slower than pumping gasoline, the public infrastructure for charging is still limited, and drivers have limited ability to take advantage of off-peak rates without home-charging. Going forward, utilities may get the added benefit of being able to draw on the batteries of parked electric vehicles in order meet peak demands and balance fluctuating loads.Installing the wiring and basic infrastructure during construction when walls are open and workers are present is much cheaper than retrofitting which may damage wall board and require more difficult extensions of wiring. Experience shows that installing a simple 220V/40 Ampere outlet (comparable to a dryer or stove outlet) for "Level 2" EV charging, in a garage or outside close to parking spaces (e.g., on a wall near a single-family driveway), will enable an EV owner to reliably charge an EV at home, scheduling it at night or otherwise outside the utilities peak demand period for the lowest rates. The presence of the wiring from the beginning would permit low-cost installation of a different charging system preferred by the EV owner. Failure to install the EV during infrastructure will create barriers to EV adoption. Those barriers will be particularly great in the context of multifamily dwellings where retrofit costs are much higher and landlords' interests conflict with those of tenants

.[1] *See* Consumer Reports, “EVs Offer Big Savings Over Traditional Gas-Powered Cars” (October 2020); Union of Concerned Scientists, https://www.ucsusa.org/about/news/rural-communities-could-benefit-most-electric-vehicles (up to $1900/year savings for rural EV owners); https://augustafreepress.com/deq-launches-clean-air-communities-program-aimed-at-driving-investment-in-electric-vehicle The police department of Westport Connecticut achieved operating and maintenance savings of over $17,000 in its first year of using a Tesla Model 3 police car instead of a fossil fuel vehicle. Among the department’s conclusions: after four years the Tesla will have saved enough money to buy another Tesla, and each EV avoids emission of over 23 tons of CO2 per year and saves $8763 in environmental and health costs. https://www.teslarati.com/tesla-model-3-westport-police-department-financial-analysis/ Those studies were based on much lower gas prices than exist today, which means that today’s savings would be much larger.

[2]https://www.epa.gov/sites/production/files/2019-11/documents/co2ffc_2017.pdf[3] DOE estimates that an EV in Virginia emits (via electric generation) less than a third as much CO2 as a gasoline-driven vehicle. https://afdc.energy.gov/vehicles/electric_emissions.html ; https://evtool.ucsusa.org/

[4] See June 23, 2020 Comments of the Sierra Club to the State Corporation Commission in SCC Docket PUR-2020-00051, Electrification of Motor Vehicles. As the comments explain, with managed off-peak charging and efficient rate structures, rising EV loads can drive down rates to all customers. Regarding operating costs, an EV has very little maintenance costs and EV's electricity cost equivalent to a gallon of gasoline, in Virginia, was $1.16 versus roughly $4.00/gallon today. https://www.energy.gov/maps/egallon

[5] https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/

[6] EV sales are already increasing, and every major vehicle manufacturer has committed to expand EV production and even to go all-electric over the next decade or so. Electric pick-up trucks will soon be available and there are long waiting lists for pick-ups. *See* https://www.reuters.com/business/autos-transportation/us-automakers-say-they-aspire-up-50-ev-sales-by-2030-sources-2021-08-04/ https://www.forbes.com/wheels/news/automaker-ev-plans/ ; https://www.cnbc.com/2022/01/05/chrysler-kicks-off-plans-to-go-all-electric-by-2028-with-airflow-concept.html
https://www.electrive.com/2021/08/05/us-carmakers-aim-for-40-50-ev-sales-by-2030/

[7] https://www.forbes.com/wheels/news/jd-power-study-electric-vehicle-owners-prefer-dedicated-home-charging-stations/ See also James Walkinshaw, Washington Post, Jan. 23, p.C4 (explaining the importance of home charging relative to public charging). Utilities’ energy sales are lowest and cheapest in off-peak hours, particularly at night. A common utility strategy is to offer time-of-use rates with low night-time prices to encourage off-peak EV charging. For EV customers to make use of such incentives, they will need access to overnight charging at home where they spend the night.

Cost Impact: The code change proposal will increase the cost of construction

The code change proposal will somewhat increase the cost of constructing parking, but the increase will be small compared to the total cost of construction and the benefits to residents and the public. EVs with home charging will save occupants money and avoid the higher costs of retrofitting in the future.

The incremental cost of installing the electric equipment will be low when a residence is constructed (perhaps 0.0005-0.003 of an average new home or less). It is easy to install the wires, panel capacity and conduits for electric vehicle charging--along with the rest of a dwelling’s wiring--when a single or multifamily dwelling is built. It is much harder and much more expensive to do so as a retrofit. The branch circuit would cost a few dollars per foot.In a single-family dwelling garage or carport, for example, a branch circuit would need to be run from the circuit breaker, which is simple when other outlets are being installed during construction. However, as a retrofit, this basic wiring could require much higher costs from complicated feeding of a line and possible need to repair wall damage. If an electric panel is located in a garage, it will be particularly inexpensive to install an outlet during initial construction because the run would be short, potentially a couple of feet.

In a large multifamily building, the cost would be greater than a single-family dwelling due the larger garage or parking lot size and possibly the garage design. However, the costs of the infrastructure required by the proposal are still low compared to the overall construction cost, to potential retrofit costs, to residents’ long-term savings from EVs, and to harm from impeding tenants’ ability to reduce carbon and other pollutants which will reduce pollutants and benefit the public. The cost can be minimized by locating the EVSE (or future location for the EVSE) close to the electrical panels. The proposal limits the costs both by limiting the requirement to one space per dwelling unit for which parking is offered and by allowing deferral of some costs for EV Ready and EV Capable spaces.

The proposed multifamily requirements are tied to the number of dwelling units and staged as spelled out in the Table, so that residents of every dwelling unit will have the opportunity to home-charge an EV, and the remaining electrical wiring and charger costs would only be incurred as occupant demand grows. (Couples in a unit can share a charger.) In submissions to the IECC as part of the 2021 IECC review process, data indicated that the cost of retrofitting commercial parking to EV ready status would be 3-8 times higher than doing to work at the time of building construction. See IECC Proposal CE217-19 Part 1(Cost Impact discussion). Such high retrofit costs will deter future retrofits and act as a barrier to EV access by residents of multifamily dwellings, potentially for decades.

Resiliency Impact Statement: This proposal will increase Resiliency
Expanding EV utilization will enhance resiliency in multiple ways.
EVSE can be designed to deliver electricity back to a dwelling, which would protect residents during periods of power outages. https://www.ford.com/trucks/f150/f150-lightning/2022/ It is anticipated that EV batteries can also be connected to the grid to provide grid balancing and back up in the future.
Switching to EVs is also critical to resiliency because it will reduce CO2, CO, SO2, particulates, methane, and other harmful emissions from fossil-fuel combusting vehicles and from producing and delivering gasoline and diesel fuel for use in vehicles. Unlike traditional vehicles with internal combustion engines (“ICE”), electric vehicles emit no air pollution and are much more energy efficient than ICE vehicles. As Virginia's electric grid shifts to zero-carbon generation, the emission reduction benefits will grow.
According to Virginia’s DEQ, “[t]he transportation sector is now the largest contributor of air pollutants and greenhouse gases in Virginia,” and “[v]ehicle emissions are the largest single source of toxic and smog-forming air pollution in Northern Virginia and much of the rest of the country.” https://www.deq.virginia.gov/air/clean-vehicles . Transportation accounts for 48.6% of Virginia’s CO2 emissions. https://www.eia.gov/environment/emissions/state/
Polluting emissions from internal combustion vehicles compound the risks of climate change and adversely impact public health. CO2 and other emissions from fossil fuel combustion and production are the primary drivers of climate change. The most recent IPCC report confirms that rapid reductions of greenhouse gas emissions is essential to avoid catastrophic climate impacts around the world. IPCC Sixth Assessment Report (February 2022), https://www.ipcc.ch/report/ar6/wg2/ Substantial harm has already occurred nationally and locally from global warming and much worse will follow without rapid reductions of greenhouse gases (particularly CO2 and methane associated with fossil fuel production and combustion). Virginia's coastal areas are among the most vulnerable to sea level rise and destructive storms. They already experience “sunny day flooding,” and sea level rise is accelerating. https://www.vims.edu/newsandevents/topstories/2020/slrc_2019.php Climate change is already harming Virginia and the harms will get much worse if we do not sharply reduce GHG emissions (particularly CO2 and methane associated with fossil fuel production and combustion). The most recent report from NOAA indicates that Virginia may face 2 feet of sea level rise by 2050 due to worsening climate change from human greenhouse gas emissions. https://www.noaa.gov/news-release/us-coastline-to-see-up-to-foot-of-sea-level-rise-by-2050 Virginia faces climate-driven sea level rise of 6.69 feet this century; the rate of sea level rise is accelerating; the danger of climate-driven severe storms, storm-surges and flooding are rising; and climate change will increasingly harm human health and lives, agriculture, businesses, military installations, private and public property, and Virginia’s economy. http://www.vasem.org/reports/2021-the-impact-of-climate-change-on-virginias-coastal-areas/ Growing dangers also include rising atmospheric and water temperatures that worsen heat-related illnesses, disruptions of economic activity, and harms to agriculture, fisheries, and our natural heritage.
Because atmospheric CO2 from emissions is cumulative, Virginia has less chance of mitigating and recovering from those harms the longer we delay maximizing energy savings and minimizing greenhouse gas pollution.
Shifting to EVs is a critical piece of the solution to global warming. Continuing to construct buildings that will not support use of clean EVs will make it harder to achieve climate goals, particularly since the buildings will likely remain in place for 70 years or more. Constructing buildings that cannot provide electric charging will also delay residents' ability to access large economic and energy savings from EV usage.
Building codes already recognize that fumes from traditional vehicles are dangerous. More broadly, small particle, SO2 and other pollution from vehicles burning fossil fuels increases heart and lung disease, as well as cognitive and other disorders. https://blog.ucsusa.org/dave-reichmuth/air-pollution-from-cars-trucks-and-buses-in-the-u-s-everyone-is-exposed-but-the-burdens-are-not-equally-shared/ As Virginia's electric grid shifts to zero-carbon generation, the emission reduction benefits will grow particularly if we shift vehicles to clean electricity. Local air pollution harms caused by vehicle pollution will also be reduced which will particularly benefit high-traffic areas, including low-income urban areas.

Workgroup Recommendation

Public Comments for: REC-R402.2-21

This proposal doesn't have any public comments.

REC-R402.4-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Construction Code

Revise as follows:

1301.1.1.1 Changes to the International Energy Conservation Code (IECC).

21. ~~Change Sections R402.4 and R402.4.1.1 to read:~~

    ~~**R402.4 Air leakage.** The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.~~

    ~~**R402.4.1.1 Installation (Mandatory).** The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction.* Where required by the code official, an *approved* third party shall inspect all components and verify compliance.~~

22. ~~Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:~~

23. ~~Change Section R402.4.1.2 to read:~~

    ~~**R402.4.1.2 Testing.** The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official.* Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.~~

    ~~**Note:** Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.~~

    ~~During testing:~~

    1. ~~Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;~~
    2. ~~Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;~~
    3. ~~Interior doors, if installed at the time of the test, shall be open;~~
    4. ~~Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;~~
    5. ~~Heating and cooling systems, if installed at the time of the test, shall be turned off; and~~
    6. ~~Supply and return registers, if installed at the time of the test, shall be fully open.~~

24. ~~Change Section R403.3.3 to read:~~

~~**R403.3.3 Duct testing (Mandatory).** Ducts shall be pressure tested to determine air leakage by one of the following methods:~~

1. ~~Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.~~
2. ~~Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.~~

~~**Exception:** A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.~~

~~A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.~~

Reason Statement: The purpose of this proposal is to bring Virginia's standards for air leakage testing and air leakage rates into full compliance with the 2021 IECC from which the new language is drawn.

The air leakage level permitted by Virginia's 2018 Energy Conservation Code predates the 2012 IECC, which required air leakage to not exceed 3.0 air changes per hour in Virginia's climate zones. Retaining the 5.0 ACH level would make Virginia's USBC more than a decade behind the IECC, and plainly out of compliance with statutory standards. Sections 36-99A and 36-99B of the Virginia Code make clear that building codes are required to "protect the health, safety and welfare of the residents of the Commonwealth" and that deviations to reduce construction costs must nevertheless be "consistent with recognized standards of health, safety, energy efficiency and water efficiency." H2227, which was enacted in 2021, calls for adoption of energy efficiency standards that are "at least as stringent" as the latest IECC.

Reducing the maximum air infiltration to 3 air changes per hour was established as technically and economically viable when the 2012 IECC was promulgated. Following promulgation of the 2012 IECC, DOE found that the changes from 2009 improved efficiency and was cost effective for occupants in that they saved money every year and quickly recouped the cost of construction. DOE/PNNL, *National Energy Cost Savings for New Single and Multifamily Homes, A Comparison of the 2006, 2009, and 2012 Editions of the IECC*, https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf

The IECC requirement has remained at 3 air changes per hour in the 2015, 2018 and 2021 IECCs. If there were any technical or economic reason to adopt 5 ACH in Virginia's climate zones, the ICC has had three cycles to make the adjustments, but it has not done so. There is no valid reason for Virginia to continue to permit leaky houses that require additional heating and cooling in order to offset the infiltration of outside air.

Tightening building air sealing to test at 3 (versus 5) air changes per hour (a.k.a. "3 ACH" or "3 ACH50") is important to residents who will save money, experience greater comfort and a healthier home. Every additional air change requires additional heating and conditioning of air in the dwelling, and reflects poor sealing which leaves gaps for pests to enter the dwelling. While indoor humidity can be an issue in buildings (regardless of the tightness of construction) during periods in which spaces are not being heated or cooled, it is not a valid reason for refusing to implement the IECC's long-established standards for 3 ACH since greater air to flow through walls and ceilings increases the risks that moisture will be captured inside walls and insulation increasing the risks of mold and deterioration.

There is a broad consensus among recognized standards that tighter sealing of walls protects the health, safety and welfare of residents. To address indoor air issues, the IECC has long required whole-house mechanical ventilation for buildings that test at less than 5 ACH and has modified the envelope barrier standards. DOE has even tighter standards (2.5 ACH50 for Climate Zone 4) for its Zero-Energy program, and Passive House standards call for 0.6 ACH50. https://basc.pnnl.gov/information/infiltration-meets-ach50-requirements ; http://passivehousebuildings.com/books/phc-2019/five-principles-of-passive-house-design-and-construction/ The National Association of Home Builders has also recognized many benefits from minimizing air leakage.[1] And, EPA encourages tighter sealing of walls to reduce air infiltration (including infiltration of humid air), reduce energy waste, reduce the risks of indoor air pollution, reduce humidity and mold in walls, and reduce risks of infiltration by insects and rodents—another specific concern in Virginia's building code, which we cited. As EPA has stated, in *EnergyStar: A complete Thermal Enclosure System* (2017):

> The energy savings from comprehensive air sealing can quickly add up when you consider all the places hot or cool air can enter or escape from your home. Having a well-sealed home also means better air quality because dirt, pollen, pests, and moisture can't get in as easily. In addition, good sealing practices help protect your home against mold and moisture damage that can be caused by condensation.

[1] See NAHB, et al., "TechNote – Building Tightness Code Compliance & Air Sealing Overview", which (a) states "Air leakage in a building should be minimized;" (b) identifies benefits to residents including ""Heating & cooling energy savings; Reduced potential for moisture movement through the building thermal enclosure; Improved insulation effectiveness and reduced risk of ice dams; Reduced peak heating and cooling loads resulting in smaller HVAC equipment; Improved comfort (reduces drafts and noise); Improved indoor air quality (limits contaminants from garages, crawl spaces, attics, and adjacent units)" and (c) suggests a possible construction strategy with a goal of 2.5 ACH – stricter than the IECC.

Cost Impact: The code change proposal will increase the cost of construction
The code change proposal will increase the cost of construction in some, but not all projects, *i.e.,* primarily when blower door tests reveal an excess of air leakage between 3 and 5 ACH. A well planned and built house should meet the 3 ACH standard, and the additional costs of caulking and other sealing techniques are limited. To the extent a blower door test reveals leaks between 3 and 5 ACH, the additional cost will typically involve filling envelope gaps with caulk and other materials which are not costly. It may take some looking to find the gaps, but it shouldn't be hard to block the leaks. Greater care by builders during the framing, insulating and sealing processes will avoid having to go back and fix leaks.
On the other hand, residents will save money and experience other benefits by reducing the volume of air changes that have to be reheated, re-cooled or dehumidified. Retrofitting to achieve the same level of tightness after walls have been closed up could require going behind walls and would be much more difficult and costly to building owners than doing the job well during the construction phase. As noted in the Reason Statement, DOE/PNNL found that the 2012 IECC changes, including the air tightness standards, would save residents money year in and year out, on a life-cycle basis. DOE/PNNL, *National Energy Cost Savings for New Single and Multifamily Homes, A Comparison of the 2006, 2009, and 2012 Editions of the IECC*, https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf If the costs had outweighed the benefits of the 3.0 ACH leakage standard, the ICC could have raised the permissible leakage rate any time in the four cycles 2012-2021. It did not, and Virginia should no longer deny the benefits to occupants of newly constructed dwellings. (Although the data published by DOE/PNNL amply demonstrates that full compliance satisfies the statutory standards, more detailed data and analysis can be requested by DHCD from PNNL, if desired.)

Resiliency Impact Statement: This proposal will increase Resiliency
Improving building energy efficiency with the 3 ACH standard will increase resiliency compared to Virginia's outdated 5 ACH standard. By reducing the volume of air that needs to be reheated or cooled every day, the proposal will reduce energy usage and cost burdens. By better preserving indoor conditioned temperatures, it will help residents and communities withstand periods of power outages from storms or other causes. Improving envelope efficiency will also reduce burdens on utilities which will help them better cope with storms and other difficulties.

By reducing demands for energy generation, tightening construction will also help mitigate climate impacts and prepare Virginia's buildings and economy for a future that requires the least energy usage and related pollution possible. Climate change is already harming Virginia and the harms will get much worse if we do not sharply reduce GHG emissions (particularly CO2 and methane). Growing climate dangers include harms to communities, infrastructure, people, property and the economy from rising seas, worsening storms and more severe rainfall events. Growing dangers also include rising atmospheric and water temperatures that threaten worsening heat-related illnesses, limits on economic activity, agriculture, fisheries, and our natural heritage. The likelihood of mitigating and recovering from those harms declines the longer we delay maximizing energy savings and minimizing GHG pollution.

Furthermore, saving energy will reduce occupants' utility bills while increasing their comfort. Reducing energy cost burdens will improve the *economic resiliency* of all residents, but particularly low and moderate income customers most harmed by high bills. It will also the *economic resiliency* of lenders, landlords and communities by reducing loan defaults and residents' choices between paying energy bills and rent, mortgages and other basic family needs. With buildings lasting 70 or more years, there is no excuse for not meeting standards established 10 years ago.

Workgroup Recommendation

Public Comments for: REC-R402.4-21

This proposal doesn't have any public comments.

REC-R402.4.1.2-21

Proponents: Laura Baker (laura@reca-codes.com); Eric Lacey (eric@reca-codes.com)

2018 Virginia Energy Conservation Code

Revise as follows:

R402.4.1.2 Testing. The building or *dwelling unit* shall be tested ~~and verified as having an~~ forair leakage . ~~rate not exceeding five air changes per hour in *Climate Zone* 4.~~ The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 m^3 /(s x m^2)] of the dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official* , testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official. ~~Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia registered design professional, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the equipment used to perform the test.~~ Testing shall be performed at any time after creation of all penetrations of the building thermal ~~envelope.~~ envelope have been sealed .

~~**Note:** Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.~~

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors and fireplace and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous *ventilation* systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units* , an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 m^3 /(s x m^2)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single and multiple-family building dwelling units.

2. Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the *International Residential Code* or Section 403.3.2 of the *International Mechanical Code* , as applicable, or with other *approved* means of ventilation.

Add new text as follows:

R402.4.1.3 Leakage rate.. When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per house in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

2018 Virgina Residential Code

Revise as follows:

N1102.4.1.2 (R402412) Testing. The *building* or dwelling unit shall be tested ~~and verified as having an~~ for air leakage ~~rate not exceeding five air changes per hour in Climate Zone 4 4.~~ . The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 m^3 /(s x m^2)] of the dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inches w.g. (50 Pa). Where required by the *code official* , testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the ~~building building~~ code official. ~~Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia registered design professional, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test.~~ Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

~~**Note:** Should additional sealing be required as a result of the test, consideration may be given to the issuance of temporary certificate of occupancy in accordance with Section 116.1.1.~~

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors and fireplace and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units* , an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 m^3/(s x m^2)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single and multiple-family building dwelling units.

2. Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the *International Residential Code* or Section 403.3.2 of the *International Mechanical Code* , as applicable, or with other *approved* means of ventilation.

Add new text as follows:

N1102.4.1.3 (R402.4.1.3) Leakage rate.. When complying with Section N1101.2.1 (R401.2.1), the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1, and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section N1102.4.1.2 (R402.4.1.2).

2018 Virginia Construction Code

Revise as follows:

1301.1.1.1 Changes to the International Energy Conservation Code (IECC). Error creating auto-diffed output. (0x01)
The following changes shall be made to the IECC:

1. Add Sections C402.1.4.2, C402.1.4.2.1, C402.1.4.2.2, C402.1.4.2.3, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5 and Change Section C402.2.1.1 to read:

C402.1.4.2 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on *construction* materials used in the roof/ceiling assembly.

C402.1.4.2.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) for *U*-factor compliance as prescribed in Section C402.1.4.
C402.1.4.2.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling *construction*.
C402.1.4.2.3 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.

C402.2.1 Roof assembly The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on *construction* materials used in the *roof assembly*.

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the tapered roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) for *R*-value compliance as prescribed in Section C402.1.3.
C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).
C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling *construction*.
C402.2.1.4 Multiple layers and staggered joints. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered. Multiple layers and staggered joints are not required where insulation tapers to the *roof deck* at a gutter edge, roof drain or scupper.
C402.2.1.5 Skylight curbs. Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.

Exception: Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

2. Change the SHGC for Climate Zone 4 (Except Marine) of Table C402.4 to read:

3. Delete Section C402.4.1.2, change Sections C402.4.2, C402.4.2.1, C402.4.2.2 and C402.4.3.

C402.4.2 Skylight area with daylight response controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Section C405.2.3.1 are installed in daylight zones under skylights.

C402.4.2.1 Daylight Zone Controls under skylights. Daylight responsive controls complying with Section C405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.
C402.4.2.2 Haze factor. Skylights that are installed in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.

C402.4.3 Maximum *U*-factor and SHGC. The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Equation 4-5.

$$PF = A/B \qquad \textbf{(Equation 4-5)}$$

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the farthest continuous extremity of any overhand, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.
Where different windows or glass doors have different PF values, they shall each be evaluated separately.

Where the fenestration projection factor for a specific vertical fenestration product is greater than or equal to 0.20, the required maximum SHGC from Table C402.4 shall be adjusted by multiplying the required maximum SHGC by the multiplier specified in Table C402.4.3 corresponding with the orientation of the fenestration product and the projection factor.

4. Add Table C402.4.3 to read:

5. Add an exception to the first paragraph of Section 403.7.7 to read:

Exception: Any grease duct serving a Type I hood installed in accordance with the *International Mechanical Code* (IMC) Section 506.3 shall not be required to have a motorized or gravity damper.

6. Add Section C403.2.2.1 to read:

C403.2.2.1 Dwelling unit mechanical ventilation. Mechanical ventilation shall be provided for *dwelling units* in accordance with the IMC.

7. Delete Section C403.7.5 and Table C403.7.5.
8. Delete Sections C404.5 through C404.5.2.1, including Tables.
9. Change Section C405.4 to read:

C405.4 Exterior lighting (Mandatory). All exterior lighting, other than low-voltage landscape lighting, shall comply with Section C405.4.1.

Exception: Where *approved* because of historical, safety, signage, or emergency considerations.

10. Change Section C502.1 to read:

C502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of Section 805 of the *Virginia Existing Building Code* (VEBC).

11. Delete Sections C502.2 through C502.2.6.2.
12. Change Section C503.1 to read:

    C503.1 General. Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

13. Delete Sections C503.2 through C503.6.
14. Change Section C504.1 to read:

    C504.1 General. *Buildings* and *structures*, and parts thereof, shall be repaired in compliance with Section 510 of the VEBC.

15. Delete Section C504.2.
16. Change Section R401.2 to read:

    R401.2 Compliance. Projects shall comply with all provisions of Chapter 4 labeled "Mandatory" and one of the following:

    1. Sections R401 through R404.
    2. Section R405.
    3. Section R406.
    4. The most recent version of REScheck, keyed to the 2018 IECC.

17. Change Section R401.3 to read:

    R401.3 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. Where *approved*, certificates for multifamily *dwelling units* shall be permitted to be located off-site at an identified location. The certificate shall indicate the predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces; *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results from any required duct system and *building* envelope air leakage testing performed on the *building.* Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types 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.

18. Change the wood frame wall *R*-value categories for Climate Zone 4 (Except Marine) in Table R402.1.2 to read:

19. Change the frame wall *U*-factor categories for Climate Zone 4 (Except Marine) in Table R402.1.4 to read:

20. Change Section R402.2.4 to read:

    R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces (e.g., *attics* and crawl spaces) shall be weatherstripped and insulated in accordance with the following values:

    1. Hinged vertical doors shall have a minimum overall R-5 insulation value;
    2. Hatches and scuttle hole covers shall be insulated to a level equivalent to the insulation on the surrounding surfaces; and
    3. Pull down stairs shall have a minimum of 75 percent of the panel area having R-5 rigid insulation.

    Access shall be provided to all *equipment* that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

21. Change Sections R402.4 and R402.4.1.1 to read:

R402.4 Air leakage. The *building* thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1.1 Installation (Mandatory). The components of the *building* thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of *construction*. Where required by the code official, an *approved* third party shall inspect all components and verify compliance.

22. Change the title of the "Insulation Installation Criteria" category of Table R402.4.1.1; change the "Shower/tub on exterior wall" category of Table R402.4.1.1, and add footnotes "b" and "c" to Table R402.4.1.1 to read:

23. Change Section R402.4.1.2 to read:

R402.4.1.2 Testing. The *building* or *dwelling unit* shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the *building official*. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia *registered design professional*, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the *equipment* used to perform the test. Testing shall be performed at any time after creation of all penetrations of the *building* thermal envelope.

Note: Should additional sealing be required as a result of the test, consideration may be given to the issuance of a temporary certificate of occupancy in accordance with Section 116.1.1.

During testing:

1. Exterior windows and doors and *fireplace* and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft, and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

24. Change Section R403.3.3 to read:

R403.3.3 Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exception: A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the equipment used to perform the test.

25. Delete Section R403.3.5.

26. Change Section R403.7 to read:

> **R403.7 Equipment and appliance sizing.** Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S or other *approved* sizing methodologies based on *building* loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.
>
> **Exception:** Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other *approved* sizing methodologies where any of the following conditions apply:
>
> 1. The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the *approved* heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.
> 2. The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the *approved* heating and cooling methodology and the next larger standard size unit is specified.
> 3. The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer.

27. Change footnote "a" in Table R406.4 to read:

    a. When onsite renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2 and the building thermal envelope shall be greater than or equal to levels of energy efficiency and solar heat gain coefficient in Table R402.1.2, with a ceiling *R*-value of 49 and a wood frame wall *R*-value of 20 or 13 + 5, or Table R402.1.4, with a ceiling *U*-factor of 0.026 and a frame wall *U*-factor of 0.060.

28. Change Section R501.1 to read:

> **R501.1 Scope.** The provisions of the *Virginia Existing Building Code* (VEBC) shall control the alteration, repair, addition and change of occupancy of existing *buildings* and *structures*.

29. Delete Sections R501.1.1 through R501.6.
30. Change Section R502.1 to read:

> **R502.1 General.** Additions to an existing *building*, *building* system or portion thereof shall conform to the provisions of Section 811 of the VEBC.

31. Delete Sections R502.1.1 through R502.1.2.
32. Change Section R503.1 to read:

> **R503.1 General.** Alterations to any *building* or *structure* shall comply with the requirements of Chapter 6 of the VEBC.

33. Delete Sections R503.1.1 through R503.2
34. Change Section R504.1 to read:

> **R504.1 General.** *Buildings*, structures and parts thereof shall be repaired in compliance with Section 510 of the VEBC.

35. Delete Section R504.2.

Reason Statement: The purpose of this code change proposal is to improve efficiency and maintain compliance flexibility for code users by modifying the air leakage testing requirements to be consistent with the 2021 IECC. Specifically, the proposal improves the baseline envelope tightness requirement from 5.0 ACH50 to 3.0 ACH50, but adds a performance path trade-off option for air tightness up to 5.0 ACH50, as long as the efficiency losses are accounted for. The proposal also adds a cfm/sq.ft. compliance option for attached dwelling units and small single-family dwelling units in order to provide more options for builders.
This proposal includes a cost-effective incremental improvement from Virginia's 2018 USBC by tightening the air leakage rate from 5.0 ACH50 to 3.0 ACH50. Based on an analysis of this code change using the U.S. Department of Energy's methodology and using BEopt modeling software, we estimate that this improvement will achieve 9.2% lower energy costs, with a simple payback period of less than 2 years. Results will obviously vary based on the characteristics and size of the home, as well as how much additional work is necessary to achieve the lower leakage rates, but given the long-term benefits of a tighter envelope -- lower energy costs, more efficient system operation, better indoor air quality, etc. -- this improvement is well-justified.

The prescriptive air leakage rate of 3.0 ACH50 has been in the code since the 2012 edition of the IECC. In the 2018 USBC update, Virginia implemented mandatory blower door testing at a rate of 5.0 ACH50, which was short of the full requirement in the 2018 IECC. Now that builders have had some additional experience with mandatory blower door testing and sealing techniques, we believe it is reasonable to further improve the requirements. At the same time, for projects that are not yet able to achieve envelope air tightness of 3.0, there is an alternative to comply via the performance path or Energy Rating Index, which will allow leakage rates up to 5.0 ACH50. This proposal also clarifies the maximum air leakage rates as 3.0 and 5.0 air changes per hour. While most code users understand the maximum air leakage rates as already being at 3.0 and 5.0 changes per hour, the addition of another digit will pre-empt any “round up” vs. “round-down” arguments from code users, providing additional support for building code officials who are simply trying to enforce the code. This part of the proposal does not change any actual requirements, but rather provides clarification and reduces inconsistency and confusion.

Cost Impact: The code change proposal will increase the cost of construction
For buildings not already achieving 3 ACH50 or less, this code change will likely increase construction costs. Based on an analysis using the U.S. DOE methodology for reviewing code changes, and using BEopt modeling software, we estimate that the average marginal cost increase of this proposal is $144. However, our analysis also showed a 9.2% improvement in overall efficiency, which would result in a simple payback of less than 2 years. We also note that for any project for which the prescriptive requirement may be infeasible, builders will have the flexibility to meet the current air leakage requirement from the 2018 USBC using tradeoffs under another compliance path.

Resiliency Impact Statement: This proposal will increase Resiliency
This proposal will increase the resiliency of homes. A properly sealed home will help maintain better indoor air quality and improve the long-term durability of the home. It will also reduce the volatility of indoor temperature swings and maintain more livable conditions during power outages due to natural emergencies.

Workgroup Recommendation

Public Comments for: REC-R402.4.1.2-21

This proposal doesn't have any public comments.

REC-R403.1.2-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Existing Building Code

Add new text as follows:

603.5.2 Heat Pump as Primary Space Heat Source. Electric resistance heat shall not be used as the primary electric heat source for space heating in new residential construction or as a replacement for a heat pump in existing dwelling units

2018 Virginia Energy Conservation Code

Revise as follows:

R403.1.2 Heat pump ~~supplementary~~ heat (Mandatory). Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.
Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load. Except in emergency heating mode, the supplementary electric-resistance heat in heat pump systems installed in new construction may not energize unless the outdoor temperature is below 40º F (4º C).

Add new text as follows:

R403.1.3 Heat Pump as Primary Space Heat Source. Electric resistance heat shall not be used as the primary electric heat source for space heating in new residential construction or as a replacement for a heat pump in existing dwelling units

Reason Statement: Electric resistance heat is a highly inefficient form of space heating when compared to electric heat pumps. Heat pumps are roughly 300% more efficient. https://mygreenmontgomery.org/2021/environmental-and-economic-advantages-of-switching-to-an-electric-heat-pump/ Baseboard electric heating also distributes heat poorly compared to ducted systems or mini-splits.Reliance on electric resistance heat for a primary heat source (as opposed to a supplemental resistance element in a heat pump for especially cold conditions) raises heating costs for residents compared to electric heat pumps. Electric resistance heating also imposes substantial seasonal and peak-period cost burdens on electric utilities, which get passed on to other utility customers.
Compared to resistance heating, heat pumps substantially reduce a customer's heating bills--by 50% compared to resistance heat according to DOE.https://www.energy.gov/energysaver/heat-and-cool/heat-pump-systems For these reasons, the proposal would restrict installation of electric resistance heating and of heat pumps that are designed to activate resistance back-up when outdoor temperatures are above 40ºF.
Heat pumps also incorporate air conditioning, which provides customers with the health and comfort benefits of cooling in the summer and avoids the cost of installing air conditioning units during construction. Builders have the option to install whole-house, ducted heat pumps or "mini-split" heat pumps without no ducts. Heat pumps are appropriate for large or small dwellings and additions.

The proposal is modeled on a Georgia building code provision (R403.1.2).

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal may, but will not necessarily, increase the cost of construction. However, it will substantially reduce total costs occupancy and lifecycle to residents.

Resistance space heating may be cheaper to install than a standard heat pump or mini-split heat pump. However, it does not provide air conditioning which is an inherent part of a heat pump, including a mini-split. Adding a stand-alone air conditioning unit to a resistance heating unit can make the total cost greater. Like baseboard electric heat, mini-splits do not require duct work. Comparable duct work would be required for both electric furnaces and central heat pumps.

The additional upfront cost of a heat pump or mini-split compared to resistance heat will be recovered by the owner or tenant through energy cost savings attributable to a heat pump's much greater energy efficiency. As noted, DOE reports that heat pumps can reduce heating costs by 50% compared to resistance heat. https://www.energy.gov/energysaver/heat-and-cool/heat-pump-systems.

Since a heat pump or mini-split provides air conditioning, it will also provide a form of seasonal comfort, including summer dehumidification, not produced by any form of electric resistance unit. Cooling in periods of intense heat is important for the health of residents, as has been recognized by the BHCD. The hazards of heat illness are growing with climate change and the associated health care costs need to be considered.

By reducing demands on utilities for expensive generation to meet peak demands and by reducing air pollution emissions from power generation, heat pumps will also reduce costs to utility customers generally and pollution costs to the public generally.

Resiliency Impact Statement: This proposal will increase Resiliency
This proposal will increase Resiliency. Heat pumps effectively heat dwellings while reducing the peak demands placed on utilities in winter months. Such demand reductions reduce risks of utility outages. Heat pumps also provide year round comfort since they both heat and cool.

Climate change poses an ever-greater resiliency threat the longer we fail to reduce greenhouse gas (GHG) emissions. It poses an ever-growing risk of heat-illness, floods, storms, sea level rise, air and ocean heating, and other disasters that threaten residents and the economy. The need to swiftly reduce carbon emissions has been recognized by multiple agencies of the U.S. government (e.g., EPA, DOE, NAS, Global Change Research Program), by international agencies (e.g., U.N., IPCC, IEA), as well as by Virginia (e.g., in Governor Northam's Executive Order 43 (2019) and in 2020 legislation by the General Assembly). Improving the efficient use of energy is recognized as a critical measure to reduce GHG emissions and harmful climate impacts, as well as to reduce land and water pollution and overall utility costs to consumers. This proposal will replace highly inefficient resistance heating with much more efficient heat pumps.

Workgroup Recommendation

Public Comments for: REC-R403.1.2-21

This proposal doesn't have any public comments.

Proposal # 934

REC-R403.3.3-21

Proponents: Eric Lacey (eric@reca-codes.com)

2018 Virgina Residential Code

Revise as follows:

N1103.3.3 (R40333) Duct testing (Mandatory). Ducts shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1-inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1-inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exception: A duct air leakage test shall not be required ~~where the ducts and air handlers are located entirely within the *building thermal envelope*.~~ for ducts serving heating, cooling or ventilation systems that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. The licensed mechanical contractor installing the mechanical system shall be permitted to perform the duct testing. The contractor shall have been trained on the *equipment* used to perform the test.

N1103.3.4 (R403.3.4) Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

~~4 3 4~~

1.

4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area where the air handler is installed at the time of the tes

3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

2.

4.0 cubic feet per minute (113.3 L/ min) per 100 square feet (9.29 m^2) of conditioned floor area.

3. Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the building thermal envelope, total leakage sh

N1103.3.5 (R40335) Building cavities (Mandatory). ~~(Section deleted.)~~
Building framing cavities shall not be used as ducts or plenums.

Reason Statement: This proposal updates the code provisions related to duct testing to be consistent with the 2021 IECC. A few of the changes proposed (such as the requirement that building cavities not be used as ducts or plenums) have been in the IECC for several editions; others (such as the addition of a duct test for ducts inside conditioned space) were added in the 2021 IECC update. It incorporates the changes brought about by proposals RE112-19, RE114-19, and RE118-19.
This proposal establishes a maximum level of allowable duct leakage -- regardless of the location of the ducts. From the proponent's original reason statement in proposal RE115:

"The purpose of this code change proposal is to help ensure long-term energy savings, occupant comfort and promote good building quality by establishing a maximum level of duct leakage permitted as a trade-off backstop for duct tightness. We propose a backstop that would still permit substantial flexibility – double the allowable leakage rate as the prescriptive requirement -- but that would establish a “worst case scenario” for all tested homes in all compliance paths.There is currently no upper limit on duct leakage in the IECC. In the 2012 IECC, all ducts (except those in conditioned space) were required on a mandatory basis to meet the prescriptive levels. The mandatory nature of the requirement was removed in 2015, allowing duct tightness to be fully traded off for other efficiency measures. We believe some trade-off is acceptable, but that a minimum level of duct tightness is necessary to ensure some reasonable level of duct performance occurs in the home. When ducts are excessively leaky, there is no assurance that conditioned air is provided where it is needed for adequate comfort. The failure to properly distribute conditioned air is likely to result in excess energy usage when the occupants adjust the thermostat to counter an inadequate distribution of conditioned air. Many of the intended benefits of high-performance homes are negated if occupants are uncomfortable and adjust the thermostat in response."

We note that this proposal (RE115) was recommended for approval by the IECC-Residential Committee and no public comments were filed, meaning that no stakeholders opposed its incorporation into the 2021 IECC.This proposal also removes the exception from duct leakage testing for systems located entirely within the building envelope. This proposal (RE112) was recommended for approval by the IECC-Residential Committee, and then was approved by over 87% of the Governmental Member Voting Representatives at ICC for inclusion in the 2021 IECC. From the proponent's original reason statement in proposal RE112: The purpose of this code change proposal is to help ensure occupant comfort, proper heating and cooling system performance, and resulting long-term energy savings by requiring a duct leakage test for all new homes, including homes with all ducts inside conditioned space. This action will also help reduce the likelihood of builder callbacks for poorly-functioning, uncomfortable HVAC systems. The IECC currently exempts homes from duct testing requirements where the air handler and all ducts are located inside conditioned space. Although moving all ducts inside conditioned space may have a positive impact on energy efficiency overall, this practice alone cannot guarantee that the ducts will be tight enough to deliver conditioned air to all occupied areas of the home. Uncomfortable occupants commonly adjust thermostat settings to counteract the effect of poor delivery of conditioned air, leading to huge losses in energy efficiency. And these homes are at far greater risk for builder callback. This proposal will improve building quality and keep occupants more comfortable by requiring a duct test for all new homes, although the allowable leakage rate will be set at twice the prescriptive rate when all ducts are located inside conditioned space.Duct leakage rates can be extremely high when ducts are not tested. We do not believe that builders intentionally cut corners in duct sealing when they know that the system will not be tested. However, without an objective test as a means of quality assurance, even careful builders may not be aware of missed connections or poor sealing. In a recent DOE field study of residential homes in Kentucky, homes received duct leakage tests even where all supply and return ducts were located inside conditioned space. The results were striking – **of the 24 homes tested (that would have qualified for the test exemption under the IECC), all 24 homes had higher leakage rates than the 2018 IECC requirement. Tested duct leakage for these homes averaged 18.5 cfm/sq.ft., with individual homes ranging from 6.26 cfm/sq.ft. to as high as 40.36 cfm/sq.ft.** *See* https://www.energycodes.gov/compliance/energy-code-field-studies. We note that 40 other homes in the same study were required to be tested (because at least some ducts were located outside conditioned space), and these homes achieved leakage rates of 9.7 cfm/sq.ft., on average – roughly half the leakage rate of homes that qualified for the exemption. Obviously, this is a small sample size, but the Field Studies found similar results in Pennsylvania, where "exempt" homes (with all ducts inside conditioned space) averaged almost 31 cfm/sq.ft. leakage, while homes required to be tested averaged almost 18 cfm/sq.ft. leakage. Although the results vary across the states sampled, these results point to a shortcoming in the IECC's "complete exemption" approach to homes with all ducts inside conditioned space.

The concept of requiring a test for all new homes is not new. DOE's Building America Program recommends that "[e]ven in conditioned space, ducts should be insulated to reduce the risk of condensation and mold. They should be tightly sealed and tested for leakage." *See* https://www.energy.gov/sites/prod/files/2014/01/f6/1_1g_ba_innov_ductsconditionedspace_011713.pdf. Likewise, the International Association of Certified Home Inspectors recommends that ducts be located entirely within conditioned space and tested to ensure air tightness. Air leakage rates at air handlers, even when all ducts are located in conditioned space, can lead to significant reduction in comfort, leading homeowners to adjust the thermostat and significantly increase energy use. *See* https://www.nachi.org/inspecting-hvac-cabinet-seams-air-leakage-sealing.htm.

Cost Impact: The code change proposal will increase the cost of construction
For homes that would not have been required to test ducts (because they are located inside conditioned space), this proposal will result in a construction cost increase of about $200 for a duct test. However, the proposal substantially reduces homeowner risk, because the test will objectively verify that the heating and cooling systems are operating as intended, and will provide an opportunity for the builder to correct any mistakes. The test will also reduce the likelihood of a builder callback.

Resiliency Impact Statement: This proposal will neither increase nor decrease Resiliency

Workgroup Recommendation

Public Comments for: REC-R403.3.3-21

This proposal doesn't have any public comments.

REC-R404.2-21

Proponents: William Penniman (wpenniman@aol.com)

2018 Virginia Energy Conservation Code

Add new text as follows:

R404.2 SOLAR-READY CONSTRUCTION FOR DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES. New detached one- and two-family dwellings, and townhouses with not less than 600 square feet (55.74 m^2) of roof area oriented between 110 degrees and 270 degrees of true north shall comply with Appendix RA Solar Ready Provisions--Detached One- and Two-Family Dwellings and Townhouses. [NOTE: denominated Appendix RB in 2021 IECC].
Exceptions:

1. New residential buildings with a permanently installed on-site renewable energy system.

2. A building with a solar-ready zone that is shaded for more than 70 percent of daylight hours annually.

2018 Virginia Construction Code

Add new text as follows:

N1104.2 Solar Ready Construction for Detached One- And Two-Family Dwellings and Townhouses. New detached one- and two-family dwellings, and townhouses with not less than 600 square feet (55.74 m^2) of roof area oriented between 110 degrees and 270 degrees of true north shall comply with Appendix RA Solar Ready Provisions--Detached One- and Two-Family Dwellings and Townhouses. [NOTE: denominated Appendix RB in 2021 IECC].
Exceptions: .

1. New residential buildings with a permanently installed on-site renewable energy system.

2. A building with a solar-ready zone that is shaded for more than 70 percent of daylight hours annually.

Reason Statement: This proposed addition to the body of the building code is designed to require builders to make new one- and two-family dwellings and townhouses "solar ready", subject to certain specific exceptions. The proposal does not require builders to install solar. However, it would enable buyers to arrange for cheaper, easier installation of rooftop solar if they choose to do so in the future. It is a low-cost measure that will reduce the cost of adding solar at a later date. The proposal is based up on the Appendix RA in the 2018 Virginia building code, which has been updated as Appendix RB in the 2021 IECC. Since the Appendix is in the current code and has not been modified from the 2018 code, it will presumptively follow the 2021 IECC's equivalent appendix, Appendix RB.

Rooftop solar energy production will reduce occupants' utility bills by reducing the quantity of energy they need to purchase for heating, lighting and other purposes. That will tend to stabilize and reduce their annual energy costs. Further, distributed generation will reduce the quantity of energy that utilities need to generate or purchase, the generation and transmission facilities to be constructed, and the line losses that would result from transmitting energy to markets from central power stations. Distributed energy production will help to save overall energy costs.

Distributed zero-carbon generation will also reduce greenhouse gas emissions, which are the primary driver of climate change and its many harmful impacts, including rising seas, flooding, dangerous high temperatures, agricultural disruption and threats to infrastructure.

Cost Impact: The code change proposal will increase the cost of construction
There will be a small increase in the initial cost of construction, which will be offset by encouraging building owners to install money-saving, GHG-reducing rooftop solar in the future. (Obviously, builders decide to install and profitably market the dwelling with rooftop solar if they desire to do so.) The principal material cost would be a 1-inch electrical conduit, which can be purchased for $2.00/foot or less, i.e., less than $100 from the roof to the electrical panel. During construction, the cost of installation will be a small increment given that the walls will be open and tradesmen will be installing similar conduits and/or wiring in the building. The costs of retrofitting are likely to be much higher after walls are closed and construction completed. Reopening and repairing walls could be required.
The small upfront costs will have little impact on a resident's annual mortgage costs, particularly when compared to the savings that will result from self-generated solar energy and from the much higher cost of retrofitting.

Resiliency Impact Statement: This proposal will increase Resiliency
This low-cost proposal will increase resiliency for residential customers who install solar and for the utility system. Residential customers with solar

will generate energy on-site, which will lower energy and total occupancy costs, reducing risks of lease and mortgage defaults. In combination with on-site battery storage, the on-site solar can power the house during periods of power outages. Distributed solar can also support utility's regional reliability when power outages occur at remote central generating stations.

Solar generation is zero-carbon, which makes it a necessary measure to mitigate worsening climate impacts which harms Virginia and its residents generally. The most recent IPCC report confirms that rapid reductions of greenhouse gas emissions is essential to avoid catastrophic climate impacts around the world. *IPCC Sixth Assessment Report* (February 2022), https://www.ipcc.ch/report/ar6/wg2/

Substantial harm has already occurred nationally and locally from global warming and much worse will follow without rapid reductions of greenhouse gases (particularly CO2 and methane associated with fossil fuel production and combustion). Virginia's coastal areas are among the most vulnerable to sea level rise and destructive storms. The most recent report from NOAA indicates that Virginia may face 2 feet of sea level rise by 2050 due to worsening climate change from human greenhouse gas emissions. https://www.noaa.gov/news-release/us-coastline-to-see-up-to-foot-of-sea-level-rise-by-2050

Growing climate dangers include harms to communities, infrastructure, people (e.g., heat-related illnesses, disease vectors and ability to work), agriculture, property (inland and coastal) and the economy. These result from many climate-driven forces, including rising temperatures and seas, wildfires, worsening storms, more severe rainfall events and damage to crops and infrastructure. In addition, by cutting greenhouse gas emissions, solar generation will help to mitigate the growing impacts that warming seas and ocean acidification have on sea life and Virginia's fisheries. Even if Virginia were not directly endangered, its residents, economy and access to resources would be endangered by the growing harms to the rest of the nation and the world.

Workgroup Recommendation

Public Comments for: REC-R404.2-21

This proposal doesn't have any public comments.

REC-R401.2-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org)

2021 International Energy Conservation Code

Add new text 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 as follows:

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

Add new text as follows:

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.

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

Revise as follows:

R401.2 Application . Residential ~~buildings shall~~ buildings shall be *all-electric buildings* and shall comply with Section ~~R401.2.5~~ R401.2.4 and either Sections R401.2.1, R401.2.2 ~~, R401.2.3 or R401.2.4.~~ or R401.2.3.

Exception: Additions, *alterations*, repairs and changes of occupancy to existing buildings complying with Chapter 5.

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 certificate shall indicate the following:

~~a gas-fired unvented room heater, "gas-fired unvented room heater," gas-fired unvented room heaters,~~

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces*.

2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.

3. The results from any required duct system and building envelope air leakage testing performed on the building.

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

5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted and the compliance path used.

Delete without substitution:

~~**R402.4.4 Rooms containing fuel-burning appliances.** In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.3, where the walls, floors and ceilings shall meet a minimum of the *basement wall R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through *conditioned space* to an *R*-value of not less than R-8.~~

~~**Exceptions:**~~

1. ~~Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.~~
2. ~~Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the International Residential Code.~~

Revise as follows:

R404.1.2 Fuel gas lighting equipment. Fuel gas lighting systems shall not be installed.~~ have continuously burning pilot lights.~~

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

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

1. Greater than or equal to

~~2.~~

10 HSPF/16 SEER air source heat pump.

~~3.~~

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

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.

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

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

1. Greater than or equal to

~~2.~~

2.0 EF electric service water-heating system.

~~3.~~

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

Reason Statement: In order to meet the state's 2045 carbon neutrality goal, Virginia must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to 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 Virginia's goal, 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.

Fortunately, heat pump technology has dramatically improved over the last few decades, giving contractors and building owners access to highly efficient electric heating and cooling, and water heating technologies. An Ecotope study of the 2017 Oregon Residential code found that homes heated by electric heat pumps use 40 percent less energy than homes heated with gas (including water heating). Even accounting for reduced efficiency in extreme cold weather, according to a study by RMI, modern air source heat pumps are more than twice as efficient as gas furnaces and can save families up to 14 percent on their utility bills in Climate Zone 5. This is one reason why the U.S. EPA just announced that standards for the most efficient appliances in 2022 certified under the ENERGY STAR program will be all-electric.

All-electric homes are also healthier homes. Gas appliances release harmful pollutants like nitrogen dioxide (NO_2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in 2017, air pollution from burning fuels in buildings led to an estimated 48,000 to 64,000 early deaths and $615 billion in health impact costs. These emissions can particularly affect children. In a meta-analysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to being diagnosed with asthma.

All-electric new construction is also less expensive to build than a home with gas appliances and in the long term will result in fewer retrofit costs for homeowners to meet future policy goals to eliminate all carbon emissions in the U.S. by 2050.

Therefore, building all-electric buildings is critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals. NBI is submitting this amendment along with amendments that address on-site renewables, electric vehicles, and grid integration techniques. These proposed changes to the 2021 IECC, working together, will put the U.S. on the path to a decarbonized, resilient, and healthier future.

Cost Impact: The code change proposal will decrease the cost of construction
Electric appliances and equipment cost less than gas appliances. Installing all-electric appliances also reduces natural gas infrastructure costs such as gas mains, services and meters. Using data from RSMeans, Grainger, Home Depot, NBI estimates that an all-electric home costs $8,735 less than a home built with natural gas appliances and equipment. A recent analysis by RMI which examined the cost effectiveness of all-electric homes in seven cities across the country from Climate Zone 2A to 6A, found that installing efficient heat pumps in water heating and space-heating compared to standard equipment installed in a mixed-fuel home resulted in life cycle cost savings in every city. Including the cost of more efficient electric equipment, the all-electric home cost on average $2,700 less than a code compliant mixed-fuel home. All-electric homes with efficient heat pumps exhibited on average $107 in lower annual utility costs. The analysis concluded that a homeowner with an all-electric home would save $3,700 over a 15-year analysis period. In addition, all electric homes with efficient heat pumps resulted in carbon emissions savings of between fifty to ninety-three percent in all climate zones. Accounting for the societal benefit carbon emissions would result in increased life cycle cost savings across all climate zones.

Finally, neither analysis cited includes the cost of electrical retrofits that will be required of homes that are not all-electric to meet future policy goals of achieving net zero carbon emissions by 2050. Simply upgrading the electrical panel itself to add electrical capacity for new electric appliances can cost a homeowner between $2,650 to $4,500. Adding electrical outlets that can service major appliances so that homeowners can replace a natural gas appliance with an all-electric appliance will also add significant additional costs especially if those appliances are in areas where dry wall must be removed and repaired.

Resiliency Impact Statement: This proposal will increase Resiliency
As the grid becomes increasingly cleaner, all electric buildings will become less carbon intense as they age, unlike buildings with fossil fuel combustion, lessening their impact on climate change. Although these buildings will require more total electricity from the grid than their fossil fuel burning counterparts, they will be able to operate entirely on clean renewable energy.

All-electric single-family and low-rise multifamily homes additionally support better indoor air quality. Better indoor air quality is directly linked to better health of residents, including reduction of respiratory and chronic illnesses. This is especially importance in homes. The reductions of these types of illnesses increase overall resilience of individuals within our communities, making them less susceptible to the impacts of extreme heat and cold, reducing medical bills, and improving overall quality of life.

Finally, these buildings will also be less dependent on the geopolitics of the fossil fuel market, leveling out energy costs during periods of disruption.

Workgroup Recommendation

Public Comments for: REC-R401.2-21

This proposal doesn't have any public comments.

REC-R401.2.5-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

R103.2.4 Electrification system.. The construction documents shall provide details for additional electric infrastructure, including branch circuits, conduit, or pre-wiring, and panel capacity in compliance with the provisions of this code.

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.

Revise as follows:

~~**R105.2.5**~~ **R105.2.6 Final inspection.** The *building* shall have a final inspection and shall not be occupied until *approved.* The final inspection shall include verification of the installation of all required *building* systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

Add new text 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.

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

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for *combustion equipment* .

Revise as follows:

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

~~2.~~
2. For

~~buildings complying under with Section~~
mixed-fuel buildings complying with Section R401.2.1, the building shall be required to install either R408.2.1 or R408.2.5 of the additional efficiency package options, and any two of R408.2.2, R408.2.3, or R408.2.4 of the additional efficiency package options.

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

~~2.1. One~~
23.1. *All-electric buildings* shall have ~~O~~ one of the additional efficiency package

~~Options in Section R408.2 shall be~~
options in Section R408.2 shall be installed without including such measures in the proposed design under Section R405; or

23.2. The proposed design of the *all-electric building* building under Section R405.3 shall have an annual energy cost that is less than or equal to the 95 percent of the annual energy cost of the standard reference design.; or

3.3 Mixed-fuel buildings shall have either R408.2.1 or R408.2.5 of the additional efficiency package options, and any two of R408.2.2, R408.2.3, or

R408.2.4 of the additional efficiency package options installed without including such measures in the proposed design under Section R405; or

~~2.2.~~
3.4 The proposed design of the

~~building under Section R405.3 shall~~
mixed-fuel building under Section R405.3 shall have an annual energy cost that is less than or equal to

~~95~~
85 percent of the annual energy cost of the standard reference design.

~~3. For 3.4. For buildings complying with the complying with the the Energy Rating Index alternative Section R401.2.3, the Energy Rating~~

Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.
The option sselected for compliance shall be identified in the certificate required by Section R401.3.

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 certificate shall indicate the following:

~~sizes and sizes and~~
1.

2.

3.

4.

<u>sizes, fuel sources, and </u>efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furı

5.

6.

7.

8.

9.

R402.1 General. The *building thermal envelope* shall comply with the requirements of Sections R402.1.1 through R402.1.5.

Exceptions:

~~Those that~~

1. The following low-energy *buildings*, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of Section R402.

1.1. Those containing no combustion equipment with a peak design rate of energy usage less than 3.4 Btu/h × ft^2 (10.7 W/m^2) or 1.0 $watt/ft^2$ of floor area for space-conditioning purposes.

1.2. Those containing no combustion equipment that do not contain *conditioned space*.

2. Log homes designed in accordance with ICC 400.

Add new text as follows:

R404.6 Additional electric infrastructure.. *Combustion equipment* shall be installed in accordance with this section.
R404.6.1 Equipment serving multiple units. *Combustion equipment* that serves multiple *dwelling units* shall comply with Section C405.16.

R404.6.2 Combustion water heating. Water heaters shall be installed in accordance with the following:

1. A dedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 3 feet (914 mm) from the water heater and be

accessible to the water heater with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Heat Pump Water Heater" and be electrically isolated.

2. A condensate drain that is no more than 2 inches (51 mm) higher than the base of the installed water heater and allows natural draining without pump assistance shall be installed within 3 feet (914 mm) of the water heater.

3. The water heater shall be installed in a space with minimum dimensions of 3 feet (914 mm) by 3 feet (914 mm) by 7 feet (2134 mm) high.

4. The water heater shall be installed in a space with a minimum volume of 700 cubic feet (20,000 L) or the equivalent of one 16-inch (406 mm) by 24-inch (610 mm) grill to a heated space and one 8-inch (203 mm) duct of no more than 10 feet (3048 mm) in length for cool exhaust air.

R404.6.3 Combustion space heating. Where a building has combustion equipment for space heating, the building shall be provided with a designated exterior location(s) in accordance with the following:

1. Natural drainage for condensate from cooling equipment operation or a condensate drain located within 3 feet (914 mm), and

2. A dedicated branch circuit in compliance with IRC Section E3702.11 based on heat pump space heating equipment sized in accordance with R403.7 and terminating within 3 feet (914 mm) of the location with no obstructions. Both ends of the branch circuit shall be labeled “For Future Heat Pump Space Heater.”

Exception: Where an electrical circuit in compliance with IRC Section E3702.11 exists for space cooling equipment.

R404.6.4 Combustion clothes drying. A dedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 6 feet (1829 mm) of natural gas clothes dryers and shall be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Clothes Drying” and be electrically isolated.

R404.6.5 Combustion cooking. A dedicated 240-Volt, 40A branch circuit shall terminate within 6 feet (1829 mm) of natural gas ranges, cooktops and ovens and be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Range” and be electrically isolated.

R404.6.6 Other combustion equipment. *Combustion equipment* and end-uses not covered by Sections R404.6.2-5 shall be provided with a branch circuit sized for an electric *appliance* , *equipment* or end use with an equivalent capacity that terminates within 6 feet (1829 mm) of the *appliance* or *equipment* .

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
404.2	Interior lighting controls
R404.6	Additional electric infrastructure

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
404.2	Interior lighting controls
R404.6	Additional electric infrastructure
R406.3	Building thermal envelope

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

TABLE R406.5 MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	~~ENERGY RATING INDEX~~ All-Electric Building	Mixed Fuel Building
0-1	52	52
2	52	52
3	51	51
4	54	54
5	55	47
6	54	46
7	53	46
8	53	53

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. Greater than or equal to 2.0 EF electric service water-heating system.
3. Greater than or equal to 0.4 solar fraction solar water-heating system.
4. Greater than or equal to 82 EF instantaneous fossil fuel service water-heating system and drain water heat recovery unit meeting the requirements of Section R403.5.3 installed on at least one shower.

Reason Statement: In order to meet the state's 2045 carbon neutrality goal, Virginia must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. Therefore it is crucial that new buildings today can be cost-effectively retrofitted in the future with electric equipment so that emissions are not "locked-in" by gas-dependent building infrastructure. Fortunately, heat pump technology has dramatically improved over the last few decades, giving contractors and building owners access to highly efficient electric heating and cooling, and water heating technologies.

One of the biggest expenses of electrification retrofits – and therefore barriers to electrification in existing buildings - is running electrical infrastructure through a completed and enclosed building that has combustion equipment. This significant future cost can be greatly reduced through making simple, low-cost modifications to buildings during construction that enable easier electrification in the future. The requirements in this proposed amendment ensure that the electrical infrastructure is in place so that building owners can convert to an all-electric building in the future and ensures that unitized gas water heaters can be replaced with high-performance heat pump water heaters (HPWHs). Because all-electric buildings are more efficient than mixed-fuel buildings, this code amendment also requires buildings with combustion equipment to be as or more efficient than all-electric buildings.

Electric Infrastructure:

The addition of R404.6 ensures the electrical plugs and physical space exists so that a building owner can cost effectively replace their gas equipment and appliances with electric equipment in the future. This language is based on the approach adopted in the electrification reach codes adopted by various California cities.

As described in R404.6.1, this proposal is limited to gas equipment that serves individual dwelling units. Equipment that serves multiple dwelling units is directed to a similar proposed code amendment in the commercial section. If LARA choses to adopt this amendment and not the electric-readiness amendment for commercial, this amendment should be revised accordingly.

R404.6.2 is focused on ensuring that water heater locations are physically capable of incorporating a future heat pump water heater (HPWH). Requirement 1 ensures that there is a branch circuit ready to support the future installation of a HPWH. Requirement 2 ensures that the condensate generated by a HPWH compressor can be easily drained away. Requirement 3 ensures that the water heater location is physically large enough to accommodate HPWHs that are frequently wider and/or taller than code-minimum gas water heaters. Requirement 4 ensures that a future HPWH has access to sufficient air volume to effectively operate. These requirements are based on the requirements adopted in several CA jurisdictions electrification reach codes.

R404.6.3 ensures the electric infrastructure for combustion space heating is present so that a heat pump can be installed in the future. The section references IRC Section E3702.11 which sets the requirement for sizing a branch circuit serving a heat pump and relies on the size of the actual equipment to be installed. Since there is not an actual equipment size to reference and equipment size can vary depending on the size of the home and the climate, the section also references Section R403.7 to establish the size of the heat pump equipment that would be required for the specific home.

R404.6.4 and R404.6.5 requires combustion clothes drying and cooking to have plugs nearby so that a homeowners can replace them with electric equipment cost effectively in the future. IRC Section E3702.9.1 requires a 240V/40A branch circuit for a standard 8.75 kVA or larger electric residential range and has been used as the basis for the sizing of the branch circuit. Six feet is cited per requirements from IRC Section E3901.5 requiring appliance receptacles to be within 6 feet of the intended appliance.

This section and others rely on new definitions for appliance, equipment, fuel gas and fuel oil which are mirrored from 2021 IMC to be useful in defining combustion equipment.

Inspection, Construction Documents and Efficiency

R401.3 requires builders to note the electric infrastructure in place on the compliance certificate to both allow for easier enforcement of these provisions and to ensure current or future homeowners are aware that they can easily replace combustion equipment and appliances with electric equipment and appliances.

Because all-electric newly constructed homes typically use less energy when compared to newly constructed mixed-fuel homes. Revisions to R401.2.5 seeks to encourage electrification and more evenly weigh the impact of the additional efficiency credits by requiring the mixed-fuel home to select a total of three packages from the options while the all-electric home is required to select one package. Of the three packages required for the mixed-fuel home, one must address the envelope (improved envelope or reduced infiltration plus better ventilation) while the remaining two impact HVAC (better equipment or more efficient ducts) and water-heating (better equipment) requirements). Since mixed fuel buildings will be required to select more package options, the amendment also adds a fourth service hot water package that combines the efficiency benefits of an instantaneous gas water heater with a drain water heat recovery unit. This package is based on analysis conducted by the Northwest Energy Efficiency Alliance[1](NEEA). Modifications to requirement 3 under R401.2.4 applies this same concept to the performance path.

Low-energy buildings

Low energy buildings are currently exempt from thermal envelope requirements. The revision to R402.1 requires low-energy buildings that choose not to install insulation to be all-electric to reduce their greenhouse gas impact.

ERI and Performance Pathway

The proposal also includes a modification to the mandatory table in R405 and R406 to ensure that projects using the ERI or performance method will also comply with electric-readiness requirements. An additional modification to R406 encourages homes following the ERI performance path to be all-electric by setting more stringent ERI values for mixed-fuel homes. This is needed as Standard 301, which sets the calculation methodology for calculating ERI, claims to be fuel agnostic. The ERI values for mixed-fuel homes match those from ASHRAE 90.2 and Appendix RC Zero Energy Residential Building Provisions as published in the 2021 IECC. The ERI values for all-electric homes are the same as the values published in Table R406.5 of the 2021 IECC.

Cost Impact: The code change proposal will increase the cost of construction
Virginia buildings that are all-electric would have no change in construction costs. Mixed fuel buildings would be slightly more expensive to build because they would both have to be electric-ready and be more efficient. Electric-ready requirements are anticipated to be nominal. Recent analysis by NBI and partners using cost data from RSMeans indicates that additional electrical infrastructure costs for water-heating, space-heating, and cooking cost $440. Cost data from Grainger indicates additional energy efficiency measures required by mixed-fuel buildings would raise construction costs by $1,350.

However if a homeowner were to have to retrofit their home from using combustion equipment to natural gas equipment costs without these requirements in place, costs could be exorbitant. For example, upgrading the electrical panel could cost upwards of $6,000 if it is not sized appropriately.

Resiliency Impact Statement: This proposal will increase Resiliency
Electric ready infrastructure allows single-family and small multifamily homes the ability to take advantage of the greening grid while spreading out the costs. As noted in the reason statement, they will likely transition from fossil fuel to electric appliances over their lifespan. Although these buildings will require more electricity from the grid than their fossil fuel burning counterparts as they transition, they will be able to operate entirely on clean renewable energy.

By constructing electric-ready, homeowners will additionally be given the tools they need to make decisions on the timing to switch fuel sources. As the costs of fuels change over time, owners will be ready to remove themselves from the volatility and geopolitics of the fossil fuel market.

Workgroup Recommendation

Public Comments for: REC-R401.2.5-21

This proposal doesn't have any public comments.

Proposal # 1059

REC-R403.1.1.1-21

Proponents: Ben Rabe (ben@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a *demand response signal* .

R403.1.1.1 Demand responsive thermostat controls. R403.1.1.1 Demand responsive thermostat controls. The thermostats shall be provided with *demand responsive 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 *demand responsive controls* are not available.

Exception: Assisted living facilities.

Reason Statement: 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.
Smart thermostat demand response is becoming one of the most pervasive utility offering throughout the country. In their 2019 Demand Response Market Snapshot, SEPA found that 58 utilities had smart thermostat offerings, comprising 1 GW of connected load. In their assessment of US national potential for load flexibility, Brattle found that smart thermostats were the largest single program offering in their estimated 200 GW of potential by 2030. As shown in the figure below, LBNL modeling for the DOE GEB roadmap shows that demand response thermostats can reduce building peak demand by up to 30%. The substantial savings impact variability is because LBNL modeled impacts at times driven by typical utility peak hours based on the utility grid region but that does not necessarily align with building peak hours. If the two are aligned, the impacts are maximized; if impacts are misaligned impacts may be shown as negative. Therefore, these impacts should not be considered to be “typical” or “maximum” in each case. To ensure the inclusion of demand response controls are treated as mandatory the thermostat requirements are added to the tropical compliance list under R407.2.

Cost Impact: The code change proposal will increase the cost of construction
In 2011, demand response thermostats (which were estimated to cost $68 more than a programmable thermostat) were found to be extremely cost effective.3 It was estimated that for every dollar spent on a grid-integrated thermostat in 2011 yielded between $2 to $9 in operating cost savings over a 15-year period. In the 10 years since, equipment prices have decreased. One can purchase a basic grid-integrated thermostat for $63 compared to a basic 7-day programmable thermostat which costs $42. Including labor costs and a 35% markup to account for direct and indirect costs of construction, the incremental construction cost of installing a demand responsive thermostat is currently estimated to be $40 making this measure even more cost effective than estimated previously. Not only will this measure result in cost savings to consumers, but it will also result in other significant societal benefits. According to DOE’s report, “A National Roadmap for Grid-Interactive Efficient Buildings”, every watt in peak demand savings was found to create 17 cents in annual electric grid system value. This value included energy savings, capacity savings, transmission deferral and ancillary services. A single-family home with a grid-integrated thermostat which is estimated to reduce peak demand savings between 0.26 to 1.09kW would result in $43 to $181 in annual electric grid system value. Grid-integrated thermostats which allow grid operators to reduce demand on the grid during the times when the carbon intensity of the electric grid is high also results in reduced carbon emissions generating additional significant societal benefits.

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid’s ability to withstand these events will become increasingly important. Demand controlled thermostats will help integrate building loads with available production, lowering energy demand. Therefore, this proposal increase resiliency by reducing overall demand on the grid.

Workgroup Recommendation

Public Comments for: REC-R403.1.1.1-21

This proposal doesn't have any public comments.

Proposal # 1062

REC-R403.5.4-21

Proponents: Ben Rabe (ben@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a *demand response signal* .

R403.5.4 Demand Responsive water heating.. Electric storage water heaters with a rated water storage volume between 40 and 120 gallons and a nameplate input rating equal to or less than 12kW shall be provided with *demand responsive controls* that comply with ANSI/CTA-2045-B Level 2, except "Price Stream Communication" functionality as defined in the standard, or another equivalent *approved demand responsive control* .

Revise as follows:

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

ANSI/CTA-2045-B Modular Communications Interface for Energy Management .

Reason Statement: 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.

In their Grid-interactive and Efficient Buildings (GEBs) Roadmap, the US Department of Energy estimates that approximately 15 GW of additional load flexibility is expected to be added to the system under reference case assumptions. Combined with energy efficiency, this is expected to provide $13 billion/year of peak demand savings to the power system and its customers. Through a comprehensive literature review and interviewing dozens of national experts, the USDOE team found that one of the biggest barriers was the lack of interoperability. A key tool to solve this problem is building codes, which can help to ensure that interoperable devices and controls are installed at the time of construction. USDOE cited explicitly the use of codes and standards as one of its recommended pathways to enable greater adoption of GEBs technologies.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for electric water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in water heaters, which enable them to provide greater storage capacity to support increased load shifting while eliminating scalding risk.

Cost Impact: The code change proposal will increase the cost of construction
Demand controls for water heaters which costs around $173 [AM1] become cost effective when enrolled in a demand response program. Armada Power customers in Ohio who enrolled their water heaters in a demand response program saved $184 annually by enrolling in the program. If utilities nationwide instituted a similar program to shape demand, a customer could reap $12 in energy cost savings for every $1 spent on the additional controls. Customer cost savings are likely to increase in many locations as utilities deploy more time-of-use rate structures, increase demand charges, and expand the daily and seasonal periods during which these rate components apply.

Not only will this measure result in cost savings to consumers, but it will also result in other significant societal benefits. According to DOE's report, "A National Roadmap for Grid-Interactive Efficient Buildings", every watt in peak demand savings was found to create 17 cents in annual electric grid system value. This value included energy savings, capacity savings, transmission deferral and ancillary services. A 3-bedroom, 2-bath apartment with a grid-integrated water heater is estimated to reduce peak demand savings by 0.3kW, which would result in $51 in annual electric grid system value. Grid-integrated water heaters which allow grid operators to reduce demand on the grid during the times when the carbon intensity of the electric grid is high, which also results in reduced carbon emissions – generating additional significant societal benefits.

Resiliency Impact Statement: This proposal will increase Resiliency
Demand responsive controls allow for utilities to send and buildings to receive signals to ramp up or down set points based on a variety of conditions. This communication ability is a critical aspect of resilience for our communities. Storage water heaters have a unique capability to act as thermal storage “batteries”. By allowing water heaters to receive a signal from the grid, water can be heated at a time when overall demand, price signals or carbon emissions are at their lowest. Pre-heating water in this way can help to lessen peak demands on the grid, creating grid resiliency, reduce costs for consumers, creating financial resiliency, and help absorb excess renewable generation, or at a minimum engage during the cleanest hours of generation, reducing carbon emissions and climate impact of water heating.

Workgroup Recommendation

Public Comments for: REC-R403.5.4-21

This proposal doesn't have any public comments.

Proposal # 1063

REC-R404.4-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org)

2021 International Energy Conservation Code

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 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 as follows:

~~**R105.2.5**~~ **R105.2.6 Final inspection.** The *building* shall have a final inspection and shall not be occupied until *approved*. The final inspection shall include verification of the installation of all required *building* systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

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.

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 certificate shall indicate the following:

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces.*
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
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.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted and the compliance path used.
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 beno 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 as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
404.2	Interior lighting controls
<u>R404.4</u>	<u>Renewable Energy Infrastructure</u>

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
404.2	Interior lighting controls
R404.4	Renewable Energy Infrastructure
R406.3	Building thermal envelope

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

Reason Statement: In 2020, renewable energy sources were responsible for 21% of U.S. electricity generation. In order to cost-effectively achieve a 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 large amount of centralized renewables and a large amount of distributed renewables located on the building site. More renewables placed on site enables more clean utility-scale renewables to be deployed efficiently. It is therefore crucial for new residential buildings to be solar-ready so that the U.S. can reach its 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.

In addition, this solar-ready requirement would help grow good paying jobs. According to the Bureau of Labor Statistics, the two fastest growing occupations in the US are solar PV and wind turbine service technician. The Interstate Renewable Energy Council estimates that to reach Biden's target of 100% renewable energy by 2035, the industry will need to employ three times the number of workers employed in 2020.

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. The amendments would require all new homes to be solar ready by requiring a designated 300 square foot minimum "solar ready zone" on the roof. Conduit and wire from this zone must be installed and space in the electrical panel must be reserved for a future solar array. Homes where solar is not feasible due to shading or not enough solar exposure due to orientation are exempt. Information on compliance with this requirement must be placed on the construction documents to improve compliance and so that future homeowners know their home is solar-ready. Revisions to Table R405.2 and R406.2 make this a mandatory requirement in the energy code. This amendment points multifamily buildings (Group R-2 and R-3 occupancies) to a similar amendment in the commercial energy code. If the residential committee chooses to accept this amendment but the commercial solar amendment is not accepted by the commercial committee, this amendment should be revised accordingly.

References:

Renewables Became the Second-Most Prevalent U.S. Electricity Source in 2020 , U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=48896.

Fact Sheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies, The White House, 22 Apr. 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

Why Local Solar For All Costs Less: A New Roadmap for the Lowest Cost Grid, Vibrant Clean Energy, Dec. 2020, www.vibrantcleanenergy.com/wp-content/uploads/2020/12/WhyDERs_ES_Final.pdf.

The National Solar Job Census 2020, Interstate Renewable Energy Council, May 2021, https://irecusa.org/wp-content/uploads/2021/07/National-Solar-Jobs-Census-2020-FINAL.pdf.

Richardson, Jake. *Solar and Wind Tech Are the Fastest Growing Jobs in US*, Red, Green, and Blue, 28 Jan. 2019, http://redgreenandblue.org/2019/01/27/solar-wind-tech-fastest-growing-jobs-us/.

Cost Impact: The code change proposal will increase the cost of construction
Recent analysis by NBI and partners using cost data from RSMeans indicates that adding the infrastructure to make a home solar ready would cost $216 or $0.09 per square foot for a typical home at the time of construction. According to an NREL report, if a home is not made solar ready but chooses to add solar at a later date, the cost of the retrofit (if the retrofit is feasible) is $4,373 or $1.84 per square foot, assuming a 2,376 s.f. home. Therefore, adding the infrastructure to make a home solar ready now saves $4,157 or $1.75 per square foot for homeowners who choose to add solar at a later date.

References:

Solar Ready: An Overview of Implementation Practices, National Renewable Energy Laboratory, Jan. 2012, www.nrel.gov/docs/fy12osti/51296.pdf.

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid’s ability to withstand these events will become increasingly important. Community resilience will be increasingly dependent on distributed generation, and more localized production can help buildings and communities keep power when other areas of the grid may be offline. This local production of power can support critical functions and provide life supporting functions of small/at home medical devices that require on power, allowing for needed cell phone charging to stay in touch during an emergency, and literally keeping the lights on for safety and security.

Workgroup Recommendation

Public Comments for: REC-R404.4-21

This proposal doesn't have any public comments.

Proposal # 1061

EC-C401.2-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new text 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 as follows:

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

C404.8.1 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.

C405.5.3 Gas lighting. Gas-fired lighting appliances shall not be permitted. ~~equipped with continuously burning pilot ignition systems~~ . ~~systems.~~

TABLE C406.1(1) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	**0B & 1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% cooling efficiency improvement	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% cooling efficiency improvement	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced lighting power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: On-site renewable energy	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: Dedicated outdoor air	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
~~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~~
C406.7.4: Heat pumpwater heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced air infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10: Energy monitoring	4	4	4	4	3	3	3	3	3	3	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

NA = Not Applicable.

TABLE C406.1(2) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% cooling efficiency improvement	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10% cooling efficiency improvement	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3: Reduced lighting power	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
C406.4: Enhanced digital lighting controls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: On-site renewable energy	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air system	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.2: Recovered or renewable water heating	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
~~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~~
C406.7.4: Heat pump water heater	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Reduced air infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10: Energy monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.11: Fault detection and diagnostics system	1	1	1	1	1	1	NA	1	1	NA	1	1	NA	1	1	1	1

NA = Not Applicable.

TABLE C406.1(3) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% cooling efficiency improvement	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10% cooling efficiency improvement	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3: Reduced lighting power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
C406.5: On-site renewable energy	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6: Dedicatedoutdoor air system	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: Recoveredor renewable water heating[a]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
~~C406.7.3: Efficient fossil fuel water heater[a]~~	~~NA~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~2~~	~~2~~	~~3~~	~~2~~	~~3~~	~~2~~	~~3~~	~~3~~	~~3~~	~~5~~
C406.7.4: Heat pump water heater[a]	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: Enhanced envelope performance	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Reduced air infiltration	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3
C406.10: Energy monitoring	3	3	3	3	3	3	3	3	3	2	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

NA = Not Applicable.

a. For schools with showers or full-service kitchens.

TABLE C406.1(4) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP M OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% cooling efficiency improvement	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10% cooling efficiency improvement	9	12	9	8	6	6	3	4	4		2	3	NA	2	2	2	1
C406.3: Reduced lighting power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406.4: Enhanced digital lighting controls	3	3	4	3	4	3	4	4	4	3	3	3	3	4	4	3	3
C406.5: On-site renewable energy	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6: Dedicated outdoor air system	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
~~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~~
C406.7.4: Heat pump water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Reduced air infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
C406.10: Energy monitoring	4	5	5	5	5	4	4	4	4	3	3	4	3	4	4	4	3
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	2

NA = Not Applicable.

TABLE C406.1(5) ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER[a] OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	**0B & 1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% cooling efficiency improvement	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10% cooling efficiency improvement	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3: Reduced lighting power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: On-site renewable energy	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air system	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.2: Recovered or renewable water heating [b]	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
~~C406.7.3: Efficient fossil fuel water heater [b]~~	~~5~~	~~5~~	~~6~~	~~6~~	~~8~~	~~7~~	~~8~~	~~8~~	~~8~~	~~9~~	~~9~~	~~9~~	~~10~~	~~10~~	~~9~~	~~10~~	~~11~~
C406.7.4: Heat pump water heater [b]	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Reduced air infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4
C406.10: Energy monitoring	3	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

NA = Not Applicable.

a. Other occupancy groups include all groups except Groups B, E, I, M and R.

b. For occupancy groups listed in Section C406.7.1.

Delete 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.~~

Reason Statement: In order to meet the state's 2045 carbon neutrality goal, Virginia must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to 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 Virginia'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. Reduced carbon emissions was also recently cited as a priority of energy code development by the ICC in their Leading the Way to Energy Efficiency: A Path Forward on Energy and Sustainability to Confront a Changing Climate in 2021.

This proposed code amendment seeks to address the carbon impact of commercial buildings by requiring all new commercial buildings to be all-electric in Section C401.2. The amendment removes vestigial language that relates to fossil fuel systems related to pool heaters and lighting and clarifies that low-energy buildings must also be all-electric. To clarify the definition of all-electric and combustion equipment, the definition for appliance, equipment, fuel gas, and fuel oil are mirrored from 2021 IMC to be useful in defining combustion equipment.

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. All-electric construction will also result in lower utility costs if high efficiency heat pump technology is used. An Ecotope study of the 2017 Oregon Residential code found that homes heated by electric heat pumps use 40 percent less energy than homes heated with gas (including water heating). Even accounting for reduced efficiency in extreme cold weather, according to a study by RMI, modern air source heat pumps are more than twice as efficient as gas furnaces and can save families up to 9 percent on their utility bills in Climate Zone 6. This is one reason why the U.S. EPA just announced that standards for the most efficient appliances in 2022 certified under the ENERGY STAR program will be all-electric.

All-electric buildings are also healthier. Gas appliances release harmful pollutants like nitrogen dioxide (NO2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in 2017, air pollution from burning fuels in buildings led to an estimated 48,000 to 64,000 early deaths and $615 billion in health impact costs. These emissions can particularly affect children. In a meta-analysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to being diagnosed with asthma.

Therefore, constructing all-electric buildings is critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals. NBI is submitting this amendment along with amendments that address on-site renewables, electric vehicles, and grid integration techniques. These proposed changes to the 2021 IECC, working together, will put the U.S. on the path to a decarbonized, resilient, and healthier future.

Cost Impact: The code change proposal will decrease the cost of construction
All-electric commercial buildings are less expensive to build than mixed fuel buildings because electric appliances and equipment are typically less expensive than combustion equipment and appliances. In additional developers avoid the cost of installing natural-gas lines and meters. Recent analysis by NBI and partners utilizing data from RS Means indicates that an all-electric 53,000 s.f. office building with a central heat pump water heater and minimum code compliant air source heat pump costs $0.09/s.f. less to build than a mixed-fuel office building of the same size. Additional analyses from a recent CASE study indicate that all-electric high-rise multifamily buildings are also less expensive to build and operate than mixed-fuel buildings. HVAC costs, for example, are on the order of $2,504 to $7,131 lower per dwelling unit depending on the HVAC system installed. Installing electric space heating and water heating equipment instead of natural gas equipment in the majority of California's climate zones also yielded a positive benefit to cost ratio over the 15- year analysis period despite California's high electricity rates.

Another study by ACEEE indicates that assuming energy-efficient construction, electrification incentives, and carbon pricing, space heating in 60% of the existing commercial building stock in the U.S. can be cost effectively retrofitted to electric space-heating with a simple payback of less than 10 years. The percentage of spaces where space-heating is cost effective across the country in new construction is likely higher because no retrofit costs are incurred in new construction and because new construction is already mandated to be energy efficient.

Finally, ensuring commercial buildings are all-electric now will guarantee that those buildings will not have to be retrofitted to be all-electric in the future to meet the nation's goal to be net-zero carbon emissions by 2050.

Resiliency Impact Statement: This proposal will increase Resiliency
As the grid becomes increasingly cleaner, all electric buildings will become less carbon intense as they age, unlike buildings with fossil fuel combustion, lessening their impact on climate change. Although these buildings will require more total electricity from the grid than their fossil fuel burning counterparts, they will be able to operate entirely on clean renewable energy.

All-electric buildings additionally support better indoor air quality. Better indoor air quality is directly linked to better health of occupants, including reduction of respiratory and chronic illnesses. The reductions of these types of illnesses increase overall resilience of individuals within our communities, making them less susceptible to the impacts of extreme heat and cold, reducing medical bills, and improving overall quality of life.

Finally, these buildings will also be less dependent on the geopolitics of the fossil fuel market, leveling out energy costs during periods of disruption.

Workgroup Recommendation

Public Comments for: EC-C401.2-21

This proposal doesn't have any public comments.

EC-C403.3-21

Proponents: Ben Rabe (ben@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org); Diana Burk (diana@newbuildings.org)

2021 International Energy Conservation Code

Revise 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), as required by Table C403.3.5, 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
1. Occupied spaces that are solely ventilated by a natural ventilation system in accordance with Section 402 of the International Mechanical Code;
1. 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.

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.
1. 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.
1. 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 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. ~~in~~

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.
Exception: 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 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:

~~Provision~~

1.

2.

3.

4.

5.

Where not required by Section 403.3.5, the p~~P~~ rovision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C

6.

7.

8.

9.

10.

11.

Reason Statement: 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. With ventilation separated from the heating and cooling delivery, 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 ventilation air is delivered using either Energy Recovery Ventilation (ERV) the heating energy requirements associated with tempering the ventilation air are significantly reduced or eliminated. Compliance with this proposed code amendments requires the following in buildings where the cooling or heating system is not 10 percent more efficient than code requirements.
a. 100% ventilation air delivered directly to each zone separate from the heating/cooling system.

b. Ventilation air delivered using an ERV

c. Run heating and cooling equipment (fans and pumps) only when there is a call for conditioning in the zone.

Note that designs based around a DOAS is not new and it has long been established that this design direction leads to more energy efficient buildings. The General Services Administration required DOAS as the baseline design for all new GSA buildings unless otherwise directed by design programming in 1998. The specifications require perimeter and interior systems have 100 percent outside air ventilation systems which are completely independent of any other air distribution system. Enthalpy heat recovery must be included if the outside air required or equipment capacity exceeds a stated amount.

This proposed code change is similar to the requirements currently adopted in the Washington State Energy Code which requires buildings of only certain occupancy types to have a DOAS system. A DOAS would be required in buildings whose occupancy is intended for Mercantile (Group M), and Educational (Group E). A DOAS would also be required in most Business's (Group B) except those exempted, certain Assembly occupancies (Group A) for performing arts or motion pictures (except for television and radio studios), casinos, and lecture halls, community halls, exhibition halls, gymnasiums, courtrooms, libraries, and places of religious worship. A DOAS would not be required in buildings where the cooling or heating system is 10 percent more efficient than code requirements.

A DOAS would also not be required in the building for occupancies for Residential (Group R), Factory and Industrial (Group F), High Hazard (Group H), Institutional (Group I), Storage (Group S), and Utility and Miscellaneous (Group U).

Cost Impact: The code change proposal will increase the cost of construction
On average the incremental cost of adding a DOAS for several building prototypes (small, medium and large office, retail, and schools) was found to be $880 per thousand square foot. The increased cost of requiring DOAS systems is more than offset by operating cost savings. When compared to a code-minimum system upgrade, very high efficiency DOAS can reduce commercial building energy use by an average of 9% to 17% depending on the type of DOAS system used in Climate Zone 4A. In California, installing a DOAS was found to save on average $4-$5 in operating costs for every additional dollar spent to install a DOAS in a building. Buildings with DOAS systems not only save energy but also exhibit improved indoor air quality which is especially important in businesses and schools.

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid's ability to withstand these events will become increasingly important. Dedicated Outdoor Air Systems will increase overall energy efficiency of space conditioning, therefore reducing strain on the electric grid would. As peak demand typically coincides with periods of high usage in the buildings sector, this would increase the resiliency of the grid.

Workgroup Recommendation

Public Comments for: EC-C403.3-21

This proposal doesn't have any public comments.

Proposal # 1042

EC-C403.4.1.6-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a demand response signal.

C403.4.1.6 Demand responsive controls. All thermostatic controls shall be provided with *demand responsive 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 *demand responsive 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.

Reason Statement: This proposal requires that thermostats in commercial buildings have demand control functionality that can be used to adjust thermostat set-points. Since this requirement is part of the construction code, it will not require buildings to participate in any demand response programs. But it will ensure that buildings are capable of participating, so that Virginia buildings will be able to help integrate building loads with available production.
Grid flexibility is one of the foundations of achieving meaningful decarbonization of building energy as it is an essential element of decarbonizing the electrical grid. Carbon free energy sources like solar and wind have varying production over the course of the day and the year. Demand responsive controls that can respond to demand response signals enable buildings to shape their loads to better align with available energy production. This could come in the form of curtailing energy use when demand is high or utilizing excess production for building tasks like pre-conditioning spaces or service hot water when demand is lower.

The ability to adjust by 4 degrees was chosen based on demand flexibility requirements in California's energy code Title 24 Part 6. This will align the requirements with the biggest American market – which is also a neighboring market – for demand responsive thermostats. The proposal includes an exemption for thermostats serving health care and assisted living facilities as these are occupancies where climate control can be related to health care.

Cost Impact: The code change proposal will increase the cost of construction
Demand responsive functionality will present a cost-saving opportunity for buildings in the future. More and more utilities are moving beyond voluntary programs and are expanding use of time-of-use rates for electricity as a tool for shaping demand. Installing demand-responsive thermostats now will allow building tenants and owners to better control their utility costs.

Demand responsive functionality has been required in Title24 since the 2013 edition and was found cost effective in CA. In the 8 years since, equipment prices have decreased (less than $60 for a basic DR thermostat7 compared to just under $30 for a basic 7-day programmable thermostat8) and WA peak prices have increased.

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid's ability to withstand these events will become increasingly important. Demand controlled thermostats will help integrate building loads with available production, lowering energy demand. Therefore, this proposal increase resiliency by reducing overall demand on the grid.

Workgroup Recommendation

Public Comments for: EC-C403.4.1.6-21

This proposal doesn't have any public comments.

Proposal # 1037

EC-C403.15-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new text 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.

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 as follows:

DOE

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

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 C403.15

Reason Statement: 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. Since Virginia legalized recreational marijuana on July 1, 2021, this industry will also experience sharp growth in Virginia.

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.
The incremental cost of installing more efficient dehumidification systems is around $8.11 per square foot of canopy. This measure results in significant energy savings of between 212 to 255 TDV kBtu/yr per square foot of canopy in Climate Zones 2-4. Every dollar spent to install more efficient equipment resulted in between $2.33 and $2.80 in operating and maintenance cost savings over the life of the system.

This proposal is based largely on the requirements listed in Section 120.6(h)1 of Title 24-2022 and is similar to requirements adopted in Denver, CO and being considered for adoption in Washington State, Michigan, and Illinois.

Cost Impact:
The incremental cost of installing more efficient dehumidification systems is around $8.11 per square foot of canopy. This measure results in significant energy savings of between 212 to 255 TDV kBtu/yr per square foot of canopy in Climate Zones 2-4. Every dollar spent to install more efficient equipment resulted in between $2.33 and $2.80 in operating and maintenance cost savings over the life of the system.

References:

Final CASE Report: Controlled Environment Horticulture, California Statewide Codes and Standards Enhancement (CASE) Program, Oct. 2020, https://title24stakeholders.com/wp-content/uploads/2020/10/2022-T24-NR-CEH-Final-CASE-Report.pdf.

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid's ability to withstand these events will become increasingly important. Indoor agricultural facilities place a huge demand on the local energy supply, rivaling that of data centers. The dehumidification proposal will significantly reduce energy demand of these facilities and therefore increase resiliency by reducing overall demand on the local grid where facilities are being added.

Workgroup Recommendation

Public Comments for: EC-C403.15-21

This proposal doesn't have any public comments.

EC-C404.11-21

Proponents: Ben Rabe (ben@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

DEMAND RESPONSE SIGNAL. . A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a demand response signal.

C404.11 Demand Responsive water heating. Electric storage water heaters with a rated water storage volume between 40 and 120 gallons and a nameplate input rating equal to or less than 12kW shall be provided with demand responsive controls that comply with Table C404.11

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 theASME Boiler and Pressure Vessel Code

3. Water heaters that use 3-phase electric power

Table C404.11

Equipment Type	Rated Water Storage Volume	Controls	
		Before 7/1/2025	As of 7/1/2025
Electric Storage Water heaters	40-120 gallons	ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a demand response signal.	ANSI/CTA-2045-B Level 2, except “Price Stream Communication” functionality as defined in the standard.

Revise as follows:

ASME

American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

Reason Statement: Water heaters can provide significant load shifting and energy storage capacity in many building types. ANSI/CTA-2045 standardizes the socket, and communications protocol, for heat pump water heaters so they can communicate with the electricity grid other demand response signal providers. In addition, 2045 adds control and communications requirements for mixing valves in HPWH to enable them to provide

greater storage capacity to support increased load shifting. The addendum also creates a definition of demand responsive control to ensure its consistent use throughout the code. ANSI/CTA-2045 is the industry standard for demand responsive controls for water heaters, but the requirement allows for other protocols to be approved by the building official.
This proposal requires that water heaters with integrated storage tanks have this demand control functionality. The requirement is limited to electric water heaters with integrated storage tanks. It only applies to water heaters over 20 gallons in order to exclude small, point-of-use water heaters; these water heaters also only have very small capacity for demand response. Water heaters in health care facilities are also exempted since the hot water provided can be considered a part of health care. The requirement would also not apply to large water heating systems, as they generally have separate storage tanks. These water heaters subject to this requirement generally serve lavatories and kitchenettes in commercial buildings and some water heating approaches in mid-rise residential. Grid flexibility is one of the foundations of achieving meaningful decarbonization of building energy as it is an essential element of decarbonizing the electrical grid. Carbon free energy sources like solar and wind have varying production over the course of the day and the year. Demand responsive controls that can respond to demand response signals enable buildings to shape their loads to better align with available energy production. This could come in the form of curtailing energy use when demand is high or utilizing excess production for building tasks like pre-conditioning spaces or service hot water when demand is lower. Demand control functionality will also present a cost-saving opportunity for buildings in the future.

More and more utilities are moving beyond voluntary programs and are expanding use of time-of-use rates for electricity as a tool for shaping demand. Installing demand-responsive lighting controls now will allow building tenants and owners to better control their utility costs. Since this requirement is part of the construction code, it will not require buildings to participate in any demand response programs. But it will ensure that buildings are capable of participating, so that VA buildings will be able to help integrate building loads with available production.

Cost Impact: The code change proposal will increase the cost of construction
Grid-integrated controls for water heaters which costs around $173 become cost effective when enrolled in a demand response program. Armada Power customers in Ohio who enrolled their water heaters in a demand response program saved $184 annually by enrolling in the program. If utilities nationwide instituted a similar program to shape demand, a customer could reap $12 in energy cost savings for every $1 spent on the additional controls

Resiliency Impact Statement: This proposal will increase Resiliency
Demand responsive controls allow for utilities to send and buildings to receive signals to ramp up or down set points based on a variety of conditions. This communication ability is a critical aspect of resilience for our communities.

Storage water heaters have a unique capability to act as thermal storage “batteries”. By allowing water heaters to receive a signal from the grid, water can be heated at a time when overall demand, price signals or carbon emissions are at their lowest. Pre-heating water in this way can help to lessen peak demands on the grid, creating grid resiliency, reduce costs for consumers, creating financial resiliency, and help absorb excess renewable generation, or at a minimum engage during the cleanest hours of generation, reducing carbon emissions and climate impact of water heating.

Workgroup Recommendation

Public Comments for: EC-C404.11-21

This proposal doesn't have any public comments.

Proposal # 1038

EC-C405.4-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org)

2021 International Energy Conservation Code

Revise 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 text 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 as follows:

C405.4 Lighting for plant growth and maintenance. ~~Not less than 95 percent of the permanently~~
Permanently installed luminaires used for plant growth and maintenance shall have a 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.

~~efficiency a as defined in accordance with ANSI/ASABE S640. efficiency a~~

Reason Statement: 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. This growth is going to occur rapidly in Virginia since Virginia legalized recreational marijuana on July 1, 2021. 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. Because of the large opportunity for energy savings, the 2021 IECC has already adopted requirements for lighting in these applications using the efficiency metric of µmol/J (micromoles per Joule) which was developed in collaboration with the American Society of Agricultural and Biological Engineers to measure the efficacy of lighting used for plant growth. A double-ended High Pressure Sodium (HPS) luminaire can meet the existing 2021 IECC standard of 1.6 µmol/J. The proposed requirement increases the efficacy level required to 1.9 µmol/J. This new efficacy standard does not require a technology shift within indoor horticulture because slightly more efficient double-ended HPS lamps that meet the existing standard can also meet the proposed standard. Because a technology shift is not required, the additional energy savings from increasing the standard from 1.6 µmol/J to 1.9 µmol/J for indoor operations is very cost-effective. This proposed amendment also institutes a lower efficacy requirement of 1.7 µmol/J for greenhouses due to lower operating hours and thus longer payback periods in these applications. This amendment also introduces requirements for lighting controls that are able to turn off the luminaire at specific times during the day and a lighting control requirement for greenhouses to ensure lights are off when sufficient daylight is available. Finally, the amendment clarifies these requirements by introducing horticultural lighting and photosynthetic photon efficacy as new definitions and by amending the definition for greenhouse. These requirements are consistent with proposed Addendum ar-2019 recently released for public review to ASHRAE Standard 90.1 and with code requirements proposed for inclusion in Section 120.6(h)2 of California's Title 24-2022. The Technical Advisory Groups in Minnesota, Washington State, and Washington D.C. are also recommending these efficacy requirements as amendments to their local commercial energy codes. This proposal was also approved by the IECC Consensus Committee.
References:

Energy Savings Potential of SSL in Horticultural Applications. U.S. Department of Energy, Dec. 2017, https://www.energy.gov/sites/prod/files/2017/12/f46/ssl_horticulture_dec2017.pdf.

Schimelpfenig, Gretchen. Energy Efficiency for Massachusetts Marijuana Cultivators, Resource Innovation Institute, Sept. 2020, resourceinnovationinstitute.wildapricot.org/RII-REPORTS/.

Final CASE Report: Controlled Environment Horticulture, California Statewide Codes and Standards Enhancement (CASE) Program, Oct. 2020, https://title24stakeholders.com/wp-content/uploads/2020/10/2022-T24-NR-CEH-Final-CASE-Report.pdf.

15-Day Express Terms 2022 Energy Code - Residential and Nonresidential, California Energy Commission, 14 July 2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238848.

Proposed Addendum ar to Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings, ASHRAE, Aug. 2021, http://osr.ashrae.org/Online-Comment-Database/ShowDoc2/Table/DocumentAttachments/FileName/3689-90.1(2019)ar%20PPR1%20Draft.pdf/download/false.

Cost Impact: The code change proposal will increase the cost of construction
This proposal will result in no additional cost for growers using greenhouses because there is little to no cost difference between luminaires meeting the current 2021 IECC requirement of 1.6 µmol/J and the proposed requirement of 1.7 µmol/J and because lighting control requirements are already common practice for these applications. For indoor grow operations, the cost of purchasing a luminaire that meets a 1.9 µmol/J requirement vs a 1.6 µmol/J would result in increased costs of approximately $13/square foot. Assuming an electricity rate of 11.09 cents/kWh, annual energy cost savings from this code proposal is approximately $4.55/square foot resulting in a three-year simple payback period.

References:

Morlino, Lauren, Emerging Technologies & Services Manager at Vermont Energy Investment Corporation . Re: Cost Information for VT Luminaires, 21 June 2021.

Final CASE Report: Controlled Environment Horticulture, California Statewide Codes and Standards Enhancement (CASE) Program, Oct. 2020, https://title24stakeholders.com/wp-content/uploads/2020/10/2022-T24-NR-CEH-Final-CASE-Report.pdf.

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid's ability to withstand these events will become increasingly important. Indoor agricultural facilities place a huge demand on the local energy supply, rivaling that of data centers. The lighting proposal will significantly reduce energy demand of these facilities and therefore increase resiliency by reducing overall demand on the local grid where facilities are being added.

Workgroup Recommendation

Public Comments for: EC-C405.4-21

This proposal doesn't have any public comments.

EC-C405.13-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org); Kimberly Newcomer (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

RENEWABLE ENERGY CERTIFICATE (REC). An instrument that represents the environmental attributes of one megawatt-hour of renewable electricity; also known as an energy attribute certificate (EAC).

C405.13 Renewable energy systems..
Each building site shall have equipment for on-site renewable energy with a rated capacity of not less than 0.25 W/ft² (2.7 W/m²) multiplied by the sum of the gross conditioned floor area of the three largest floors.

Exceptions:

1. Any building located where an unshaded flat plate collector oriented towards the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 3.5 kWh/m²·day (1.1 kBtu/ft²·day).

2. Any building where more than 80 percent of the roof area is covered by any combination of equipment other than for on-site renewable energy systems, planters, vegetated space, skylights, or occupied roof deck.

3. Any building where more than 50 percent of roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2,500 annual hours between 8:00 AM and 4:00 PM.

C405.13.1 Renewable energy certificate documentation. Documentation shall be provided to the code official that indicates that renewable energy certificates (RECs) associated with the on-site renewable energy will be retained and retired by or on behalf of the owner or tenant.

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.

Revise as follows:

C406.5 On-site renewable energy. ~~Buildings shall comply with Section C406.5.1 or C406.5.2.~~ The total minimum ratings of on-site renewable energy systems, not including onsite renewable energy system capacity used for compliance with Section C405.13, shall be one of the following

TABLE C407.4.1(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Space use classification	Same as proposed	The space use classification shall be chosen in accordance with Table C405.3.2(1) or C405.3.2(2) for all areas of the building covered by this permit. Where the space use classification for a building is not known, the building shall be categorized as an office building.
Roofs	Type: insulation entirely above deck	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, above-grade	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Floors, slab-on-grade	Type: unheated	As proposed
	F-factor: as specified in Table C402.1.4	As proposed
Opaque doors	Type: swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: none	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1. 2. The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 watt per square foot based on the categorization of buildings with unknown space classification as offices.	As proposed
Lighting, exterior	The lighting power shall be determined in accordance with Tables C405.5.2(1), C405.5.2(2) and C405.5.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed **Exception:** Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Mechanical ventilation	Same as proposed	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type[a]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in the tables in Section C403.3.2.	As proposed
	Capacity[b]: sized proportionally to the capacities in the proposed design based on sizing runs, and shall be established such that no smaller number of unmet heating load hours and no larger heating capacity safety factors are provided than in the proposed design.	As proposed

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Cooling systems	Fuel type: same as proposed design	As proposed
	Equipment type[c]: as specified in Tables C407.4.1(2) and C407.4.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(3)	As proposed
	Capacity[b]: sized proportionally to the capacities in the proposed design based on sizing runs, and shall be established such that no smaller number of unmet cooling load hours and no larger cooling capacity safety factors are provided than in the proposed design.	As proposed
	Economizer[d]: same as proposed, in accordance with Section C403.5.	As proposed
Service water heating[e]	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, as proposed multiplied by efficiency as provided by the manufacturer of the DWHR unit.
	Capacity: same as proposed	As proposed
	Where no service water hot water system exists or is specified in the proposed design, no service hot water heating shall be modeled.	
On-site Renewable Energy	Where a *system* providing *on-site renewable energy* has been modeled in the *proposed design* the same *system* shall be modeled identically in the *standard reference design* except the rated capacity shall meet the requirements of Section C405.13	As proposed
	Where no system is designed or included in the proposed design, model an unshaded photovoltaic system with the following characteristics:	
	Size: Rated capacity per Section C405.13	
	Module Type: Crystalline Silicon Panel with a glass cover, 19.1% nominal efficiency and temperature coefficient of -0.35%/°C, Performance shall be based on a reference temperature of 77°F (25°C), airmass of 1.5 atmosphere and irradiance of 317 Btu/h·ft^2 (1000 W/m^2).	
	Array Type: Rack mounted array with installed nominal operating cell temperature (INOCT) of 103°F (45°C).	
	Total System Losses (DC output to AC output): 11.3%.	
	Tilt: 0-degrees (mounted horizontally).	
	Azimuth: 180 degrees.	

For SI: 1 watt per square foot = 10.7 w/m^2.

SWHF = Service Water Heat Recovery Factor, DWHR = Drain Water Heat Recovery.

a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.

b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.

c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.

d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.

e. The SWHF shall be applied as follows:

1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 **–** (DWHR unit efficiency × 0.36)].
2. Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then SWHF = [1 **–** (DWHR unit efficiency × 0.33)].
3. Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then SWHF = [1 **–** (DWHR unit efficiency × 0.26)].
4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reason Statement: In order to meet the state's 2045 carbon neutrality goal, Virginia must not only reduce energy use through energy efficiency but also move to utility scale and on-site renewable energy. In 2020, renewable energy sources were responsible for 21% of U.S. electricity generation. In order to cost-effectively achieve Virginia's goal to achieve carbon neutrality by 2045, it is paramount to begin installing a nominal capacity of renewable energy on-site in all new buildings now. According to a recent study entitled "A New Roadmap for the Lowest Cost Grid", the least expensive grid involves a large amount of centralized renewables and a large amount of distributed renewables located on the building site. More renewables placed onsite can enable the efficient deployment of rapidly expanding utility-scale renewables. It is therefore crucial for new commercial buildings to install renewable energy on-site during new construction so that the U.S. can reach its 100% carbon-free power sector goal in the most cost-effective manner. Installing renewables on site will also allow building owners to economically benefit from the transition towards a low-carbon economy, to prepare their building for expansion of renewable capacity, and to benefit from additional resiliency during disruptions in centrally supplied power. In addition, this proposal will expand good paying jobs in one of the nation's fastest growing employment sectors. According to the Bureau of Labor Statistics, the two fastest growing occupations in the US in 2019 were solar PV installers and wind turbine service technician. The Interstate Renewable Energy Council estimates that to reach Biden's target of 100% renewable energy by 2035, the industry will need to employ three times the number of workers employed in 2020.
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 closelyaligns 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.

The addenda establishes a prescriptive requirement for onsite renewable energy of 1.5W/s.f. of the three largest floors of all commercial buildings. The size of the required on-site renewable energy will supply on average 30% of building energy use. The recent technical brief from PNNL indicates there is enough roof space to meet this requirement for the vast majority of commercial buildings. If there is insufficient roof space or substantial shading, building owners are allowed to be exempted from on-site renewable energy requirements if they procure an equivalent amount of renewable energy off-site from a community renewable energy facility, a physical power purchase agreement or a financial power purchase agreement.

The proposal also requires building owners to retain any renewable energy credits (RECS) so that no other individual or organization can claim or take credit for the production from the system (thus preventing double-counting). REC documentation requirements are based on those currently in R406.7.3 of the 2021 IECC and 701.4.1.1.1 of the 2021 IgCC, and revisions pending for ASHRAE Standard 189.1-2023.

Finally, this proposal includes requirements to illustrate raceways used for the renewable energy system in construction documents and revises section C406.5 to prevent double-counting of the minimum renewable energy requirements in section C405.

References:

Renewables Became the Second-Most Prevalent U.S. Electricity Source in 2020 , U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=48896.

Fact Sheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies, The White House, 22 Apr. 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

Why Local Solar For All Costs Less: A New Roadmap for the Lowest Cost Grid, Vibrant Clean Energy, Dec. 2020, www.vibrantcleanenergy.com/wp-content/uploads/2020/12/ https://irecusa.org/wp-content/uploads/2021/07/National-Solar-Jobs-Census-2020-FINAL.pdf. WhyDERs_ES_Final.pdf.

The National Solar Job Census 2020, Interstate Renewable Energy Council, May 2021,

Richardson, Jake. Solar and Wind Tech Are the Fastest Growing Jobs in US, Red, Green, and Blue, 28 Jan. 2019, http://redgreenandblue.org/2019/01/27/solar-wind-tech-fastest-growing-jobs-us/.

ANSI/ASHRAE/IES Addendum by, ck, and cp to ANSI/ASHRAE/IES Standards 90.1-2019, ASHRAE Standards Committee, 31 July 2020, https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_by_ck_cp_202007

Cost Impact: The code change proposal will increase the cost of construction
This proposed code change will increase cost of construction modestly for commercial buildings following the prescriptive pathway of the 2021 IECC. The following table lists the required size of the photovoltaic array and cost effectiveness of that array under this proposed code amendment for a set of prototype commercial buildings following the prescriptive pathway. Analysis of the approximate total installed costs for these photovoltaic system is estimated at $2.20/W based on analysis by NBI and partners. The annual energy cost savings in the first year of production are based on generation estimated by NREL's PVWatts in Minneapolis (which has below average solar radiation compared with the majority of the U.S.) and average U.S. electricity rates according to the U.S. EIA. The analysis indicates that this requirement would result in a payback time that is far less than the system lifetime.

¤	PV·System·Size·(kW)¤	PV·Cost/s.f.¤	Annual·Energy·Cost·Savings¤	Simple·Payback·Period·(yrs)¤
Small·Business¶ (3-story,·10,000·s.f.)¤	2.5·¤	·$5,070·¤	·$·410¤	12.4¤
Multifamily·High·Rise·(10-story,·80,000·s.f.)¤	6.0¤	·$12,168¤	·$1,383¤	8.8¤
Office·¶ (4-story,·50,000·s.f.)¤	9.4¤	·$19,013·¤	·$·1,536·¤	12.4¤

Resiliency Impact Statement: This proposal will increase Resiliency
Resiliency is an essential component of adapting to the effects of climate change. As we see increasing number of severe weather events, the electric grid's ability to withstand these events will become increasingly important. Community resilience will be increasingly dependent on distributed generation, and more localized production can help buildings and communities keep power when other areas of the grid may be offline. This local production of power can support critical building functions – varying by building type and use during a resilience event – providing life supporting functions of small/at home medical devices that require on power, allowing for needed cell phone charging to stay in touch during an emergency, and literally keeping the lights on for safety and security.

Workgroup Recommendation

Public Comments for: EC-C405.13-21

This proposal doesn't have any public comments.

EC-C405.16-21

Proponents: Ben Rabe (ben@newbuildings.org); Diana Burk (diana@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

C103.2.2 Electrification system. The construction documents shall provide details for additional electric infrastructure, including branch circuits, conduit, or pre-wiring, and panel capacity in compliance with the provisions of this code.

Revise as follows:

C105.2.5 Electrical system. Inspections shall verify lighting system controls, ~~components and~~ components meters , and additional electric infrastructure as required by the code, *approved* plans and specifications.

Add new text 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 and/or lighting that uses *fuel gas* or *fuel oil* .

COMMERCIAL COOKING APPLIANCES. 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.

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

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for such *equipment* .

C405.16 Additional electric infrastructure. C405.16 Additional electric infrastructure. Buildings that contain *combustion equipment* and end-uses shall be required to install electric infrastructure in accordance with this section.

C405.16.1 Electric infrastructure for dwelling and sleeping units. *Combustion equipment* and end-uses serving individual *dwelling units* or *sleeping units* shall comply with Section R404.6.

C405.16.2 Combustion space heating. Space heating *equipment* that uses *fossil fuels* shall comply with either C405.16.2.1 or C405.16.2.2

C405.16.2.1Unitized heating. Warm-air furnaceswith a capacitylessthan 225,000 Btu/handgas- and oil-fired boilerswith a capacitylessthan 400,000 Btu/hshall be provided with a designated exterior location(s) in accordance with the following:

a. Natural drainage for condensate from cooling equipment operationor a condensate drain located within 3 feet (914 mm)of the location of the space heating equipment, and

b. A dedicated branch circuit in compliance withNFPA70 Section 424.4based on heat pump space heating equipment sized in accordance withthe requirements of ANSI/ASHRAE/IES Standard 90.1,Section 6.4.2 and terminating within 3 feet (914 mm) of the locationof the space heating equipmentwith no obstructions. Both ends of the branch circuit shall be labeled “For Future Heat Pump Space Heater.”

Exception to C405.16.2.1(b): Where an electrical circuit in compliance withNFPA70 Sections 440.4(B) and 440.35exists for space cooling equipment.

C405.16.2.2Central heating. All other space heating*equipment* shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the*equipment* and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric*equipment* with an equivalent equipmentcapacity. The electrical junction box and electrical panel shall have labels stating, “ForFutureElectricSpace HeatingEquipment”.

C405.16.3 Combustion water heating .Water heating *equipment* that uses*fossil fuels* shall comply with either C405.16.3.1 or C405.16.3.2

C405.16.3.1Unitizedwater heating .Water heaters with a capacity less than 300,000 Btu/h (88 kW) shall be installed in accordance with the following:

1. A dedicated 208/240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 3 feet (914 mm) from the water heater and be accessible to the water heater with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Heat Pump Water Heater" and be electrically isolated,

2. A condensate drain that is no more than 2 inches (51 mm) higher than the base of the installed water heater and allows natural draining without pump assistance shall be installed within 3 feet (914 mm) of the water heater,

3. The water heater shall be installed in a space with minimum dimensions of 3 feet (914 mm) by 3 feet (914 mm) by 7 feet (2134 mm) high, and

4. The water heater shall be installed in a space with a minimum volume of 700 cubic feet (20,000 L) or the equivalent of one 16-inch (406 mm) by 24-inch (610 mm) grill to a heated space and one 8-inch (203 mm) duct of no more than 10 feet (3048 mm) in length for cool exhaust air.

C405.16.3.2Central water heating. Water heaters with a capacitygreaterthanor equal to300,000 Btu/h (88 kW) shall beprovided withthe following:

1. Conduit that is continuous between a junction box located within 3 feet (914 mm) of the*equipment* and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric*equipment* with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For Future ElectricWater HeatingEquipment”, and

2. A condensate drain that is no more than 2 inches (51 mm) higher than the base of the installed water heater and allows natural draining without pump assistance shall be installed within 3 feet (914 mm) of the water heater,

C405.16.4 Combustion cooking. Cooking *equipment* thatuse*fossil fuel* shall comply with either C405.16.4.1 orC405.16.4.2

C405.16.4.1 Commercial cooking.*Commercial cooking appliances* shall be provided with a dedicated branch circuit with a minimum capacity of 12 kVA per 1kBtuof appliance input capacity. The branch circuit shall terminate within 3 feet (914 mm) of the appliance with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Cooking Equipment” and be electrically isolated.

C405.16.4.2Light and medium dutycooking. Light-and mediumduty cooking *equipment* not designated as*commercial cooking appliances* shall be provided with a dedicated branch circuitin compliance with NFPA 70 Section422.10. The branch circuitshall terminate within 6 feet (1829 mm) of*fossil fuel* ranges, cooktops and ovens and be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future ElectricCookingEquipment” and be electrically isolated.

C405.16.5 Combustion clothes drying .Clothes drying *equipment* that use*fossil fuels* shall comply with either C405.16.5.1 or C405.16.5.2

C405.16.5.1 Commercial drying. Clothes drying*equipment*, and end-usesfor commercial laundry applicationsshall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the*equipment* and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric*equipment* with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For Future ElectricClothes DryingEquipment”, and

C405.16.5.2 Residential drying. Clothes drying*equipment*, *appliances*, and end-uses serving multiple*dwelling units* or sleeping areaswith a capacity less thanor equal to9.2 cubicfeetshall be provided withadedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 6 feet (1829 mm) of*fossil fuel* clothes dryers and shall be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Clothes DryingEquipment” and be electrically isolated.

Revise as follows:

C406.1 Additional energy efficiency credit requirements. New *all-electric buildings* shall achieve a total of 10 ~~credits~~ credits and new *mixed-fuel buildings* shall achieve a total of 15 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:

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.

Reason Statement: In order to meet the state's 2045 carbon neutrality goal, Virginia must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. Therefore it is crucial that new buildings today can be cost-effectively retrofitted in the future with electric equipment so that emissions are not "locked-in" by gas-dependent building infrastructure. Fortunately, heat pump technology has dramatically improved over the last few decades, giving contractors and building owners access to highly efficient electric heating and cooling, and water heating technologies.

One of the biggest expenses of electrification retrofits – and therefore barriers to electrification in existing buildings - is running electrical infrastructure through a completed and enclosed building that has combustion equipment. This significant future cost can be greatly reduced through making simple, low-cost modifications to buildings during construction that enable easier electrification in the future. The requirements in this proposed amendment ensure that the electrical infrastructure is in place so that building owners can convert to an all-electric building in the future and ensures that unitized gas water heaters can be replaced with high-performance heat pump water heaters (HPWHs).

Cost Impact: The code change proposal will increase the cost of construction
Virginia buildings that are all-electric would have no change in construction costs. Mixed fuel buildings would be slightly more expensive to build because they would both have to be electric-ready and meet additional efficiency requirements. Electric-ready requirements are anticipated to be nominal. Recent analysis by NBI and partners using cost data from RSMeans indicates that additional electrical infrastructure costs for water-heating and space-heating would cost a typical office building an additional $8,380. However if a building owner were to have to retrofit their building from using combustion equipment to natural gas equipment costs without these requirements in place, costs could be exorbitant.

Resiliency Impact Statement: This proposal will increase Resiliency
Electric ready infrastructure allows buildings the ability to take advantage of the greening grid while spreading out the costs. As noted in the reason statement, they will likely transition from fossil fuel to electric appliances over their lifespan. Although these buildings will require more electricity from the grid than their fossil fuel burning counterparts as they transition, they will be able to operate entirely on clean renewable energy.

By constructing electric-ready, building owners will additionally be given the tools they need to make decisions on the timing to switch fuel sources. As the costs of fuels change over time, owners will be ready to remove themselves from the volatility and geopolitics of the fossil fuel market.

Workgroup Recommendation

Public Comments for: EC-C405.16-21

This proposal doesn't have any public comments.