IECC - Residential
IRC - Energy

2016 GROUP B PUBLIC COMMENT AGENDA

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ICC
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RE3-16
R202

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Add new definition as follows:

SECTION R202 DEFINITIONS

AIR-IMPERMEABLE INSULATION. An insulation having an air permability of equal to or less than 0.02 L/s-m^2 at 75 Pa pressure differential when tested in accordance with ASTM E2178 or E283.

Reference standards type: This is an update to reference standard(s) already in the ICC Code Books
Add new standard(s) as follows:
ASTM E2178-13 Standard Test Method for Air Permeance of Building Materials

Reason: Definition carried over from the IRC
The term air permeable insulation is utilized in the IECC specifically in Table R404.1.1. Carrying this definition over to from the IRC to the IECC helps clarify what can and cannot be used in specific installation according to the code.

Cost Impact: Will not increase the cost of construction
There would be no cost impact associated with this proposed definition as it is being added to create better consistency between the code families and clarity for the intent of the current code.

Analysis: The term is defined in IRC Chapter 2.
The standard proposed for inclusion in this code, ASTM E2178-13, is referenced in the *International Energy Conservation Code-Commercial Provisions*.

**RE3-16 : R202
INSULATION-
SCHWARZ12371**

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

AIR-IMPERMEABLE INSULATION. An insulation ~~having~~ which also functions as an air ~~permability of equal to or less than 0.02 L/s-m2 at 75 Pa pressure differential when tested in accordance with ASTM E2178 or E283~~ barrier material.

Committee Reason: The modification was needed to correct the proposed defiintion to align with what is in the ASTM standards. The as-modified proposal was approved because it is difficult to explain what is intended without a definition.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Disapprove.

Commenter's Reason: The definition as submitted, and definitely as modified by the Residential Energy Committee provides no useful information for the code user.

We found 2 places in the residential portion of the code which uses this term.

R402.2.3 Eave baffle. For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.

And table R402.4.1.1 where use of such insulation as a sealing material is prohibited.

In neither place does the definition provide information to the code user. We did note that the term is also used in the commercial half of the code, but the proponent did not submit this definition for that half of the code.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

RE3-16

RE6-16
R202 (IRC N1101.6)

Proposed Change as Submitted

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

R202 (N1101.6) HIGH-EFFICACY LAMPS. ~~Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps~~
Lamps with a minimum efficacy of~~:~~

1. ~~Sixty lumens per watt for lamps over 40 watts;~~
2. ~~Fifty lumens per watt for lamps over 15 watts to 40 watts; and~~
3. ~~Fourty lumens per watt for lamps 15 watts or less.~~

75 lumens per watt.

Reason: The wide availability and falling prices of LED lamps makes them a cost-effective option for improving residential efficiency. The proposed threshold of 75 lumens/Watt encourages the use of the new technologies while still permitting many better CFL technologies.

Energy Savings: DOE conducted an energy analysis using the established methodology: https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).[1] In analyzing the energy cost savings and cost-effectiveness of this code change proposal, DOE evaluated the option of replacing all CFLs (luminous efficacy of 55 lumens/watt) with LEDs (luminous efficacy of 78 lumens/watt). The energy analysis indicates that LEDs save about $6 per year in overall energy costs across all climate zones. This represents 0.22% to 0.75% of IECC-regulated end uses (heating, cooling, lighting and water heating), depending on climate zone.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC (https://www.energycodes.gov/development/2018IECC).

Bibliography:

1. Taylor, ZT; Mendon, VV; and Fernandez, N. (2015). Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes. Pacific Northwest National Laboratory for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-21294 Rev1. https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).
2. See http://www.mckinsey.com/insights/energy_resources_materials/peering_into_energys_crystal_ball?cid=other-eml-alt-mkq-mck-oth-1507 (http://www.mckinsey.com/insights/energy_resources_materials/peering_into_energys_crystal_ball?cid=other-eml-alt-mkq-mck-oth-1507)
3. Preliminary Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: General Service Lamps. U.S. Department of Energy. December 1, 2014.
4. J. Tuenge. "SSL Pricing and Efficacy Trend Analysis for Utility Program Planning." Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy, October 2013. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_trend-analysis_2013.pdf. (http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_trend-analysis_2013.pdf)

Cost Impact: Will increase the cost of construction
This change will increase the cost of construction because it requires higher efficacy lighting (lamps and/or fixtures), which will likely eliminate some lower-end CFL options and/or push builders to newer LED technologies. The cost of LEDs has been steadily declining over the last several years and is expected to continue to decline between now and the publication of the 2018 IECC. Based on current price estimates and projected price reductions as the LED market matures, this analysis assumes that in 2018 LEDs will cost $4.84 per lamp compared to CFLs at $3.10 per lamp.[2,3,4]

Cost-effectiveness: DOE conducted a cost-effectiveness analysis using the established methodology:

https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).[1] The analysis indicates life-cycle cost savings in all climate zones, ranging from about $33 to $63. The full analysis is available at https://www.energycodes.gov/sites/default/files/documents/iecc2018_R-5_analysis_final.pdf (https://www.energycodes.gov/sites/default/files/documents/iecc2018_R-5_analysis_final.pdf).

RE6-16 : R202 LAMPS-WILLIAMS12247

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The prior action on RE5-16 takes care of this topic in a better way. Besides, how would an inspector verify the efficacy of installed lamps? Save the cartons for each lamp?

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : jim edelson, representing new building institute (jim@newbuildings.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R202 (N1101.6) HIGH-EFFICACY LAMPS. Lamps with a minimum efficacy of ~~75~~

1. 90 lumens per watt for lamps over 40 watts;
2. 60 lumens per watt for lamps over 15 watts to 40 watts;
3. 45 lumens per watt for lamps over 5 watts to 15 watts;
4. 30 lumens per watt for lamps 5 watts or less.

Commenter's Reason: This set of specifications updates the definition to reflect widely-available products currently in a market that has significantly changed since the old definition was written. Products meeting these specifications are nearly certain to dominate the high-efficacy market in 2018 and beyond – the earliest possible dates for jurisdictions to adopt the 2018 IECC. These specifications have been in California code since Title 24-2013.

Proponent : Joe Nebbia, representing Newport Partners LLC requests Approve as Submitted.

Commenter's Reason: There are several problems currently with the market perceptions around high-efficacy lighting. First we see a widespread misconception that halogen bulbs qualify as high-efficacy lighting under the code. They are marketed as energy efficient halogen bulbs and we have met both builders and code officials that assume that means they meet the code.

The other misperception we are seeing is that high-efficacy bulbs means CFLs. There is a negative market perception that in order to get efficiency with our lighting we have to accept lighting with inferior performance.

During consumer preference research we performed as part of a NYSERDA project in New York State that Newport conducted, we used a lighting demonstration box to ask consumers (925 people surveyed) which type of lighting they preferred. We used a hidden bulb light box with an incandescent bulb, a CFL, and an LED, all with the same color temperature rating and lumen output. This research resulted in 59% of consumers choosing the LED lighting and therefore the bulb as their top preference. Only 16% preferred the CFL.

While 25% preferred the incandescent, those bulbs will not meet the high efficacy requirements of the code anyway. What the survey did tell us is that we can push forward from CFLs and the negative connotation that is connected with them.

Second, within our research for NYSERDA we also supported the design and construction of five all-LED demonstration homes. Over the course of that two year project, LED lighting technology has already changed exponentially. Given the current rate of change in technology, this 75 lm/w efficacy will seem even more reasonable as time goes on.

We urge your support of RE6-16 because it recognizes the market improvement that LEDs offer while moving the perception of high-efficacy lighting away from CFLs. It will not impact the ability to put in halogen or incandescent bulbs because they are already limited by the high-efficacy lighting percentage.

Bibliography:

- http://www.newportventures.net/PDF/ssl-lighting/LED_Lighting_Continues_to_Impress_121615.pdf (http://www.newportventures.net/PDF/ssl-lighting/LED_Lighting_Continues_to_Impress_121615.pdf)
- http://www.newportventures.net/PDF/ssl-lighting/Gauging-Consumer-Perception-Residential-LightingFinal-2014.pdf (http://www.newportventures.net/PDF/ssl-lighting/Gauging-Consumer-Perception-Residential-LightingFinal-2014.pdf)

RE6-16

RE10-16

R303.4 (New) [IRC N1101.13 (New)]

Proposed Change as Submitted

Proponent : Mike Moore, Newport Ventures, representing Broan-NuTone, representing Broan-NuTone (mmoore@newportventures.net)

2015 International Residential Code

Add new text as follows:

R303.4 (N1101.13) Whole-house mechanical ventilation system airflow testing. Where a whole-house mechanical ventilation system is provided, the airflow shall be tested and verified according to the ventilation equipment manufacturer's instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles or in the connected ventilation ducts. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*.

Reason: If not installed correctly, whole-house mechanical ventilation systems can fail to deliver the minimum outdoor air needed to provided acceptable indoor air quality. A recent study in Florida[1] found that only three of 21 whole house mechanical ventilation systems had a flow rate near the design level. Because these systems perform a vital function in supporting building durability and occupant health, these systems should be verified for flow when installed. This requirement and text are aligned with ASHRAE 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings.

Bibliography: 1. Sonne et al. (2015). Investigation of the Effectiveness and Failure Rates of Whole-House Mechanical Ventilation Systems in Florida. FSEC-CR-2002-15. http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-2002-15.pdf.

Cost Impact: Will increase the cost of construction

Testing the airflow of a whole house mechanical ventilation system should take about 15-20 minutes. Assuming a skilled labor rate of $50/hr, the incremental cost for the test is estimated at $12-$33. There is no requirement for a third party to conduct the test, which can help reduce costs.

RE10-16 : R303.4 (NEW)-MOORE11067

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There are fans that have potentiometers to adjust the flow and those types of fans were not allowed as an exception. Builders are not able to do their own testing of these fans.. The indicated cost impact information appears to be significant lower than what it actually will be in many cases.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Residential Code

R303.4 (N1101.13) Whole-house mechanical ventilation system airflow testing. Where a whole-house mechanical ventilation system is provided, the airflow shall be ~~tested and~~ verified ~~according to~~ using the ~~ventilation equipment manufacturer's instructions~~ manufacturer's on-board diagnostics, or by using ~~a flow hood, flow grid, or other~~ an airflow measuring device at the mechanical ventilation fan's inlet ~~terminals or grilles,~~ outlet terminals or ~~grilles or in~~ within the ~~connected ventilation~~ system's ducts. A written report of the results of the ~~test~~ verification results shall be signed by the party conducting the test and provided to the *code official*.

Commenter's Reason: The committee disapproved the original proposal because they believed it did not include the option to verify flow rates based on on-board diagnostics and because they believed that it did not permit builders to self-test. This comment addresses both of these concerns. Flow rate verification can now be accomplished by following manufacturers' instructions (e.g., referencing on-board diagnostics) or by conducting a test. Also, the language has been structured to ensure that any party may verify the whole house mechanical ventilation flow rate, including the builder. Please note that this flow rate verification requirement only applies to whole house mechanical ventilation systems and not to local exhaust systems.

Proponent : Jeremy Field, representing Building Efficiency Resources requests Approve as Submitted.

Commenter's Reason: As an experienced RESNET Quality Assurance Designee, I have inspected hundreds of homes in the field which have had home energy ratings performed on them. Most of these homes in the past 2-3 years have been built to comply with either the 2012 or the 2015 IECC which mandates mechanical ventilation. Most of these homes do not have mechanical ventilation systems installed that actually meet the mandatory CFM delivery rates that are required by the Code. The reason for this non-compliance is simple; whereas building air tightness and duct system leakage have requirements for someone to test these components to demonstrate meeting a specific threshold, there is no provision in the model energy code for anyone to test mechanical ventilation. Instead, installing contractors rely on "rules of thumb" or other non-scientific methods to attempt to meet the code requirements, with the resulting delivered airflow and/or system runtime often being significant off from the requirements of the code. Thus most often results in under ventilation of homes, which is a potenital buildling durability and indoor air quality problem, but also can result in overventilation which is a comfort and energy penalty.

I strongly encourage this provisoin to be accepted as it will result in actual compliance verification of a critical building system to be performed.

RE10-16

RE12-16

R202 (New) (IRC N1101.6 (New)], R401.2 (IRC N1101.13), R407 (New) [IRC N1107 (New)], R408 (New) [IRC N1108 (New)]

Proposed Change as Submitted

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

SECTION 202 (N1101.6) DEFINITIONS

ERI REFERENCE DESIGN. A version of the rated design that meets the minimum requirements of the 2006 *International Energy Conservation Code.*

Add new definition as follows:

ECI REFERENCE DESIGN

A version of the *rated design* that meets the minimum requirements of the current I*nternational Energy Conservation Code* when expressed in terms of energy cost.

EUI REFERENCE DESIGN

A version of the *rated design* that meets the minimum requirements of the current I*nternational Energy Conservation Code* when expressed in terms of energy usage.

Revise as follows:

R202 (IRC N1101.6) RATED DESIGN. A description of the proposed *building* used to determine the energy rating index, energy cost index or energy use index..

R401.2 (IRC N1101.13) Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 labeled "Mandatory."
3. An energy rating index (ERI) approach in Section R406.
4. An energy cost index (ECI) approach in Section 407.
5. An energy ~~rating~~ use index (~~ERI~~ EUI) approach in Section ~~R406~~ 408.

Add new text as follows:

SECTION R407 (IRC N1107) ENERGY COST INDEX COMPLIANCE ALTERNATIVE

R407.1(IRC N1107.1) Scope This section establishes criteria for compliance using an Energy Cost Index (ECI) analysis.

R407.2.(IRC N1107.2) Mandatory requirements

Compliance with this section requires meeting or exceeding the provisions identified in Sections R401 through R404 labeled as mandatory and the prescriptive provisions of Section R403.5.3. The building thermal envelope efficiency shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or R402.1.4 of the 2018 *International Energy Conservation Code*.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R407.3 (IRC N1107.3) Energy cost index The Energy Cost Index (ECI) shall be a numerical integer value that is based on a linear scale constructed such that the *ECI reference design* has an Index value of 100 and a residential building that has no purchased energy costs or net energy costs has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy cost of the *rated design* relative to the total energy cost of the *ECI reference design*. The ECI shall consider all energy used in the residential building. Energy used to recharge or refuel a vehicle for on-road (and off-site) transportation purposes shall not be included in the *ECI reference design* or the *rated design*.

R407.3.1 (IRC N1107.3.1) ECI reference design The *ECI reference design* shall be configured such that it meets the minimum requirements of the 2018 *International Energy Conservation Code* prescriptive requirements.

The proposed *residential building* shall be shown to have an annual total purchased or net energy cost that is less than or equal to the annual purchased or net energy cost of the *ERI reference design*.

R407.4 (IRC N1107.4) ECI-based compliance

Compliance based on an ECI analysis requires that the *rated design* be shown to have an ECI less than or equal to the ECI of the *ECI reference design*.

R407.5 (IRC N1107,5) Verification by approved agency or entity.

Verification of compliance with Section R407 shall be completed by a *code official* or an *approved* third party.

R407.6 (IRC N1107.6) Documentation Documentation of the software used to determine the ECI and the parameters for the *residential building* shall be in accordance with Sections R407.6.1 through R407.6.3.

R407.6.1 (IRC N1107.6.1) Compliance software tools Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official*.

R407.6.2 (IRC N1107.6.2) Compliance report Compliance software tools shall generate a report that documents that the ECI of the rated design complies with Sections R407.3 and R407.4. The compliance documentation shall include the following information:

1. Address or other form of identification of the residential building or buildings.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ECI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool used.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R407.6.3 (IRC N1107.6.3) Additional documentation The *code official* shall be permitted to require the following documents:

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

R407.7(IRC N1107.7) Calculation software tools Calculation software, where used, shall be in accordance with Sections R407.7.1 through R407.7.3.

R407.7.1 (IRC N1107.7.1) Minimum capabilities Calculation procedures used to comply with this section shall be software tools capable of calculating the ECI as described in Section R407.3, and shall include the following capabilities:

1. Generation of the *ECI reference design* using only the input for the *rated design*. The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ECI reference design*.
2. Calculation of whole building, as a single zone or dual zone, sizing for the heating and cooling equipment in the *ECI reference design* residence in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load efficiency and equipment operation on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed code official inspection checklist listing each of the rated design component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

R407.7.2 (IRC N1107.7.2) Specific approval Performance analysis tools meeting the applicable sections of Section R407 shall be *approved*. Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official* shall approve tools for a specified application or limited scope.

R407.7.3 (IRC 1107.7.3) Input values Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an *approved* source.

R408 (IRC N1108). ENERGY USE INDEX COMPLIANCE ALTERNATIVE

R408.1 (IRC N1108.1) Scope

This section establishes criteria for compliance using an Energy Use Index (EUI) analysis.

R408.2 (IRC N1108.2) Mandatory requirements Compliance with this section requires meeting or exceeding all of the provisions identified in Sections R401 through R404 labeled as mandatory and the prescriptive provisions of Section R403.5.3. The building thermal envelope efficiency shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or R402.1.4 of the 2018 *International Energy Conservation Code*.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R408.3 (IRC N1108.3) **Energy Use Index** The Energy Use Index (EUI) shall be a numerical integer value that is based on a linear scale constructed such that the *EUI reference design* has an Index value of 100 and a residential building that has no annual energy usage or annual net energy usage has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy usage of the *rated design* relative to the total energy usage of the *EUI reference design*. The EUI shall consider all energy used in the *residential building*. Energy used to recharge or refuel a vehicle for on-road (and off-site) transportation purposes shall not be included in the *EUI reference design or* the *rated design*.

R408.3.1 (IRC N1108.3.1) **EUI reference design** The *EUI reference design* shall be configured such that it meets the minimum requirements of the 2018 *International Energy Conservation Code* prescriptive requirements.

The proposed *residential building* shall be shown to have an annual total or annual net energy usage that is less than or equal to the annual total or annual net energy usage of the *EUI reference design*.

R408.4 (IRC N1108.4) **EUI-based compliance** Compliance based on an EUI analysis requires that the *rated design* be shown to have an EUI less than or equal to the EUI of the *EUI reference design*.

R408.5 (IRC N1108.5) **Verification by approved agency or entity**

Verification of compliance with Section R408 shall be completed by a *code official* or an *approved* third party.

R408.6 (IRC N1108.6) **Documentation** Documentation of the software used to determine the EUI and the parameters for the *residential building* shall be in accordance with Sections R408.6.1 through R408.6.3.

R408.6.1 (IRC N1108.6.1) **Compliance software tools** Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official*.

R408.6.2 (N1108.6.2) **Compliance report** Compliance software tools shall generate a report that documents that the EUI of the rated design complies with Sections R407.3 and R407.4. The compliance documentation shall include the following information:

1. Address or other form of identification of the residential building or buildings.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *EUI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool used.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R408.6.3 (N1108.6.3) **Additional documentation** The *code official* shall be permitted to require the following documents:

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

R408.7 (N1108.7) **Calculation software tools**
Calculation software, where used, shall be in accordance with Sections R408.7.1 through R408.7.3.

R408.7.1 (N1108.7.1) **Minimum capabilities** Calculation procedures used to comply with this section shall be software tools capable of calculating the EUI as described in Section R408.3, and shall include the following capabilities:

1. Generation of the *EuI reference design* using only the input for the *rated design*. The calculation procedure shall not allow the user to directly modify the building component characteristics of the *EUI reference design*.
2. Calculation of whole building, as a single zone or dual zone, sizing for the heating and cooling equipment in the *EUI reference design* residence in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load efficiency and equipment operation on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed code official inspection checklist listing each of the rated design component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

R408.7.2 (N1108.7.2) **Specific approval** Performance analysis tools meeting the applicable sections of Section R408 shall be *approved*. Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official* shall approve tools for a specified application or limited scope.

R408.7.3 (N1108.7.3) **Input values.** Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an *approved* source.

Reason: This proposal adds two new compliance options to the Residential portion of the IECC. It improves the code in the following ways:

1) It provides more flexibility to builders and designers. With these two new options, builders and designers have more flexibility in terms of technology and design choices for residential buildings.

2) These new options use the current IECC as the baseline for comparison, rather than a code that is nearly 10 years old. By using the current IECC as a baseline, there is no need to discuss whether one previous version of the code, or certain sections of the previous code, are the "correct" baseline. Using previous versions of a code will overstate the actual savings and performance of a new residential building relative to a current baseline.

3) These options are modeled without any modifications that can distort the actual energy usage or energy cost of a residential building.

4) These options are based on metrics that are usable and understandable to consumers. Consumers see actual energy usage and actual energy costs on their monthly electric or natural gas bills.

Cost Impact: Will not increase the cost of construction
This proposal adds new compliance options that are based on computer simulations, and provide more options to designers and builders. They do not change any of the requirements in the code and do not increase construction costs.

RE12-16 : R401.2-ROSENSTOCK11920

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The code doesn't need two more performance options.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~EUI REFERENCE DESIGN~~

~~A version of the *rated design* that meets the minimum requirements of the current *International Energy Conservation Code* when expressed in terms of energy usage.~~

R202 (IRC N1101.6) RATED DESIGN. A description of the proposed *building* used to determine the energy rating index~~,~~ or energy cost index ~~or energy use index.~~.

R401.2 ~~(IRC N1101.13)~~ Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 labeled "Mandatory."
3. ~~An energy rating index (ERI) approach in Section R406.~~
3. An energy ~~cost~~ rating index (~~ECI~~ ERI) approach in Section ~~407~~ R406.
4. An energy ~~use~~ cost index (~~EUI~~ ECI) approach in Section ~~408~~ 407.

~~R408 (IRC N1108). ENERGY USE INDEX COMPLIANCE ALTERNATIVE~~

~~**R408.1 (IRC N1108.1) Scope** This section establishes criteria for compliance using an Energy Use Index (EUI) analysis.~~

~~**R408.3 (IRC N1108.3) Energy Use Index** The Energy Use Index (EUI) shall be a numerical integer value that is based on a linear scale constructed such that the *EUI reference design* has an Index value of 100 and a residential building that has no annual energy usage or annual net energy usage has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy usage of the *rated design* relative to the total energy usage of the *EUI reference design*. The EUI shall consider all energy used in the *residential building*. Energy used to recharge or refuel a vehicle for on-road (and off-site) transportation purposes shall not be included in the *EUI reference design or* the *rated design*.~~

~~**R408.3.1 (IRC N1108.3.1) EUI reference design** The *EUI reference design* shall be configured such that it meets the minimum requirements of the 2018 *International Energy Conservation Code* prescriptive requirements.~~

~~The proposed *residential building* shall be shown to have an annual total or annual net energy usage that is less than or equal to the annual total or annual net energy usage of the *EUI reference design*.~~

~~**R408.4 (IRC N1108.4) EUI-based compliance** Compliance based on an EUI analysis requires that the *rated design* be shown to have an EUI less than or equal to the EUI of the *EUI reference design*.~~

~~**R408.5 (IRC N1108.5) Verification by approved agency or entity** Verification of compliance with Section R408 shall be completed by a *code official* or an *approved* third party.~~

~~**R408.6 (IRC N1108.6) Documentation** Documentation of the software used to determine the EUI and the parameters for the *residential building* shall be in accordance with Sections R408.6.1 through R408.6.3.~~

~~**R408.6.1 (IRC N1108.6.1) Compliance software tools** Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *code official*.~~

~~**R408.6.2 (N1108.6.2) Compliance report** Compliance software tools shall generate a report that documents that the EUI of the rated design complies with Sections R407.3 and R407.4. The compliance documentation shall include the following information:~~

~~1. Address or other form of identification of the residential building or buildings.~~
~~2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *EUI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.~~
~~3. Name of individual completing the compliance report.~~
~~4. Name and version of the compliance software tool used.~~

~~**Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.~~

~~**R408.6.3 (N1108.6.3) Additional documentation** The *code official* shall be permitted to require the following documents:~~

~~1. Documentation of the building component characteristics of the *EUI reference design*.~~
~~2. A certification signed by the builder providing the building component characteristics of the *rated design*.~~
~~3. Documentation of the actual values used in the software calculations for the *rated design*.~~

~~**R408.7 (N1108.7) Calculation software tools** Calculation software, where used, shall be in accordance with Sections R408.7.1 through R408.7.3.~~

~~**R408.7.1 (N1108.7.1) Minimum capabilities** Calculation procedures used to comply with this section shall be software tools capable of calculating the EUI as described in Section R408.3, and shall include the following capabilities:~~

~~1. Generation of the *EuI reference design* using only the input for the *rated design*. The calculation procedure shall not allow the user to directly modify the building component characteristics of the *EUI reference design*.~~
~~2. Calculation of whole building, as a single zone or dual zone, sizing for the heating and cooling equipment in the *EUI reference design* residence in accordance with Section R403.7.~~
~~3. Calculations that account for the effects of indoor and outdoor temperatures and part-load efficiency and equipment operation on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.~~
~~4. Printed code official inspection checklist listing each of the rated design component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.~~

~~**R408.7.2 (N1108.7.2) Specific approval** Performance analysis tools meeting the applicable sections of Section R408 shall be *approved*. Tools are permitted to be *approved* based on meeting a specified threshold for a jurisdiction. The *code official*~~

~~shall approve tools for a specified application or limited scope.~~

~~**R408.7.3 (N1108.7.3) Input values.** Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an *approved* source.~~

Commenter's Reason: This public comment retains the intent of the original proposal to allow an energy cost index (ECI) compliance path but eliminates the energy use index path to address the committee's concern.

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Submitted.

Commenter's Reason: This proposal provides alternatives to the ERI, which may be restricted to only using the RESNET standard going forward (based on RE166). Other performance paths in other building codes use energy costs (such as ASHRAE 90.1, ASHRAE 189.1, and the National Green Building Standard). In addition, RESNET has established a Cost Based Rating Index Task Group to assess whether their standard should use energy costs.
Providing more options, with the parameters established in the original proposal, will provide much more flexibility and more options for residential building designers.

RE12-16

RE15-16

R402.4.1.2.1 (New)

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Add new text as follows:

R402.4.1.2.1 Multi-unit buildings and single family attached building. Multi-unit buildings and single family attached buildings shall be tested as a single zone or as individual dwelling units. Common areas shall be treated as isolated test zones by equalizing pressures to adjacent zones. All conditioned areas of the building shall be tested except where a sampling test procedure is approved by the code official. A *conditioned floor area* weighted average air changes per hour for all tested zones shall be permitted to demonstrate air leakage rate compliance for the building.

Reason: Air tightness testing for single-family detached homes is very straightforward, however, it is much more difficult to accurately test attached dwelling units and multi-family/multi-story buildings. Currently the IECC treats low-rise multifamily buildings of three stories or less like single-family homes and multifamily buildings of four stories or more like commercial buildings. Regardless of height, all multifamily buildings have the same air-tightness testing complications to address, such as does the entire building need to be tested at one time, how are the corridors addressed, does every dwelling unit within the multifamily building need to be tested, can the leakages be averaged between the dwelling units and is the leakage tested only to the outside or should it include leakage to adjacent dwelling units. Large multiple dwelling buildings are often tested as isolated test zones due to the nature of the actual testing procedures and available equipment needed to depressurize large volumes of conditioned space and this proposal would recognize this challenge for those conducting the testing. In addition it also clarifies that every dwelling need not be required to be tested where recognized by the code official. By approving this proposal, low-rise multifamily buildings, two-unit dwellings and townhouses will avoid these complications, but still be held to the same level of performance as high-rise (R-2) residential as well as commercial buildings.

Cost Impact: Will not increase the cost of construction

This proposal offers an optional procedure to building air testing for compliance on typical large-scale projects which is not currently available and will cost less to test.

RE15-16 : R401.4.1.2.1 (NEW)-SURRENA12406

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

Revise as follow

R402.4.1.2.1 Multi-unit buildings and single family attached building. Multi-unit buildings and single family attached buildings shall be tested as a single zone , multiple zones or as individual dwelling units. ~~Common areas shall be treated as isolated test zones by equalizing pressures to adjacent zones.~~ All conditioned areas of the building shall be tested except where a sampling test procedure is approved by the code official. A *conditioned floor area* weighted average air changes per hour for all tested zones shall be permitted to demonstrate air leakage rate compliance for the building.

Committee Reason: The modification was made because flexibility is needed for testing of multi-family units. Code officials are in control of approving the sampling method and that seems to be working well currently.

The proposal was approved as modified because sampling testing is needed for construction efficiency.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing

Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: RE15 should be disapproved because it introduces an undefined, potentially broad exception to the air leakage test requirement for multi-unit and single-family attached buildings. This will lead to inconsistency and reduced energy efficiency in these buildings for no justifiable reason. There are three key problems with this proposal:

- Air leakage test sampling is inappropriate for code compliance, particularly for attached single-family buildings and multi-unit buildings. Each homeowner is entitled to a home that complies with the minimum standards set by the code. There is no reason why townhouses cannot be tested individually, just as a single-family detached building would be tested. Likewise, for larger multi-unit buildings, each dwelling unit should be tested. Unlike automobiles, buildings are not constructed in a serial manner on an assembly line by the same workers. Because of production schedules, inspections, and other elements of the building process, it is likely that several different tradespeople will complete work on the thermal envelope of a multi-unit building, creating the risk that air leakage will vary significantly from one unit to another. The only way to objectively and accurately measure the dwelling unit's true air leakage rate for compliance with code specifications is to test it.
- Even if sampling were appropriate for code compliance, the proposed new section does not provide any guidance for the code official as to what is an appropriate "sampling test procedure." Is it appropriate to test only one of two attached townhouses, and deem the two units a "single zone?" One of 15 multifamily dwelling units? The proposal gives no hints about what a jurisdiction or a code official should view as being an adequate number or percentage of units in a sampling test procedure, nor does it reference any existing sampling procedures or national standards that might be appropriate.
- The proposal introduces "area weighted averaging" into air leakage testing, but does not explain which areas may be averaged, and how this calculation should be carried out. Should common areas be given the same "weight" as dwelling units in a multifamily building? Should each building be required to test at least some common areas and some dwelling units? Would it be OK for one dwelling unit to have poor air leakage and another excellent air leakage? Is that fair to the individual home occupant?

RE15 introduces a number of new and undefined concepts into the IECC, and it could become a huge efficiency loophole. We recommend disapproval.

RE15-16

RE17-16

R402.1 (IRC N1102.1)

Proposed Change as Submitted

Proponent : Robert Pickett, RobPickett &Associates, LLC representing the Log & Timber Homes Council, representing Log & Timber Homes Council (robpickett@vermontel.net); Craig Drumheller, National Association of Home Builders, representing National Association of Home Builders (CDrumheller@nahb.org)

2015 International Energy Conservation Code

R402.1 (N1102.1) General (Prescriptive). The *building thermal envelope* shall meet the requirements of Sections R402.1.1 through R402.1.5.

~~Exception~~Exceptions:

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. Those 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.
    2. Those that do not contain *conditioned space*.

2. Log homes designed in accordance with ICC-400.

Reason: This amendment refers design of log homes to ICC400 *Standard on the Design and Construction of Log Structures* (ICC400) as it is the only consensus standard for log building. This amendment would benefit future state and local adoption as it is consistent with existing State amendments or legislation. At least four states have passed legislation referring to ICC400, while several other states have amended their energy conservation code to add log home specific paths. In 2015, the City and County of Denver adopted language similar to the proposed, and Vermont amended the 2015 IECC to add Table 402.1.5, *Log Home Insulation, Fenestration and Heating Requirements by Component*. Idaho added Table R402.a *Log Home Prescriptive Thermal Envelope Requirements by Component* to their 2014 code. Minnesota added Footnote H to Table 1102.1(1) to their 2012 IECC.
The design, construction and performance of log walls are quite different than the convention construction methods detailed in the IRC (and residential requirements of the IECC). ICC400 responds to the thermal envelope requirements of the IRC Chapter 11 and IECC Chapter 4. The standard offers prescriptive, calculated/engineered and performance/testing paths for substantiating the performance of log walls, and trade-off packages for each Climate Zone. Therefore, the thermal envelope of log homes would be evaluated as follows:

- **THERMAL:** ICC400-2012 **Section 305 Thermal Envelope** presents requirements for weather protection and determination of thermal properties, offering prescriptive, calculation, and performance options. **TABLE 305.3.1.2 Insulation and Fenestration Requirements by Component** provides one such prescriptive option.
- **AIR INFILTRATION:** Guidance is provided in ICC400 in **Section 306 Infiltration**. Section 306, along with 305.1 Weather protection and 304 Provisions for Settling in Log Structures all work in unison to address the issue. The same blower door requirement of the 2015 code shall apply to log walls as for any other method of construction.
- **VAPOR RETARDERS:** As noted in Exception 3 of IRC Section R702.7 Vapor retarders, "Construction where moisture or its freezing will not damage the materials." There is no cavity to protect in a log wall, and all joinery is covered by ICC400-2012.
- **EXTERIOR COVERING:** The Exception in IRC Section R703.1 General refers to "Log walls designed and constructed in accordance with the provisions of ICC400." The standard covers all discussion of weather resistance, drainage planes, etc.

The members of the Log & Timber Homes Council have encouraged certifying log homes through Energy Star® for many years. With the attention to design and construction details in accordance with ICC400, log homes with a nominal 6" wide log profile have been certified as 5-Star Plus with ratings in the 50's and lower. Blower door testing has demonstrated that log homes meet the 3ACH50 requirements of Climate Zones 4-8. These tests have demonstrated that perhaps it is the tightness as well as mass of a log home that provide the satisfaction and comfort of the occupants.

It is important to note that ICC400 pertains to building solid wood walls and structural framing with logs. It defaults to the I-Codes for design conditions, foundations, roofing, mechanical, electrical, plumbing, etc. In Section 305 Thermal Envelope, ICC400 calls for compliance with the requirements of the IECC with an exception for log walls. The thermal properties of log walls can be taken from prescriptive tables, tested or calculated per the stipulated equations. Application of thermal mass is described to establish conformance with the IECC.

Bibliography: ***ICC Standard on the Design and Construction of Log Structures (ICC 400)***
Please note: ICC copyrighted documents can only be distributed through their publications department. Electronic and print copies can be obtained from the ICC store at http://shop.iccsafe.org/catalogsearch/result/?order=relevance&dir=desc&q=ICC+400 (http://shop.iccsafe.org/catalogsearch/result/?order=relevance&dir=desc&q=ICC+400).

Energy Performance of Log Homes, Log & Timber Homes Council, NAHB, 2015, 42 pgs. http://loghomes.org/wp-content/uploads/2013/06/EnergyPerformanceWP_2010.pdf

Preservation & Maintenance of Log Structures, Log & Timber Homes Council, NAHB, 2003, 16 pgs. http://loghomes.org/wp-content/uploads/2013/06/Preservation-Maintenance-of-Log-Structures-10-15-03.pdf

Cost Impact: Will not increase the cost of construction
Log wall construction is an alternate method of construction from the wood frame, steel frame, and concrete masonry options addressed in the energy conservation codes. The intent is to evaluate solid wood walls rather than apply prescriptive requirements that may impact the esthetic and/or durability of the wall system.
Without this change, readers may believe that they have only three options: 1.) Build with very large logs, 2.) Add insulation to the outside, or 3.) Add insulation to the inside.

> **Option 1:** Prescriptive mass wall R-values set minimum log widths that are not commonly available, require greater cost to build, and cannot be milled by equipment used today. These factors will constrict the industry to the high-end custom home market. It will cause the existing log home inventory significant undue stress as owners of otherwise energy efficient log homes will be pressed to insulate their nominal 6" log walls (average width of 5"-5.5"). A survey of the industry indicates that a 10" round/8x nominal or smaller covers 80% of the log home products built and in production in climate zones 5-8, which is over 55% of the log home market. The 10" round/8x nominal log size equates to an average log width of about 7"-7.5".
>
> **Option 2:** This would be consistent with the details for cross-laminated timber (CLT).
>
> **Option 3:** It should be noted that adding insulation to the inside of a log wall is not recommended as it restricts the benefits of mass wall effects while eliminating the opportunity for inspection that may otherwise identify a need for maintenance.

All three options are extremely costly as opposed to trade-offs in the building thermal envelope, which is why most log home companies use REScheck for compliance. This can help keep the log width to a size that is economical for production, builder and home owner. Therefore the cost of construction can actually be reduced by evaluating log walls by measures other than prescriptive wall R-value (R/inch of wood).

Effect of the proposed amendment on the cost of design: __ Increase __ Reduce XXX No Effect

Effect of the proposed amendment on the cost of construction: __ Increase XXX Reduce __ No Effect

Is the amendment proposal more or less restrictive than the I-Codes? __ More __ Less XXX Same

RE17-16 : R402.1-PICKETT12100

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Log homes are unique structures that are hard to fit into the prescriptive structure of the energy code. Many people, other than log home manufacturers, are involved with ICC 400 to make that standard what it needs to be for that product. Therefore, this is a good proposal that should be included in the code.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing

Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: This proposal should be disapproved because it completely exempts log homes from the thermal envelope requirements of the IECC, permitting these homes to waste substantially more energy than a home built to the IECC. The following reasons support disapproval:

- The proposal is a substantial rollback from the current IECC requirements, which do not exempt log homes from the IECC. While a few jurisdictions have adopted specific amendments related to log walls, these amendments are typically narrowly focused on replacing the efficiency lost as a result of the log walls. And although ICC-400 has been proposed as an alternative to the code in a few states, we believe that these proposals have been rejected and we are not aware of any states that currently allow this. And even if a few states did allow it, this certainly does not justify the national model code completely exempting log homes from all thermal envelope requirements.
- While it is understandable that meeting the prescriptive requirements of the IECC with regard to log walls may be more challenging than walls with other types of construction, this certainly does not justify eliminating IECC requirements for the remainder of the building:
  - In short, the proposed remedy is much broader than the problem it is intended to solve.
  - Moreover, as to the walls, the builder has the option to trade-off the energy loss by using more efficient components in the remainder of the building through a UA trade-off or the performance or ERI compliance paths rather than simply foregoing energy efficiency altogether.
  - Owners of log homes, like owners of other homes, deserve comfortable, energy-efficient homes.
- The energy cost impact of this proposal on a log home would be substantial. We estimate that homes built to ICC-400 would be up to 23% less efficient, depending on the climate zone, wood type and log thickness, leading to higher energy use (and utility bills) for owners over the home's useful lifetime:

Comparison of Worst Case Efficiency Rollback of Building to 2015 IECC with Mass Walls vs. ICC-400

CZ	% Rollback vs Mass Wall
1	1.9%
2	5.5%
3	11.1%
4	14.5%
5	14.5%
6	19.4%
7	22.6%
8	23.2%

- The comparison above shows how much energy could be lost if log homes are permitted to comply with ICC-400 instead of the IECC with the normal mass wall insulation requirement. The energy losses would be even more significant if ICC-400 were compared against the wood frame wall insulation requirement.
- Another major problem with this proposal is that ICC-400, which was last updated in 2011, does not contain key thermal envelope provisions that are found in the IECC, such as envelope air leakage sealing or testing requirements. In other words, in addition to weaker insulation in the thermal envelope, the log home envelope would also be permitted to have high air leakage with no testing.
- In addition, the language of the proposal is imprecise, which will create enforcement problems:
  - What qualifies as a "log home?" This term is not defined in the IRC or IECC. Must the walls be made of solid logs? On all levels? Or could homes with only some logs fall under this broad exception?
  - The language also does not appear to require log homes to *comply* with ICC-400 in order to qualify for the exception – log homes need only be "designed in accordance with ICC-400," which could create enforcement problems for building code officials since it could be initially designed *but not built* in accordance with ICC-400.

RE17 creates an extremely overbroad exemption that is not well-enough defined to ensure that it will be applied as intended. Most importantly, this proposal would lead to a significant loss in energy efficiency, and it should be disapproved.

Proponent : Bridget Herring (bridget@mathisconsulting.com) requests Disapprove.

Commenter's Reason: ICC 400-2012 has little-to-no enforceable vapor provision.
"305.1.2 Moisture control and air leakage. The design shall resist air and moisture infiltration."
Section 306 goes into greater detail, but is not the IRC/IBC, as required by the IECC.
Broad variability in thermal resistance, depending on structural logs chosen, but inadequate in many instances. For example, in climate zone 4 the requirement is for 5" logs, which could have thermal performance as low as about R-4.4 to as high as about R-8.7, depending on density.

In general, ICC 400-2012 references the wrong sections of the IECC for compliance, because of re-organization of the IECC's commercial and residential chapters in the last version.

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Disapprove.

Commenter's Reason: We request disapproval. The IECC was developed with log and other mass walls considered. Allowing other standards to fill the place of the IECC for one group of products is bad precedent. This will encourage other industries to develop energy standards for their products for reference in the IECC.
The proposal as submitted will reduce the energy savings in the IECC and is contrary to the goal of the IECC. The intent of the IECC is as follows (section R101.3): "This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

RE17-16

RE18-16

Table R402.1.2 (IRC Table N1102.1.2), Table R402.1.4 (IRC Table N1102.1.4)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	19 ~~13~~	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	30 ~~19~~	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

TABLE R402.1.4 (N1102.1.4)
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	0.047 ~~0.064~~	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.033 ~~0.047~~	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	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. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 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. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Reason: The purpose of this code change is to modify the requirements related to the minimum R-value and maximum U-factor for floors to improve building efficiency in climate zones 2 and 4. This revision moves the prescriptive insulation value for floors in Climate Zone 2 and 4 to the next nominal level -- from R-13 to R-19 and R-19 to R-30, respectively. These proposed changes will yield savings in range of 1% in CZ 2 and 1.8% in CZ 4 for homes with floors over unconditioned space.

Cost Impact: Will increase the cost of construction
For a standard-sized two-story single family home, the construction cost will increase by approximately $132 in climate zone 2 and $288 in climate zone 4, per the NREL Residential Energy Efficiency Measure Database (http://www.nrel.gov/ap/retrofits/group_listing.cfm (http://www.nrel.gov/ap/retrofits/group_listing.cfm)). Although construction costs are increased in this proposal, improvements to the floor insulation requirements yield a positive life-cycle cost when analyzed over a 30 year period. The analysis used to assess this efficiency improvement is generally based on the U.S. DOE's residential code change methodology.

RE18-16 : R402.1.2-FAY12778

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Less than 2 percent savings does seem to justify the expense to attain.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.1.2 (N1102.1.2)
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	19	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 [h]	8/13	30 [g]	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Commenter's Reason: This proposal should be approved as modified because it improves the long-term performance of buildings in climate zones 2 and 4, by improving floor insulation requirements. The modification simply adds footnote "g" to the floor insulation requirement in climate zone 4, consistent with other climate zones -- where there is not enough room to install the full thickness of R-30 insulation in these circumstances, the floor cavity must be filled with insulation to a minimum of R-19. Although most other thermal envelope requirements have improved somewhat over the last decade, floor insulation requirements have remained almost unchanged. (Only climate zones 7-8 have seen any improvement in floor insulation requirements in recent years.) The proposed changes in climate zones 2 and 4 are consistent with neighboring climate zones, so techniques should already be understood, and materials should be widely available, to meet these requirements. As highlighted in the proposal Reason Statement, these R-values are cost-effective for climate zones 2 and 4, and will provide energy-saving and comfort benefits over the useful life of the home.

We recommend approval as modified, which will improve energy efficiency and comfort for homes in climate zones 2 and 4 by improving floor insulation requirements.

RE18-16

RE19-16

Table R402.1.2 (IRC Table N1102.1.2), Table R402.1.4 (IRC Table N1102.1.4)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

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

CLIMATE ZONE	FENESTRATION *U*-FACTOR [b]	SKYLIGHT [b] *U*-FACTOR	GLAZED FENESTRATION SHGC [b, f]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE [j]	FLOOR *R*-VALUE	BASEMENT [d] WALL *R*-VALUE	SLAB [e] *R*-VALUE & DEPTH	CRAWL SPACE [d] 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	~~0.35~~0.32	0.55	0.25	38	20 or 13+5 [i]	8/13	19	5/13 [g]	0	5/13
4 except Marine	~~0.35~~0.32	0.55	0.40	49	20 or 13+5 [i]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	~~0.32~~0.30[c]	0.55	NR	49	20 or 13+5 [i]	13/17	30 [h]	15/19	10, 2 ft	15/19
6	~~0.32~~0.30[c]	0.55	NR	49	20+5 or 13+10 [i]	15/20	30 [h]	15/19	10, 4 ft	15/19
7 and 8	~~0.32~~0.30[c]	0.55	NR	49	20+5 or 13+10 [i]	19/21	38 [h]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. Exception: A maximum U-factor of 0.32 shall apply in climate zone Marine 4 and climate zones 5 – 8 to vertical fenestration products installed in buildings located: (i) above 4000 feet in elevation above sea level or (ii) in windborne debris regions where protection of openings is required under IRC section R301.2.1.2.

d. "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. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

e. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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

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

h. Or insulation sufficient to fill the framing cavity, R-19 minimum.

i. The first value is cavity insulation, the second value is continuous insulation, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

j. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

TABLE R402.1.4 (N1102.1.4)
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	~~0.35~~0.32	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	~~0.35~~0.32	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	~~0.32~~0.30[b]	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	~~0.32~~0.30[b]	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	~~0.32~~0.30[b]	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. Exception: A maximum U-factor of 0.32 shall apply in climate zone Marine 4 and climate zones 5 – 8 to vertical fenestration products installed in buildings located: (i) above 4000 feet in elevation above sea level or (ii) in windborne debris regions where protection of openings is required under IRC section R301.2.1.2.
c. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 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.
d. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Reason: This proposal improves the U-factors for fenestration in residential buildings in climate zones 3 – 8. A market survey by ACEEE has shown that share of window products meeting these requirements exceeded 80% in 2011. *See***http://aceee.org/files/pdf/fact-sheet/Energy%20Star%20Windows%20Survey%20Results.pdf** (http://aceee.org/files/pdf/fact-sheet/Energy%20Star%20Windows%20Survey%20Results.pdf)
This proposal is consistent with a draft proposal published by U.S. DOE earlier this year. U.S. DOE concluded that these requirements would be cost-effective.

This proposal also establishes an exception for fenestration installed at high altitudes (above 4000 feet in elevation) and in windborne debris areas because these products suffer from efficiency disadvantages due to product design as compared to products with the same frames and same low-e coatings in the rest of the country. High altitudes typically require a breather tube in the insulating glass unit, which eliminates the use of argon and increases the U-factor, while glazing in windborne debris regions generally uses laminated glass, which can reduce the gap width in the insulating glass unit, resulting in a higher U-factor. In these limited cases, this proposal leaves the U-factor requirement in climate zones Marine 4 and 5-8 at the current 0.32 level.

Cost Impact: Will increase the cost of construction
Given the level of market penetration, in many cases builders are likely already meeting the improved requirements and will not require an upgrade to the window or additional cost. However, in some limited cases, builders may incur increased costs. Any upgrade necessary would generally only require the relatively minimal cost of an improved low-e coating.

RE19-16 : R402.1.2-FAY12802

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Although the exception has good reason for buildings above 4000 feet or in wind-borne regions, lowering the maximum U-factor for all other buildings in those climate zones is not justified.

Assembly Motion: **As Submitted**
Online Vote Results: **Successful**
Support: 54.31% (126) Oppose: 45.69% (106)
Assembly Action: **Approved as Submitted**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve

as Submitted.

Commenter's Reason: This proposal should be approved as submitted because it saves energy by improving the fenestration U-factor requirements in climate zones 3-8, while also providing flexibility for fenestration installed at high altitudes (over 4,000 feet in elevation) and in buildings that must meet code wind-borne debris requirements. For these two special circumstances, the fenestration U-factor requirement would remain at 0.32, which is the current requirement. As outlined in the original Reason Statement, it is important to recognize the unique physical properties of windows in these two situations and why an exception may be necessary in some cases.

The Committee Reason Statement expresses support for these two exceptions, but claims that the lower U-factors are not justified. However, we note that the Committee later recommended adoption of the identical U-factors being proposed in this proposal (see RE31-16). There was considerable support expressed for RE19 by building code officials in regions that would be served by the exceptions, and a floor motion to adopt this proposal as submitted was successful.

Approval of RE19 as submitted will improve energy efficiency across much of the nation while allowing reasonable options for fenestration in high-altitude and wind-borne debris regions. Since the provisions of RE19 do not conflict with RE31-16 (RE31 does not address possible exceptions), if RE31 is also approved, the two proposals can be easily coordinated editorially by ICC staff.

Proponent : Jeff Inks, representing Window & Door Manufacturers Association (jinks@wdma.com) requests Approve as Submitted.

Commenter's Reason: While we believe that market availability of window, door and skylight products should not be a primary driver for amending energy codes in this regard, we believe the proposed changes in fenestration U-factor for climate zones 3-8 are reasonable. While the same U-factor changes are proposed in RE-31 which were approved at the CAH, we are supportive of this particular proposal because it also includes a new footnote providing a limited and needed exception for products installed above 4000 ft above sea level in climate zones Marine4 zones 5-8 and for products that must meet windbore debris protection requirements.

These exceptions are needed for high altitude and wind borne debris protection products if the proposed increases in U-factor stringency are to be approved. High altitude products generally require breather or capillary tubes in the insulating glass unit to allow pressure equalization when the products are transported to higher elevations for installation. The pressure equalization is necessary to avoid breakage. However, the tubes eliminate the ability to use gas fills commonly used to achieve higher levels of thermal performance. Meanwhile, windborne debris protection requirements for fenestration are typically met by the use of laminated glass which reduces the gap width in the insulating glass unit and thus the thermal performance. The proposed exceptions are reasonable and simply maintain the current requirements for products installed in those areas.

Proponent : Assembly Motion requests Approve as Submitted.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Approve as Submitted was Successful by a vote of 54.31% (126) to 45.69% (106) by eligible members online during the period of May 11 - May 26, 2016.

RE19-16

RE22-16

Table R402.1.2 (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	0.35	0.55	0.25	38	20 or 13+5 [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be ~~added~~ provided under the full slab area of a heated slab in addition to the required slab edge *R*-values for ~~heated~~ unheated slabs~~. Insulation depth shall be~~ as indicated in the ~~depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs~~ table.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Reason: This proposal improves the effectiveness of heated (radiant) slab insulation. The current practice of simply adding an additional R-5 insulation to the perimeter of a heated slab results in substantially greater heat loss from a heated slab than unheated slab which creates an avoidable and inappropriate energy cost penalty to consumers that use heated (radiant) slabs instead of unheated slabs. For example, ASHRAE 90.1 Appendix A (Table A6.3.1) shows that R-15 slab edge insulation only on a heated slab results in an F-factor of 1.25 whereas R-10 slab edge insulation only on an unheated slab results in an F-factor of 0.54. Thus, there is a more than two-fold increase in heat loss from the heated slab than there is from the unheated slab, even though the heated slab has an additional R-5 perimeter insulation as currently required by code. This is a very inefficient and non-equivalent way to insulate a heated slab. Instead, placing the additional R-5 insulation underneath a heated slab brings the performance of a heated slab more closely in line with the performance of an unheated slab such that consumers do not pay for a heated slab and then also doubly pay for higher energy costs over the life of the building. This practice will also provide the benefit of improved temperature control and comfort and is considered a common and good practice for heated (radiant) slabs.

Cost Impact: Will increase the cost of construction
That this proposal may increase cost is debatable. In many cases, radiant slabs are insulated with sub-slab insulation as a matter of good practice and this is obvious to many who use them. In fact, at least some states already require the use of sub-slab insulation with heated radiant slabs. This proposal will also decrease long-term costs of operating a heated slab in comparison to use of an unheated slab with perimeter insulation only. There are also practical and cost-saving advantages of not increasing perimeter insulation thickness, particularly when placed in its most effective location on the exterior side of the slab edge.

RE22-16 : TABLE R402.1.2-CRANDELL12876

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The proposed changes give a short payback period for minimal required effort.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards (martha.vangeem@gmail.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be provided under the full slab area of a heated slab in addition to the required slab edge *R* -values for ~~unheated~~ slabs as indicated in the table. The slab edge insulation for heated slabs is not 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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Commenter's Reason: This modification clarifies the proposal. The word "unheated" is deleted because there is no criteria for "unheated" slabs. The sentence in the proposal is confusing as to whether the insulation under the slab is requried for all slabs or just heated slabs. The reason in the original proposal indicates that the intent is that the insulation under the slab is for heated slabs. In addtion, the second sentence is added because the edge insulation should not be required to extend below the slab when insulation under the slab is provided.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Disapprove.

Commenter's Reason: This is a significant change which hasn't been completely justified. It takes a simple requirement that applies in some climate zones for heated slabs into a requirement in all climate zones for unheated slabs. The cost of that change has not been justified and further it is impractical in Climate Zones 1, 2 and 3. It is unlikely the costs can be justified in those zones.

Section M2103.2.1 of the IRC and Section 1209.5.1 of the IMC read as follows:

Slab-on-grade installation. Radiant piping utilized in slab-on-grade applications shall be provided with insulating materials installed beneath the piping having a minimum *R*-value of 5."

The existing code only requires insulation beneath the piping – but perhaps not under the full slab. Therefore the text in this footnote should be seen as an expansion of the existing requirements. Again it is not adequately justified.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

RE22-16

RE23-16

R402.1.2 (IRC N1102.1.2)

Proposed Change as Submitted

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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]~~ [c]		FLOOR *R*-VALUE	BASEMENT [c] WALL *R*-VALUE	SLAB ~~[d]~~ *R*-VALUE & DEPTH		CRAWL SPACE [c] WALL *R*-VALUE
						Interior Insulation Method	Exterior Insulation Method			Unheated Slab	Heated[d] Slab	
1	NR	0.75	0.25	30	13	~~3/~~ 4 or 0+3ci[h]	2.4ci	13	0	0	5ci, 2 ft	0
2	0.40	0.65	0.25	38	13	~~4/~~ 6 or 0+4.6ci[h]	3.4ci	13	0	0	5ci, 2ft	0
3	0.35	0.55	0.25	38	20 or 13+5ci[h]	~~8/~~ 13 or 0+9ci[h]	7.5ci	19	5ci or 13~~5/13~~ [f]	0	5ci, 2 ft	5ci or 13 [f] ~~5/13~~
4 except Marine	0.35	0.55	0.40	49	20 or 13+5ci[h]	~~8/~~ 13 or 0+9ci[h]	7.5ci	19	10ci or 13~~10/13~~	10ci, 2 ft	15ci, 2 ft	10ci or 13~~10/13~~
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5ci[h]	~~13/~~ 17 or 11+4.8ci or 13+3.8ci or R15+2.9ci or 0+12.8ci[h]	9.4ci	30 [g]	15ci or 13+5ci[h] or ~~15/~~ 19	10ci, 2 ft	15ci, 2 ft	15ci or 13+5ci[h] or ~~15/~~ 19
6	0.32	0.55	NR	49	20+5ci or 13+10ci[h]	~~15/~~ 20 or 11+6.3ci or 13+5.2ci or 15+4.2ci or 0+14.3ci[h]	14ci	30 [g]	15ci or 13+5ci[h] or ~~15/~~ 19	10ci, 4 ft	15ci, 4 ft	15ci or 13+5ci[h] or ~~15/~~ 19
7 and 8	0.32	0.55	NR	49	20+5ci or 13+10ci[h]	~~19/~~ 21 or 11+6.8ci or 13+5.7ci or 15+4.7ci or 0+14.9ci[h]	14.8ci	38 [g]	15ci or 13+5ci[h] or ~~15/~~ 19	10ci, 4 ft	15ci, 4 ft	15ci or 13+5ci[h] or ~~15/~~ 19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

~~c. "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. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.~~
c. Mass walls shall be insulated using an interior insulation method or an exterior insulation method. Where cavity insulation is installed, such insulation shall be installed on the interior side of the wall and between wood framing members. Where only continuous insulation (ci) is installed on the wall or is installed in combination with cavity insulation, the continuous insulation shall be installed on the interior or exterior surface of the wall in accordance with the selected insulation method. The installation of any metal or wood framing materials shall be over the continuous insulation.
d. For ~~R-5 shall be added to~~ Climate Zones 1 through 3, the ~~required slab edge *R* -values for heated slabs. Insulation~~ insulation depth shall not be required to be greater than the depth of the footing or 2 feet, whichever is less~~in Climate Zones 1 through 3 for heated slabs~~.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. The first value is cavity insulation, the second value is continuous insulation (ci), so "13+~~5~~ 5ci" means R-13 cavity insulation plus R-5 continuous insulation.

~~i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.~~

Reason: This proposal provides clarity in regard to insulation locations or placement (e.g., cavity insulation, continuous insulation, and combinations of such). This also enables the inclusion of additional options for mass walls for exterior and interior insulation strategies. For the interior insulation strategy on mass walls, options include cavity insulation only, cavity plus continuous insulation, and continuous insulation. Thus, providing a full suite of insulation placement options enabling also a full suite of insulation materials and methods. With these clarifications and options, enforcement should be improved while also providing options that best fit a given project. The actual R-value for mass walls are "fine tuned" (in many cases slightly reduced) to better agree with U-factors for mass walls and more efficient designs. Similar clarifications are made to basement wall and crawlspace wall insulation requirements which include options from footnotes directly in the table for improved useability. No technical changes are made in those cases. In addition, heated slabs and unheated slabs are treated separately in the table to avoid using a footnote requiring insulation to be added to values reported in the table (thus the footnote is deleted). All of these changes will add options and improve clarity of the table and are consistent with U-factor requirements in the code such that there are effectively no technical changes (increases or decreases) in the intended energy efficiency.

Cost Impact: Will not increase the cost of construction
This proposal is a clarification and provides additional options which may actually decrease costs in some cases.

RE23-16 : TABLE R402.1.2-CRANDELL12884

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed changes makes the prescriptive methods too complicated. The table needs to be simple. There are other paths that could be followed to allow various combinations of insulation schemes to be used.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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	0.35	0.55	0.25	38	20 or 13+5 [h]	8/13	19	~~5/~~13 or 0+5ci [f,h]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 [h]	8/13	19	~~10 /~~13 or 0+10ci[h]	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 [h]	13/17	30 [g]	~~15/~~19 or 13+5ci or 0+15ci[h]	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	~~15/~~19 or 13+5ci or 0+15ci[h]	10, 4 ft	15/19

7 and 8	0.32	0.55	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	~~15/~~19 or 13+5ci or 0+15ci[h]	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

~~c. "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. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.~~

c. Where continuous insulation (ci) is used, it shall be permitted to be installed on the interior or exterior of the wall. Metal or wood furring shall be permitted to be installed over the continuous insulation. Where cavity insulation is used, it shall be installed on the interior side of the wall between wood framing members. Where a combination of continuous and cavity insulation are installed on the interior side of the wall, the cavity insulation shall be installed on the interior side of the continuous insulation.

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. The first value is cavity insulation, the second value is continuous insulation (ci), so "13+~~5~~ 5ci" means R-13 cavity insulation plus R-5 continuous insulation.

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Commenter's Reason: This public comment to RE23 focuses only on clarification of the basement wall insulation requirements and options addressed in the original RE23 proposal. It makes no technical change to the current R-value requirements (based on the U-factor), but does add one option for combined cavity and continuous insulation in Climate Zone 5 - 8 which addresses a commonly used application. As in the original proposal, footnote c is revised to give simple, clear, and enforceable guidance on the installation and location of the cavity and continuous insulation components on basement walls.

Public Comment 2:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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	0.35	0.55	0.25	38	20 or 13+5 [h]	8/13	19	5/13 [f]	0	~~5/~~13 or 0+5ci[h]
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 [h]	8/13	19	10 /13	10, 2 ft	~~10/~~13 or 0+10ci[h]
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	~~15/~~19 or 13+5ci or 0+15ci[h]
6	0.32	0.55	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	~~15/~~19 or 13+5ci or 0+15ci[h]

7 and 8	0.32	0.55	NR	49	20+5 or 13+10 h	19/21	38 g	15/19	10, 4 ft	~~15/~~19 or 13+5ci or 0+15ci h

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

~~c. "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. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.~~

c. Where continuous insulation (ci) is used, it shall be permitted to be installed on the interior or exterior of the wall. Metal or wood furring shall be permitted to be installed over the continuous insulation. Where cavity insulation is used, it shall be installed on the interior side of the wall between wood framing members. Where a combination of continuous and cavity insulation are installed on the interior side of the wall, the cavity insulation shall be installed on the interior side of the continuous insulation.

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. The first value is cavity insulation, the second value is continuous insulation (ci), so "13+~~5~~ 5ci" means R-13 cavity insulation plus R-5 continuous insulation.

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Commenter's Reason: This public comment to RE23 focuses only on clarification of the crawlspace wall insulation requirements and options addressed in the original RE23 proposal. It makes no technical change to the current R-value requirements (based on the U-factor), but does add one option for combined cavity and continuous insulation in Climate Zone 5 - 8 for added flexibility. As in the original proposal, footnote c is revised to give simple, clear, and enforceable guidance on the installation and location of the cavity and continuous insulation components on crawlspace walls.

Public Comment 3:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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
									Unheated	Heated d	
1	NR	0.75	0.25	30	13	3/4	13	0	0	5ci	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	5ci	0
3	0.35	0.55	0.25	38	20 or 13+5 h	8/13	19	5/13 f	0	5ci	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 h	8/13	19	10 /13	10ci, 2 ft	5ci	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 h	13/17	30 g	15/19	10ci, 2 ft	5ci	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 h	15/20	30 g	15/19	10ci, 4 ft	5ci	15/19

7 and 8	0.32	0.55	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10ci, 4 ft	5ci	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d.— R-5 shall be ~~added~~ provided under the full slab area of a heated slab in additionto the ~~required~~ slab edge ~~*R* -values~~ R-values for ~~heated~~ unheated slabs~~. Insulation depth shall be~~ as indicated in the ~~depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs~~table.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. The first value is cavity insulation, the second value is continuous insulation (ci), so "13+~~5~~ 5ci" means R-13 cavity insulation plus R-5 continuous insulation.

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Commenter's Reason: This public comment to RE23 focuses only on clarification of the slab insulation requirements and also coordinates with approval of technical changes to footnote d in RE22 for R-5 heated slab insulation. To further clarify and improve the enforceability of the revised footnote d, the table has been reformatted into two columns for unheated and heated slabs.

Public Comment 4:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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
						Interior Insulation Method	**Exterior Insulation Method**				
1	NR	0.75	0.25	30	13	~~3/~~4 or 0+3ci[h]	3ci	13	0	0	0
2	0.40	0.65	0.25	38	13	~~4/~~6 or 0+5ci[h]	4ci	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 [h]	~~8/~~13 or 0+9ci[h]	7.5ci	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 [h]	~~8/~~13 or 0+9ci[h]	7.5ci	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 [h]	~~13/~~17 or 13+4ci or 0+13ci[h]	10ci	30 [g]	15/19	10, 2 ft	15/19

6	0.32	0.55	NR	49	20+5 or 13+10 [h]	~~15/~~20 or 13+5ci or 0+15ci[h]	14ci	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 [h]	~~19/~~21 or 13+6ci or 0+15ci[h]	15ci	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. ~~"15/19" means R-15~~ Where continuous insulation ~~on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19"~~ (ci) is used, it shall be permitted to be ~~met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation~~ installed on the interior or exterior of the ~~home~~ wall. ~~"10/13" means R-10 continuous~~ Where cavity insulation is used, it shall be installed on the interior ~~or exterior~~ side of the wall between wood framing members. Where a combination of continuous and cavity insulation is installed on the interior side of the ~~home or R-13~~ wall, the cavity insulation ~~at~~ shall be installed on the interior side of the ~~basement wall~~ continuous insulation.

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. The first value is cavity insulation, the second value is continuous insulation (ci), so "13+~~5~~ 5ci" means R-13 cavity insulation plus R-5 continuous insulation.

~~i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.~~
i.

Commenter's Reason: This public comment on the original RE23 proposal focuses on clarifying and improving the mass wall insulation requirements for flexibility, better cost-effectiveness of insulation, and enforceability. The requirements are shown in two columns addressing insulation location requirements which are different for the two applications (and require different amounts of insulation due to differences in how location of insulation affects thermal mass effects). In addition, an interior insulation option using combined cavity and continuous insulation is provided in Climate Zones 5 through 8 for additional flexibility and efficiency in meeting the insulation requirements. This proposal does not change the technical performance requirement, but provides added clarity and flexibility to the prescriptive requirements. Refer to the reason statement with the original RE23 proposal for additional information.

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Table R402.1.2 (IRC Table N1102.1.2), Table R402.1.4 (IRC Table N1102.1.4), R402.2.13 (IRC N1102.2.13), R402.4.1.2 (IRC N1102.4.1.2), R402.5 (IRC N1102.5), Table R405.5.2(1) [IRC Table N1102.5.5.2(1)], Table R406.4 (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating and Air-Conditioning Engineers (sferguson@ashrae.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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
0 and 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	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones ~~1~~ 0 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones ~~1~~ 0 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

TABLE R402.1.4 (N1102.1.4)
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
0 and 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	0.35	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	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. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.17 in Climate ~~Zone~~ Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. Basement wall *U*- factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

R402.2.13 (N1102.2.13) Sunroom insulation. *Sunrooms* enclosing conditioned space shall meet the insulation requirements of this code.

Exception: For *sunrooms* with *thermal isolation*, and enclosing conditioned space, the following exceptions to the insulation requirements of this code shall apply:

1. The minimum ceiling insulation *R*-values shall be R-19 in *Climate Zones*~~1~~ 0 through 4 and R-24 in *Climate Zones* 5 through 8.
2. The minimum wall *R*-value shall be R-13 in all *climate zones*. Walls separating a *sunroom* with a *thermal isolation* from *conditioned space* shall meet the *building thermal envelope* requirements of this code.

R402.4.1.2 (N1102.4.1.2) 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 Zones ~~1 and~~ 0 through 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.5 (N1102.5) Maximum fenestration *U*-factor and SHGC (Mandatory). The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones ~~1~~ 0 through 3 shall be 0.50.

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of Table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame.	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: from Table N1102.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-factor: same as fenestration from Table N1102.1.4	As proposed
Vertical fenestration other than opaque doors	Total area[h] = (a)The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area (b)15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	SHGC: as specified in Table N1102.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 0, 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the mea- sured air exchange rate[a] . The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.

Notes to Table not shown for clarity and remain unchanged.

TABLE R406.4 (N1106.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
0 and 1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

Reason: This proposal updates the climate zones to correspond with the release of *ASHRAE Standard 169-2013, Climatic Data for Building Design Standards*. *Standard 169-2013* includes more-recent weather data and the creation of a new Climate Zone 0. Approximately 10% of the counties in the United States have a change in Climate Zone designation due to this change, with most of these changes resulting in a change to warmer climate zones.

Generally, the new Climate Zone 0 is the hotter portion of the previous Climate Zone 1, which was the warmest climate zone. Cities in Climate Zone 0 include Mumbai (Bombay), Jakarta and Abu Dhabi. There are no cities in the United States in Climate Zone 0; Miami and the islands of Hawaii are in Climate Zone 1. The separation of Climate Zones 0 and 1 allows separate criteria for IECC to be developed that are more specific to the hotter regions of Climate Zone 0.

The changes for Part II repeat all of the criteria for Climate Zone 1 for Climate Zone 0. This represents no increase or decrease in stringency for Climate Zone 0 and thus, no increase in the cost of construction.

Cost Impact: Will not increase the cost of construction
This represents no increase or decrease in stringency for Climate Zone 0 and no increase in the cost of construction.

RE25-16 : TABLE R402.1.2-FERGUSON12883

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There is not a climate zone map or climate zone table in the code that references climate zone zero. Thus, there is no need to have this in the code.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Steven Ferguson, representing American Society of Heating, Refrigerating, and Air-Conditioning Engineers (sferguson@ashrae.org) requests Approve as Submitted.

Commenter's Reason: This public comment ensures that all of the climate zone data in the IECC is consistent w ith ASHRAE Standards 90.1 and 169.
If future errata (editorial corrections) are found in ASHRAE Standard 169, this path (referencing to 169) is the only way to make sure the IECC Climate Zones are consistent with other national model energy requirements.

Proponent : Martha VanGeem, representing Masonry Alliance for Codes and Standards requests Approve as Submitted.

Commenter's Reason: We request as submitted because most of the objections have been satisfied by CE21 Part II AM. CE21 Part II defines Climate Zone 0. In addition, CE21 Part II as modified includes the U.S. map and U.S. county tables indicating climate zones, which addresses most of the testimony at the April hearing on CE21 Part II. See additional reasoning in original proposal.

RE26-16

Table R402.1.2 (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : Mike Fischer, Kellen Company,representing Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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: CAVITY INSULATION ONLY	WOOD FRAME WALL *R*-VALUE: COMBINATION CAVITY AND CONTINUOUS INSULATION (ci)	WOOD FRAME WALL *R*-VALUE: CONTINUOUS INSULATION (ci) ONLY	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	-	9ci	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	-	9ci	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 ~~or 13+5 [h]~~	13+5 [h]	14ci	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 ~~or 13+5 [h]~~	13+5 [h]	14ci	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 ~~or 13+5 [h]~~	13+5 [h]	14ci	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	30[j] ~~20+5 or 13+10 [h]~~	20+5 [h] or 13+10 [h]	19ci	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	30[j] ~~20+5 or 13+10 [h]~~	20+5 [h] or 13+10 [h]	19ci	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

j. Requires 2 x 8 wall framing.

Reason: The prescriptive R-Value table in the IECC contains limited options for different combinations of wall insulation materials using cavity insulation alone or in conjunction with continuous insulation installed on the outside of the wall framing. This proposal revises the table and provides R-Value options for cavity insulation and continuous insulation in all climate zones that meet or exceed the U-Factor requirements in Table 402.1.4, while retaining the current combination assemblies.

Cost Impact: Will not increase the cost of construction
The proposal adds no mandatory requirements, but increases the flexibility of the code by providing additional compliance options. Flexbility in the codes tend to lower costs of construction.

RE26-16 : TABLE R402.1.2-FISCHER13309

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The typical building practice doesn't put all of the insulation on the exterior of the building. There are complications for building 2 x 8 wall framing to accommodate insulation schemes.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Center for the Polyurethanes Industry of the American Chemistry Council (mfischer@kellencompany.com); Rob Brooks, representing Dow Building Solutions (rob.brooks.mail@gmail.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.1.2 (N1102.1.2)
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: CAVITY INSULATION ONLY	WOOD FRAME WALL *R*-VALUE: COMBINATION CAVITY AND CONTINUOUS INSULATION (ci)	WOOD FRAME WALL *R*-VALUE: CONTINUOUS INSULATION (ci) ONLY	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	-	9ci	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	-	9ci	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20	13+5 [h]	14ci	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20	13+5 [h]	14ci	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20	13+5 [h]	14ci	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	30~~[j]~~	20+5 [h] or 13+10 [h]	19ci	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	30~~[j]~~	20+5 [h] or 13+10 [h]	19ci	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

~~j. Requires 2 x 8 wall framing.~~

Commenter's Reason: The committee reason statement for disapproval cited two concerns:

1.The typical building practice doesn't put all of the insulation on the exterior of the building.
2.There are complications for building 2 x 8 wall framing to accommodate insulation schemes.

We agree with the committee reason statement that the use of exterior continuous-only insulation (without cavity insulation) is uncommon for the entire thermal envelope of the structure. However, there are conditions where this is needed in wall segments such as mechanical chases in exterior walls, cases where there are high wall framing factors for structural reasons (including special bracing panels, or moment frames used in high wind/seismic areas or multi-stud columns) where the cavity may contain something else besides insulation. This is consistent with the use of the prescriptive method, where walls are permitted to be broken into segments for code compliance. This option provides guidance as to the insulation requirements for continuous-only insulation when a small portion of the wall needs additional insulation to make up for the increased framing factor.

This is a parallel approach to RE-30 which reduces insulation when the framing factor is reduced. Here, we are providing an option to increase insulation on the outside when the framing factor is increased and the cavity is not available to insulate.

There were comments that certain insulation types would require the use of hybrid systems (R-13 cavity insulation plus R-10 continuous insulation) in lieu of a single cavity insulation material (R-30) in 2x8 walls. There are insulation materials that meet the R-30 requirement, such as closed-cell spray foam. We argue that all insulation options should be made available, and that either cavity or hybrid cavity-continuous systems provide an opportunity for all insulation types based upon equivalency per the required U-factor. Therefore, we have eliminated footnote j which refers to a specific framing size.

RE26-16

RE27-16

Table R402.1.2, (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : Mike Fischer, Kellen Company, representing Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	CONTINUOUS INSULATION (ci) ROOF DESIGN[j]	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	28	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	34	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	34	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	38	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	38	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	38	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	38	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

j. Requires uncompressed continuous insulation extending over the top plate of the wall at eaves.

Reason: The prescriptive R-Value table in the IECC contains an option for traditional ceiling insulation installed between and around roof truss assemblies, but does not contain an R-Value option for continuous insulation. With the increase in the use of continuous insulation in roof assemblies, whether through advanced roof framing, SIPS panels, or other systems, it is appropriate to include that option, with values that meet the U-Factor requirements in Table R402.1.4, in Table 402.1.2.

Cost Impact: Will not increase the cost of construction
The proposal provides additional flexibility but no mandatory requirements. Thus, there is no impact to the cost of construction.

RE27-16 : TABLE R402.1.2-FISCHER13325

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The revised table is confusing as to whether both ceiling insulation and continuous insulation in the roof is necessary.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Center for the Polyurethanes Industry of the American Chemistry Council (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.1.2 (N1102.1.2)
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 BELOW ROOF DECK[k]	CONTINUOUS INSULATION (ci) ABOVE ROOF DECK ~~DESIGN~~[j]	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	~~28~~26	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	~~34~~31	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	~~34~~31	20 or 13+5 [h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	~~38~~36	20 or 13+5 [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	~~38~~36	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	~~38~~36	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	~~38~~36	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

j. Requires uncompressed continuous insulation extending over the top plate of the wall at eaves.Continuous insulation shall be installed above roof sheathing and does not require ceiling insulation below the roof sheathing.

k. Ceiling insulation for unvented attics is permitted to be installed directly below the roof sheathing.

Commenter's Reason: This proposed change helps to clarify the requirements for insulation installed either in the ceiling or at the roof deck. A shown in Figure 1, ceiling insulation can be installed directly above the ceiling gypsum (option 1), below the roof sheathing (option 2) or above the roof sheathing (option 3). The R-value required for continuous insulation in option 1 is less than options 2 or 3 because of the reduced thermal bridging.
The prescriptive R-Value table in the IECC contains an option for traditional ceiling insulation installed between and around roof truss assemblies, but does not contain an R-Value option for continuous insulation installed above the roof sheathing without ceiling insulation. With the increase in the use of continuous insulation in roof assemblies, whether through advanced roof framing, SIPS panels, or other systems, it is appropriate to include that option, with values that meet the U-Factor requirements in Table R402.1.4, in Table 402.1.2.

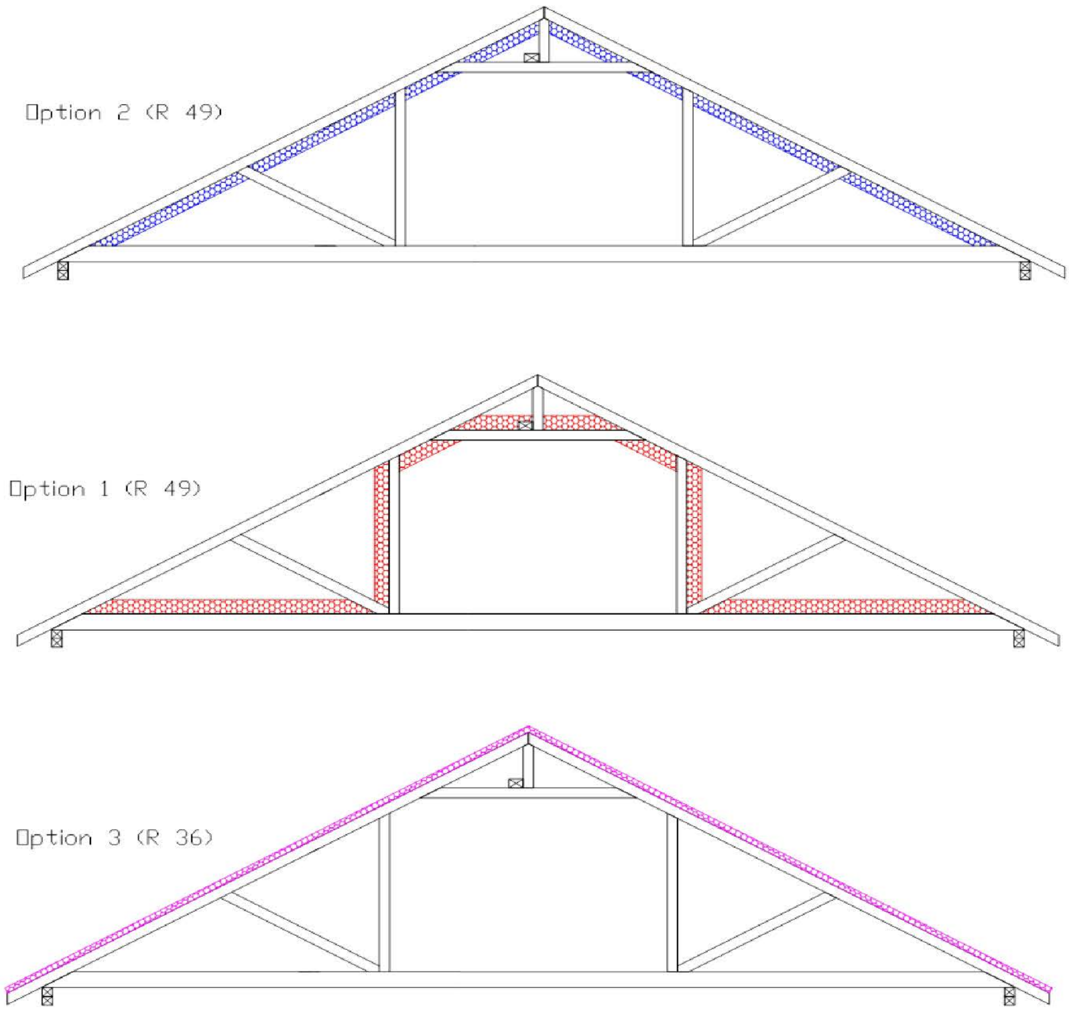


FIGURE 1: OPTIONS FOR INSTALLING INSULATION IN CEILING, ABOVE OR BELOW ROOF SHEATHING

Location	Roof Material - Unvented attic	R-values	
		Cavity Path	Stud Path
Roof above rafters/trusses	Outside winter air	0.17	0.17
	Continuous insulation above deck	26	26
	OSB deck - 7/16	0.62	0.62
Below roof deck	Wood frame member		6.875
	Cavity insulation below deck	0.0	
Ceiling	1/2 drywall	0.45	0.45
	Inside air film	0.61	0.61
Sum R-value of individual path		27.85	34.725
Framing factor		93%	7%
U-factor of assembly		0.035	

Location	Roof Material - Unvented attic	R-values	
		Cavity Path	Stud Path
Roof above rafters/trusses	Outside winter air	0.17	0.17
	Continuous insulation above deck	31	31
	OSB deck - 7/16	0.62	0.62
Below roof deck	Wood frame member		6.875
	Cavity insulation below deck	0.0	
Ceiling	1/2 drywall	0.45	0.45
	Inside air film	0.61	0.61
Sum R-value of individual path		32.85	39.725
Framing factor		93%	7%
U-factor of assembly		0.030	

Location	Roof Material - Unvented attic	R-values	
		Cavity Path	Stud Path
Roof above rafters/trusses	Outside winter air	0.17	0.17
	Continuous insulation above deck	36	36
	OSB deck - 7/16	0.62	0.62
Below roof deck	Wood frame member		6.875
	Cavity insulation below deck	0.0	
Ceiling	1/2 drywall	0.45	0.45
	Inside air film	0.61	0.61
Sum R-value of individual path		37.85	44.725
Framing factor		93%	7%
U-factor of assembly		0.026	

RE27-16

RE28-16

R402.1.2 (IRC: N1102.1.2)

Proposed Change as Submitted

Proponent : Tom Kositzky, representing Coalition for Fair Energy Codes; Mark Halverson, representing APA (mark.halverson@apawood.org); Loren Ross, representing American Wood Council (LRoss@awc.org); Greg Johnson, representing Coalition for Fair Energy Codes (gjohnsonconsulting@gmail.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	~~0.35~~ 0.32	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	~~0.35~~0.32	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	~~0.32~~0.30	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	~~0.32~~0.30	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
	0.26	0.55	NR	49	**25**	15/20	30[g]	15/19	10 , 4ft	15/19
7 and 8	~~0.32~~0.30	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19
	0.26	0.55	NR	49	**25**	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

Reason: This proposal adds a prescriptive cavity-only wall insulation option in Climate Zones 6-8 where none currently exists. This new path provides equivalent energy performance by combining the proposed R25 wood frame wall R-value with better performing windows (U=0.26), such that equivalent energy performance is achieved. The proposed change provides flexibility to builders who use the prescriptive table but prefer to not use continuous insulation. The proposal also changes the fenestration U-factors in Climate Zones 3-8 to match the levels proposed for the 2018 IECC by the U.S. Department of Energy.

In recent years, states with Climate Zones 6-8 have commonly amended the wood frame wall requirements to allow *R20* cavity-only insulation, resulting in a less energy efficient code. This has been done, in part, to maintain an alternative to the prescriptive continuous insulation mandate in the model energy code. This proposal provides a wall cavity insulation level that can still work with 2x6 framing, yet is significantly higher than R20 insulation. While the proposal is energy neutral with the model code, it actually has the potential to produce significant energy savings at reduced cost due to less local resistance to model energy code adoption and fewer incentives for states to amend the wood wall insulation requirements to lower levels.

This new Climate Zone 6-8 option has been evaluated using both a total UA and energy simulation approach and was found to have better performance than the current R20+5 continuous insulation requirement and the current fenestration U-factor requirements in the 2015 IECC. The proposal was also found to be energy neutral when the DOE proposed 2018 IECC fenestration U-factor levels are assumed.

A Total UA analysis was performed comparing the proposed option with a variety of IECC-compliant continuous insulation options.

Effective[1] Wall R-Value Comparison:
2015 IECC Base Case vs. Proposed Cavity Insulation Option
(Climate Zone 6-8)

	Fenestration U-factor	Opaque Wall U-factor	Fenestration Percentage							
			13%		15%		17%		20%	
			$U_{effective}$	$R_{effective}$	$U_{effective}$	$R_{effective}$	$U_{effective}$	$R_{effective}$	$U_{effective}$	$R_{effective}$
2015 IECC Base Case for R20+5 c.i.										
-With +5 c.i. *and* continuous OSB sheathing[2]	0.32	0.045	0.081	12.38	0.086	11.59	0.092	10.90	0.100	10.00
-Same, plus proposed 2018 IECC windows[2,3]	0.30	0.045	0.078	12.80	0.083	12.01	0.088	11.32	0.096	10.42
-With only +5 continuous insulated sheathing[4]	0.32	0.046	0.082	12.25	0.087	11.48	0.093	10.80	0.101	9.92
-2018 IECC windows and +5 c.i. sheathing[3,4]	0.30	0.046	0.079	12.66	0.084	11.89	0.089	11.21	0.097	10.33
Proposed 2018 IECC - For walls without c.i.										
-R25 / 0.26 windows	0.26	0.054	0.081	12.38	0.085	11.78	0.089	11.23	0.095	10.50

[1]$R_{effective}$ = the R-value of the entire assembly, including windows and the opaque wall assembly.

[2] The IECC U-factor for R20+5 assumes the use of continuous insulation **plus** continuous structural sheathing. The R-value of the continuous structural sheathing lowers the U-factor to 0.045 as shown in Table R402.1.4.

[3]The DOE proposed 2018 IECC improved fenestration U-factors are assumed for this assembly.

[4]Foam-sheathed walls with let-in wall bracing (no continuous stuctrual sheathing) also meet the the prescriptive R-value table, resulting in an assembly U-factor or 0.046.

Total UA Analysis Background Information

Base Case 2015 IECC R20+5 Wall (With Continuous Insulation and Continuous OSB)		
Wall Thermal Resistance Component	R-value Studs, Plates	R-value Insulation
Outside Winter Air Film[A]	0.17	0.17
Vinly Siding[A]	0.62	0.62
Continuous Insulation	5.00	5.00
Oriented Strand Board[A]	0.62	0.62
Framing / Cavity Insulation	6.875	20.00
1/2" Drywall[A]	0.45	0.45
Inside Air Film[A]	0.68	0.68
Total R-value of Path	**14.42**	**27.54**
Factored Area	**25%**	**75%**
Total Opaque Wall U-Factor	**0.045**	
Total Opaque Wall R-Value	**22.43**	
Fenestration U-factor	**0.32 or proposed 0.30**	

Base Case 2015 IECC R20+5 Wall (With Continuous Insulation & Let-in Wall Bracing)		
Wall Thermal Resistance Component	R-value Studs, Plates	R-value Insulation
Outside Winter Air Film[A]	0.17	0.17
Vinly Siding[A]	0.62	0.62
Continuous Insulation	5.00	5.00
Oriented Strand Board[A]	0.00	0.00
Framing / Cavity Insulation	6.875	20.00
1/2" Drywall[A]	0.45	0.45
Inside Air Film[A]	0.68	0.68
Total R-value of Path	**13.80**	**26.92**
Factored Area	**25%**	**75%**
Total Opaque Wall U-Factor	**0.046**	
Total Opaque Wall R-Value	**21.75**	
Fenestration U-factor	**0.32 or proposed 0.30**	

Proposed R25 Wall (Used with 0.26U Windows)		
Wall Thermal Resistance Component	R-value Studs, Plates	R-value Insulation
Outside Winter Air Film[A]	0.17	0.17
Vinyl Siding[A]	0.62	0.62
Continuous Insulation	0.00	0.00
Oriented Strand Board[A]	0.62	0.62
Framing / Cavity Insulation	6.875	25.00
1/2" Drywall[A]	0.45	0.45
Inside Air Film[A]	0.68	0.68
Total R-value of Path	**9.42**	**27.54**
Factored Area	**25%**	**75%**
Total Opaque Wall U-Factor	**0.054**	
Total Opaque Wall R-Value	**18.59**	
Fenestration U-factor	**0.26**	

[A]2013 ASHRAE Handbook of Fundamentals

Energy Simulation Comparing an Improved 2015 IECC with the Proposed Cavity Insulation Path

This simulated whole building analysis was modeled using the US Department of Energy's prototype single family home in the report, *DOE Methodology for Evaluating cost Effectiveness of Residential Energy Code Changes*[1]. The energy simulation was completed using RemDesign 14.6.1, one of the most widely used accredited energy rating tools. The results demonstrate that a house in Climate Zone 6 with R-25 cavity insulation and 0.26 U-factor windows uses only 0.04 percent more energy per year than a house built according to an improved 2015 IECC baseline that includes the proposed new 0.30 U-factor windows and R20+5 insulation (which also includes the added benefit of two continuous layers of wall sheathing). The 0.04 percent increase in annual energy use would result in 0.07 MMBTU's per year, roughly equating to $6 more in annual energy cost per year. This analysis only evaluated differences in above grade opaque walls and windows. All other building components and systems were identical in the analysis.

[1]Home characteristics taken from the US Department of Energy's, *Methodology for Evaluating cost Effectiveness of Residential Energy Code Changes,* published August 2015.

Building	Total Heating (MMBTU)	Heating Wall & Window load (MMBTU)	Total Cooling Load (MMBTU)	Cooling Wall & Window load (MMBTU)	Total Heating & Cooling Cost	Wall and Window Cost
CZ6- 0.30 WDW & R20+5 walls (with 2 continuous layers of wall sheathing)	74.2	17.1+13.1=30.2	8.6	-.01+7.3=7.2	$497.00	$224.49
CZ6- 0.26 WDW & R25 walls	74.7	20.6+10.2=30.8	8.8	-.01+7.6=7.5	$503.00	$230.71

Building	Heating	Cooling	Total
CZ6-.30 WDW & 20+5 walls	74.2	8.6	82.8
CZ6-.26 WDW & R-25 walls	74.7	8.8	83.5
	MMBTU Difference		**-0.07**
	Percent Difference		**0.4%**

Cost Impact: Will increase the cost of construction

This proposal does result in higher construction costs but only in respect to the decreased window U-factors for Climate Zones 3-8. The optional wall insulation/window path proposed for Climate Zones 6-8 will not increase the cost of construction, since the existing continuous insulation wall assemblies remain unchanged. The addition of the proposed prescriptive wall insulation path merely provides and option, which could result in reduced construction costs over the existing continuous insulation assemblies in Table R402.1.2.

According to the U.S. Department of energy's cost-effectiveness methodology, the proposed lower fenestration U-factors show a positive life-cycle cost savings in climate Zones 3 through **8**.(A)

(A)
(%20https%3A//www.energycodes.gov/development/2018IECC#residential)https://www.energycodes.gov/development/2018IECC#reside

(%20https%3A//www.energycodes.gov/development/2018IECC#residential)

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The revised table having two different paths for a climate zone is going to be confusing without some direction on how to use those paths. Proponent indicated that they would add a note to the table to provide direction.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Tom Kositzky, representing Coalition for Fair Energy Codes (tom.kositzky@apawood.org); Loren Ross, representing American Wood Council (LRoss@awc.org); Mark Halverson, representing APA - The Engineered Wood Association (mark.halverson@apawood.org); Greg Johnson, representing Self (gjohnsonconsulting@gmail.com); David Collins, Sustainability, Energy, High Performance Code Action Committee, representing The American Institute of Architects requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.1.2 (N1102.1.2)
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	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6 Option1	0.30	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
6 Option 2	**0.26**	0.55	NR	49	**25[j]**	15/20	30[g]	15/19	10 , 4 ft	15/19
7 and 8 Option 1	0.30	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19
7 and 8 Option 2	**0.26**	0.55	NR	49	**25[j]**	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

j. Use of Option 2 wood frame wall R-value requires Option 2 fenestration U-factor for building thermal envelope walls.

Commenter's Reason:

The public comment resolves a formatting issue in the proposed change to clarify how the two prescriptive options for insulating wood frame walls are applied. This resolves the concern voiced by the committee when it disapproved the original proposal.

This proposal creates a prescriptive, cavity only insulation option for Climate Zones 6-8 which is easily verifiable on plans and in the field by comparing window labels to the wall assembly. This energy neutral, affordable option eliminates a key barrier to adoption of the most current residential energy code provisions. Adoptions of the most recent version of the IECC save more energy.

RE28-16

RE30-16

Table R402.1.2 (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	0.35	0.55	0.25	38	20 or 13+5[h,I]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h,I]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,I]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,I]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,I]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

j. R-18 insulation shall be permitted in place of the R-20 requirement provided that the wall framing factor is 20% or less of exterior walls having 24 inch o.c. nominal vertical stud spacing.

Reason: The ASHRAE Handbook of Fundamentals and ASHRAE Transaction 1995 Volume 101, Part 2 assumes that wood framed walls have a framing factor of 25%. Meaning 25 percent of the wall area consists of structural framing members and the remainder of the wall is a cavity suitable for installing insulation. When calculating the U-factor for a wall assembly, a high framing factor increases the overall assembly U-Factor. Reducing the framing factor will also provide an increase in the thermal performance of the wall.

This proposal provides an option for a thermally equivalent tradeoff for 2x6 wall assemblies which have reduced framing factors and R-18 insulation. Below are the calculations showing equal U-Factors for both assemblies (0.060).

	2x6 Wall R-20 25%FF (16" o.c.)			2x6 Wall R-18 20% FF		
Wall Thermal Resistance by Component	R-Value Studs	R-Value Cavity	Assembly U-Factor	R-Value Studs	R-Value Cavity	Assembly U-Factor
Wall - Outside Winter Air Film[A]	0.17			0.17		
Siding - Vinyl[A]	0.62			0.62		
Continuous Insulation	0			0		
OSB - 7/16"[A]	0.62			0.62		
SPF Stud/Cavity Insulation	6.875	20		6.875	18	
1/2" Drywall[A]	0.45			0.45		
Inside Air Film[A]	0.68			0.68		
Studs at 16" o.c.[A]	25%	75%		20%	80%	
Total Wall R-Values	9.42	22.54		9.42	20.54	
Total Wall U-Factor	0.106	0.044	0.060	0.106	0.049	0.060
[A]2009 ASHRAE Handbook of Fundamentals						

Enermodal, 2001. Characterization of Framing Factors for Low-Rise Residential Building Envelopes (904-RP). Final Report prepared for ASHRAE, Atlanta, GA (USA)

Cost Impact: Will not increase the cost of construction
This proposal offers an optional way to compliance, by allowing a framing and insulation alternative to what is currently in the code without reducing the overall efficiency.

RE30-16 : TABLE R402.1.2-SURRENA12441

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

Revise as follows:

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

j. R-18 cavity insulation shall be permitted in place of ~~the~~ R-20 ~~requirement~~ cavity insulation provided ~~that~~ the exterior wall framing factor is 20% or less ~~of~~ , or exterior walls having 24 inch o.c. nominal vertical stud spacing are used.

Committee Reason: The modification was made because the overall insulation value of a wall with 24 inches on-center studs is going to be at least equal, if not greater than a wall having 20 percent less framing members than a 16 inch on-center framed wall.

The as-modified proposal provides another option for similar if not greater energy savings. The 24 inch on-center framing is an easier path for compliance as opposed to making the wall thicker to accomodate thicker insulation schemes to offset more framing members.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

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

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

j. R-18 cavity insulation shall be permitted in place of R-20 cavity insulation provided that the exterior wall framing factor is 20% or less, or exterior walls having 24 inch o.c. nominal vertical stud spacing are used. For exterior walls with less than 16 inch o.c. nominal vertical stud spacing or where the framing factor exceeds 25%, the R-value of cavity insulation, continuous insulation, or both shall be adjusted as necessary to comply with Table R402.1.4 (N1102.1.4).

Commenter's Reason: We support the concept that less framing requires less R-value; however, for a consistent treatment of framing and insulation, the same principle requires that more R-value be provided for walls that require more framing. The footnote as currently approved and modified by the committee is incomplete because it provides an option to achieve compliance with a decreased framing factor (e.g., 24"oc framing) without also providing options or direction for achieving compliance where the framing may be required by building code to be less than 16"oc with a framing factor of greater than 25% (the baseline of the table). While insulation can be reduced when there is a lower framing factor, there are cases where framing must be increased which requires options or direction for increasing insulation to compensate. For example, window walls or tall walls with framing commonly spaced at less than 16" oc are not uncommon and a greater than 25% framing factor is often required for these conditions by the building code or by design. For example, Section R602.3.1 of the 2015 IRC requires use of 12"oc framing for tall walls (and some designs have even more framing). Similarly, Figure 602.10.6.4 of the 2015 IRC addresses portal framing and when used for exterior building walls (not just garages), the framing factor may commonly exceed 60%! Therefore, both conditions (an increase or decrease in the framing factor) must be addressed for a complete treatment of this topic for code compliance. This public comment provides appropriate direction to ensure code compliance for both cases.

Proponent : Donald Surrena, National Association of Home Builders, representing National Association of Home Builders (dsurrena@nahb.org) requests Approve as Modified by Committee.

Commenter's Reason: The ASHRAE Handbook of Fundamentals and ASHRAE Transaction 1995 Volume 101, Part 2 indicates wood framed walls have a framing factor of 25%. Meaning 25 percent of the wall area consists of structural framing members (studs) and the remainder of the wall is a cavity suitable for installing insulation. When calculating the U-factor for a wall assembly, a high framing factor increases the overall assembly U-Factor (more studs lowers the wall efficiency). Reducing the framing factor will also provide an increase in the thermal performance of the wall (less studs increases the energy efficiency of the wall).

This proposal provides an option for a thermally equivalent tradeoff (equal if not more efficient) for 2x6 wall assemblies which have reduced framing factors (less studs) and R-18 insulation as shown as being equivalent in ASHRAE Handbook of Fundamentals and 2 studies noted in the footnotes below). Below are the calculations showing equal U-Factors for both assemblies (0.060).

Wall Thermal Resistance by Component	2X6 Wall R-20 25% FF (16" o.c.)			2X6 Wall R-18[d] 20% FF (24" o.c.)		
	R-Value Studs	R-Value Cavity	Assembly U-Factor	R-Value Studs	R-Value Cavity	Assembly U-Factor
Wall – Outside Winter Air Film[a]	0.17			0.17		
Siding - Vinyl[a]	0.62			0.62		
Continuous Insulation	0			0		
OSB – 7/16"[a]	0.62			0.62		
SPF Stud Cavity Insulation	6.875	20		6.875	18	
½" Drywall[a]	0.45			0.45		
Inside Air Film[a]	0.68			0.68		
Studs at 16"o.c.[b,c]	25%	75%		20%	80%	
Total Wall R-Value	9.42	22.54		9.42	20.54	
Total Wall U-Factor	0.106	0.044	0.060	0.106	0.049	0.060

a. 2009 ASHRAE Handbook of Fundamentals

b. Enermodal, 2001. Characterization of Framing Factors for Low -Rise Residential Building

c. Envelopes (904-RP). Final Report prepared for ASHRAE, Atlanta, GA (USA)

d. R-19 Fiberglass batt insulation compressed into a 2X6 cavity.

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Disapprove.

Commenter's Reason:

The proposed footnote both as originally submitted and as modified by the Residential energy committee is confusing and poorly written. The term framing factor is undefined in the code and our search for a definition showed there isn't a consensus of the definition of that term. It may be a term of art that is generically understood in the field, but if it's going to be the basis of an exception (as this footnote should be viewed), it needs to be clearly defined. Finally we are concerned that the text fosters an assumption of equivalency between a 24 inch on center stud spacing and advanced framing. There is much more to advanced framing that is implied here.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: This proposal should be disapproved because it will roll back the overall efficiency of the IECC by 0.4% on a national basis. It reduces the efficiency of wood frame walls and creates a confusing exception in the footnote of the prescriptive R-value table.

The simplicity of the current Table R402.1.2 is that an assessment of compliance can be made without consulting additional tables or references or specific exceptions, but through simple verification. This proposal adds a layer of complexity that is not needed, particularly when the user already has flexibility in the form of numerous other compliance alternatives such as the U-factor alternative, Total UA alternative, performance trade-offs or trade-offs within the ERI compliance path. Although the proponent attempted to clarify the footnote through a modification at the Committee Action Hearing, the proposal still suffers from major problems.

The main problem is that walls with 24 inch on-center studs can have a very wide range of framing factors – yet this proposal assumes that the two conditions go hand-in-hand. In fact, it is actually very difficult to get to a 20% framing fraction (or less) simply by installing studs at 24 inches on-center. A related technical problem is one that has plagued similar proposals that have been rejected in the past – how is 24 inch o.c. defined? How broad are exceptions for things like cripples, jack studs, or corners? And while the Reason Statement references 2 X 6 framing, the code language itself does not specify stud thickness. All of these tweaks can result in huge variations in the actual framing fraction and ultimately, the energy efficiency of the wall.

To be clear, framing with a lower percentage of studs can improve energy efficiency. But it is very difficult to define this circumstance in a way that it can be clearly enforced, particularly as a prescriptive option. And while the proponent attached a few cursory calculations to the Reason Statement, these calculations beg the question: "Who is responsible for calculating the framing fraction of each wall?" This trade-off might be equivalent *at best*, but at worst will result in walls nowhere near as efficient as simply installing the R-20 insulation required by the code. Because walls are unlikely to be retroactively insulated after they are finished, it is important to build them right the first time.

RE30 creates an unneeded option that is already covered under alternatives included in the IECC. Additionally, it is implemented in a way that reduces the energy efficiency of the home. We recommend disapproval.

Proponent : Shaunna Mozingo, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net) requests Disapprove.

Commenter's Reason: This proposal only adds confusion to the R-value table by bringing in U-factor trade-offs. There are already many other ways to do this including the U-factor Table, the Total UA Alternative, the Simulated Performance Approach and the Energy Rating Index Path. It doesn't also need to be included into the prescriptive R-value Table.

RE30-16

RE31-16

Table R402.1.2 (IRC Table N1101.1.2), R402.1.4 (IRC Table N1101.1.4)

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	~~0.35~~0.32	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	~~0.35~~0.32	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	~~0.32~~0.30	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	~~0.32~~0.30	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	~~0.32~~0.30	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

TABLE R402.1.4 (N1102.1.4)
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	~~0.35~~ 0.32	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	~~0.35~~0.32	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	~~0.32~~0.30	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	~~0.32~~0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	~~0.32~~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. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 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. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Reason: *Window efficiency has been aggressively targeted by programs such as ENERGY STAR because, compared to opaque walls, windows result in a much higher heat loss. Many Building America projects after 2010 incorporate window U-factors as low as 0.27, especially in cold climates, indicating that low-U glazing is finding widespread use in the marketplace.[1] Given these developments, this code change proposal considers improving maximum allowable fenestration U-factors to match older ENERGY STAR specifications where data indicate there is substantial market penetration. According to the 2013 ENERGY STAR market assessment conducted by Ducker Worldwide, the overall ENERGY STAR penetration for residential windows in the year 2013 was estimated to be 80%.[2] For new construction alone, ENERGY STAR residential window market penetration ranges from 70% to 88% based on climatic region, except for Florida which has a lower penetration rate of 36%. This proposed change only affects climate zones 3 through 8, for which data indicate excellent market penetration. It can thus be concluded that the current residential building market is sufficiently primed for lowering window U-factors in these climate zones.*
Energy Savings: DOE's analysis of the energy impact of this proposed change found energy savings in climate zones 3 through 8. Savings ranged from about 0.6% to 1.1% of IECC-regulated end uses (heating, cooling, water heating, and lighting).

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC (https://www.energycodes.gov/development/2018IECC).

Cost Impact: *Data collected by DOE indicates an incremental cost of $0.18/ft2 for a window with a U-factor of 0.30 compared to a window with a U-factor of 0.35.[3] The present analysis conservatively assumes the same incremental cost of $0.18/ft2 for windows with a U-factor of 0.32 compared to windows with a U-factor of 0.35.*

[1] See Case Studies in the "cold/very cold" regions in the Building America Solution Center at https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold (https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold)

[2] Available from ENERGY STAR by request

[3] Residential Energy Efficiency Measures – Prototype Estimate and Cost Data available at http://bc3.pnnl.gov/sites/default/files/Residential_Report.pdf (http://bc3.pnnl.gov/sites/default/files/Residential_Report.pdf)

Cost Impact: Will not increase the cost of construction
Cost Impact: *Data collected by DOE indicates an incremental cost of $0.18/ft2 for a window with a U-factor of 0.30 compared to a window with a U-factor of 0.35.[3] The present analysis conservatively assumes the same incremental cost of $0.18/ft2 for windows with a U-factor of 0.32 compared to windows with a U-factor of 0.35.*
Cost-effectiveness: *Assuming windows have a useful life of 30 years, an evaluation of the life-cycle cost savings of these improved levels over the 2015 IECC requirements using DOE's cost-effectiveness methodology shows positive life-cycle cost savings in climate zones 3 to 8. Life-cycle savings range from about $16 in zone 3 to $388 in zone 8.*

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Windows with these U-factors are now readily available in the market place. The extra cost has a short payback period.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jeff Inks, representing Window & Door Manufacturers Association (jinks@wdma.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

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

CLIMATE ZONE	FENESTRATION *U*-FACTOR [b,j]	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	20 or 13+5 [h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30[j]	0.55	NR	49	20 or 13+5 [h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	0.30[j]	0.55	NR	49	20+5 or 13+10 [h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	0.30[j]	0.55	NR	49	20+5 or 13+10 [h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

<u>j. A maximum U-factor of 0.32 shall apply in climate zone Marine 4 and climate zones 5-8 to vertical fenestration products installed in buildings located: (i) above 4000 feet in elevation above sea level and (ii) in windborne debris regions where protection of openings is required in accordance with IRC Section R301.2.1.2.</u>

Commenter's Reason: While we believe that market availability of window, door and skylight products should not be a primary driver for amending energy codes in this regard, we believe the proposed changes in fenestration U-factor for climate zones 3-8 are reasonable. However, further amendment is needed by this public comment which adds a new footnote j allowing limited exceptions to the U-factor requirements for products installed above 4000ft above sea level in climate zones Marine 4 & zones 5-8, as well as for products that must meet windborne debris protection requirements.
These exceptions are needed for high altitude and wind borne debris protection products if the proposed increases in U-factor stringency are to be approved. High altitude products generally require breather or capillary tubes in the insulating glass unit to allow pressure equalization when the products are transported to higher elevations for installation. The pressure equalization is necessary to avoid breakage. However, the tubes eliminate the ability to use gas fills commonly used to achieve higher levels of thermal performance. Meanwhile, windborne debris protection requirements for fenestration are typically met by the use of laminated glass which reduces the gap width in the insulating glass unit and thus the thermal performance. The proposed exceptions are reasonable and simply maintain the current requirements for products installed in those areas.

RE31-16

RE36-16

Table R402.1.2 [IRC Table N1102.1.2], Table R402.1.4 [IRC Table N1102.1.4]

Proposed Change as Submitted

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (N1102.1.2)
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	~~0.35~~0.32	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13 [f]	0	5/13
4 except Marine	~~0.35~~ 0.32	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	~~0.32~~ 0.30	0.55	NR	49	20 or 13+5[h]	13/17	30 [g]	15/19	10, 2 ft	15/19
6	~~0.32~~ 0.30	0.55	NR	49	20+5 or 13+10[h]	15/20	30 [g]	15/19	10, 4 ft	15/19
7 and 8	~~0.32~~ 0.30	0.55	NR	49	20+5 or 13+10[h]	19/21	38 [g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U* -factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R* -value of the insulation shall not be 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: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

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

d. R-5 shall be added to the required slab edge *R* -values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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. Or insulation sufficient to fill the framing cavity, R-19 minimum.

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

i. The second *R* -value applies when more than half the insulation is on the interior of the mass wall.

TABLE R402.1.4 (N1102.1.4)

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	~~0.35~~ 0.32	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	~~0.35~~ 0.32	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	~~0.32~~ 0.30	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	~~0.32~~ 0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	~~0.32~~ 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. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 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. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Reason: Window efficiency has been aggressively targeted by programs such as ENERGY STAR because, compared to opaque walls, windows result in a much higher heat loss. Many Building America projects after 2010 incorporate window U-factors as low as 0.27, especially in cold climates, indicating that low-U glazing is finding widespread use in the marketplace.[1] Given these developments, this code change proposal considers improving maximum allowable fenestration U-factors to match older ENERGY STAR specifications where data indicate there is substantial market penetration. According to the 2013 ENERGY STAR market assessment conducted by Ducker Worldwide, the overall ENERGY STAR penetration for residential windows in the year 2013 was estimated to be 80%.[2] For new construction alone, ENERGY STAR residential window market penetration ranges from 70% to 88% based on climatic region, except for Florida which has a lower penetration rate of 36%. This proposed change only affects climate zones 3 through 8, for which data indicate excellent market penetration. It can thus be concluded that the current residential building market is sufficiently primed for lowering window U-factors in these climate zones. In evaluating the ENERGY STAR 5.0 requirements, it was found that the climate-zone 4 U-factor of 0.32 was also cost-effective in climate zone 3, so the proposal includes that level in zone 3.

Energy Savings: DOE conducted an energy analysis using the established methodology: https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).[3] Analysis of the energy impact of this proposed change found energy savings in climate zones 3 through 8. Savings ranged from about 0.7% to 1.1% of IECC-regulated end uses (heating, cooling, water heating, and lighting).

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC (https://www.energycodes.gov/development/2018IECC).

Bibliography:

1. See Case Studies in the "cold/very cold" regions in the Building America Solution Center at https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold (https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold)
2. Available from ENERGY STAR by request
3. Taylor, ZT; Mendon, VV; and Fernandez, N. (2015). Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes. Pacific Northwest National Laboratory for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-21294 Rev1. https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).
4. Residential Energy Efficiency Measures -- Prototype Estimate and Cost Data available at http://bc3.pnnl.gov/sites/default/files/Residential_Report.pdf (http://bc3.pnnl.gov/sites/default/files/Residential_Report.pdf)

Cost Impact: Will increase the cost of construction

Data collected by DOE indicates an incremental cost of $0.18/ft^2 for a window with a U-factor of 0.30 compared to a window with a U-factor of 0.35.[4] The present analysis conservatively assumes the same incremental cost of $0.18/ft^2 for windows with a U-factor of 0.32 compared to windows with a U-factor of 0.35.

Cost-effectiveness: DOE conducted a cost-effectiveness analysis using the established methodology: https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).[4] Assuming windows have a useful life of 30 years, an evaluation of the life-cycle cost savings of these improved levels over the 2015 IECC requirements using DOE's cost-effectiveness methodology shows positive life-cycle cost savings in climate zones 3 through 8. Life-cycle savings range from about $57 in zone 3 to $539 in zone 8. The full analysis is available at: https://www.energycodes.gov/sites/default/files/documents/iecc2018_R-2_analysis_final.pdf (https://www.energycodes.gov/sites/default/files/documents/iecc2018_R-2_analysis_final.pdf).

RE36-16 : TABLE R402.1.2-WILLIAMS12203

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The Committee already approved RE31-16. This is nearly the same proposal so there is no need to approve this one.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Submitted.

Commenter's Reason: RE36-16 was disapproved in deference to another similar proposal (RE31-16). DOE stands on its original Reason statement for RE36-16.

RE36-16

RE37-16

Table R402.1.4 (IRC Table N1102.1.2)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

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

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SGHC d,e	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	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.25	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.40	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	NR	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	NR	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	NR	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. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 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. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.
d. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.
e. There are no SHGC requirements in the Marine Zone.

Reason: The purpose of this code change is to list the fenestration SHGC requirements in Table R402.1.4 as well as Table R402.1.2 (just as the U-factor requirements are listed in both tables). This proposal is simply editorial and will ensure that the SHGC requirements are not overlooked when Table R402.1.4 is used instead of Table R402.1.2 for compliance.

Cost Impact: Will not increase the cost of construction
Since there is no proposed change in requirements, this proposal will not affect the cost of the construction.

RE37-16 : R402.1.4-FAY12803

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The title of the table is about, and the contents of the table are, U-factors. Putting Solar Heat Gain Coefficients in this table does not make sense.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition

(misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: This proposal should be approved as submitted because it facilitates compliance with and enforcement of the code by repeating fenestration SHGC requirements in the prescriptive U-factor table that are identical to those in the prescriptive R-value table. Adding the SHGC requirements to both prescriptive tables is a commonsense improvement that helps ensure that the correct fenestration is specified, installed, and inspected by showing both prescriptive requirements (U-factor and SHGC) in the same place in both tables. This approach is consistent with the approach already used in the current code for fenestration U-factor, which repeats the same U-factor requirements for fenestration in both tables. **To be clear -- this proposal does not create any new requirements; it simply repeats the appropriate SHGC values in both prescriptive tables.**

The Committee reasoning for disapproving this proposal focused on the fact that the title and contents of the table are U-factor related. However, the Committee ignored the fact that the "U-factor Equivalents" table is used as the basis for the Total UA and Simulated Performance Alternative options, *both of which require compliance with SHGC requirements*. While an experienced user of the IECC may already know to check the SHGC requirements for all compliance paths, it may not be obvious to a code user focused on either the Total UA or Performance options.

Approval as submitted will improve code usability – and ultimately energy efficiency as a result of improved compliance – by including fenestration SHGC specifications in both prescriptive tables, without any impact on actual requirements.

RE37-16

RE40-16
R402.2.2 (IRC N1102.2.2)

Proposed Change as Submitted

Proponent : Mike Fischer, Kellen Company, representing Center for the Polyurethanes Industry of the American Chemistry Council (mfischer@kellencompany.com)

2015 International Energy Conservation Code

Revise as follows:

R402.2.2 (N1102.2.2) Ceilings without attic spaces. Where Section R402.1.2 would require R-38 or R-49 insulation ~~levels above R-30~~ in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. The full height of uncompressed R-30 insulation shall extend over the top of the wall plate at the eaves. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the *U*-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

Reason: The proposed language relates to the current provision in the IECC-R that allows for some limited lower R-Values where the roof/ceiling design provides limited space. This might typically apply where a room addition or a sun room with a single slope roof constructed with simple dimensional lumber framing instead of trusses. The proposal is largely editorial in that it does not change the insulation requirements, but reorganizes the text in R402.2.2 to match the format and style used on R402.2.1.
The proposal makes one clarification that in order to use this option the insulation must extend over the wall top plate to avoid a thermal short circuit.

Cost Impact: Will not increase the cost of construction
The proposal is an editorial reorganization for clarification of current requirements. Thus, the cost of construction is not changed.

**RE40-16 :
R402.2.2-
FISCHER13133**

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

402.2.2 (N1102.2.2) Ceilings without attic spaces. Where Section R402.1.2 would require ~~R-38 or R-49~~ insulation levels above R-30 in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. The full height of uncompressed R-30 insulation shall extend over the top of the wall plate at the eaves. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the *U*-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

Committee Reason: The modification was made to eliminate further correlation problems should the greater insulation levels change.

The as modified proposal was approved because it provides clear direction on where the thricker insulation requirement is needed.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.2.2 (N1102.2.2) Ceilings without attic spaces. Where Section R402.1.2 would require insulation levels ~~above~~ greater than R-30 in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. ~~The full height of uncompressed R-30 insulation~~ Insulation shall extend over the top of the wall plate ~~at~~ to the ~~eaves~~ outer edge of such plate and shall not be compressed. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the *U*-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

Commenter's Reason: The SEHPCAC reviewed approved changes to analyze if in the CAC's opinion whether the newly approved text was clear, understandable and enforceable. This proposal as approved by the committee is not clear. First the phrase 'above R-30' could be read as physically above (higher) or providing a 'higher' level of insulation. We feel 'greater the R30' reflects the intent of the proponent.

Secondly, the new sentence added in the middle of the paragraph seems to be adding new requirements without clearly stating them as a requirement. For example the 'full height of uncompressed insulation'. Is that intended as a prohibition of compressing the insulation in certain locations? If so, it is not clear. Further the 'extension' over the wall plate at the eaves ' is, at best, imprecise. We acknowledge the struggles of the proponent to craft clear language. We took a number of runs at it to develop this proposed revision. We feel it better expresses the intent of the proponent. Without this or similar improve to the text, the proposal should be disapproved because it would introduce unenforceable code text.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

RE40-16

RE47-16

R402.2.3 (IRC N1102.2.3), R402.2.4 (IRC N1102.2.4), Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Delete without substitution:

~~**R402.2.3 (N1102.4.2.3) Eave baffle.** For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.~~

Delete and substitute as follows:

~~**R402.2.4 (N1102.2.4) Access hatches and doors.** Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. 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.~~

- ~~**Exception:** Vertical doors that provide access from conditioned to unconditioned spaces shall be permitted to meet the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.~~

Revise as follows:

TABLE R402.4.1.1 <u>(N1102.4.1.1)</u>
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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. <u>Access openings, drop down stair, or knee wall door attic hatch access panels, shall be insulated to the same level as the assembly they are penetrating through.</u> <u>Access to all equipment located in insulated attics shall be provided that prevents damaging or compressing the installed insulation.</u> <u>An insulation dam shall be provided in order to prevent loose-fill insulation from spilling into the living space and to provide a permanent means of maintaining the installed R-value of the loose fill at the access or other locations in the attic.</u> <u>For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents and maintain an opening greater than or equal to the net free area of the soffit vent. The baffle shall extend from the soffit vent over the top of the attic insulation and sufficient space shall be maintained so insulation will cover the top plate. The baffle shall be any solid air barrier material.</u>

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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: Section R402.2.3 and R402.2.4 in the prescriptive path of the code describe aspects of insulating installation criteria that should be mandatory for all pathways of the energy code. The criteria ensure that R-value of the installed material is maintained and specifically addresses installation issues that will not affect the ability of a Builder to gain greater flexibility through utilization of performance paths in the code.

Cost Impact: Will increase the cost of construction
The majority of the country is still utilizing the prescriptive path for code compliance so there will be no or little cost implications associated with the adoption of this proposal. Rather this proposal will ensure that proper installation techniques are

maintained regardless of the path that is chosen.

RE47-16 : R402.2.3-SCHWARZ12733

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The committee made changes to address access hatches but this table will not include those changes.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.2.3 (N1102.2.3) Eave baffle. For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents.

R402.2.4 (N1102.2.4) Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces.

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stair, or knee wall doors to unconditioned attic spaces shall be sealed. For air-permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vent to maintain an opening greater than or equal to the net free area of the soffit vent. The baffle shall extend from the soffit vent over the top of the attic insulation and sufficient space shall be maintained so the required depth of insulation will cover the top plate. The baffle shall be permitted to be any rigid air barrier material and shall be installed to prevent air from bypassing the baffle through adjacent soffit bays.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access openings, drop down stair, ~~or~~ knee wall doors, attic hatch access panels, shall be insulated to the same level as the assembly they are penetrating through. Access to all equipment located in insulated attics shall be provided that prevents damage~~ing~~ or compression~~ing~~of the installed insulation. An insulation dam shall be provided in order to prevent loose-fill insulation from spilling into the living space, from higher locations to lower locations in the attic,or from insulated condition space over to unconditioned uninsulated space, and to provide a permanent means of maintaining the installed R-value of the loose fill ~~at the access or other locations in the attic.~~ insulation at these locations. ~~For air-permeable insulations in vented attics, a baffle shall be installed adjacent to sof f it and eave vents and maintain an opening greater than or equal to the net free area of the soffit vent. The baffle shall extend from the soffit vent over the top of the attic insulation and sufficient space shall be maintained so insulation will cover the top plate. The baffle shall be any solid air barrier material.~~
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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committees reason statement that attic access approved changes to the code in RE50 are not included in this proposal neglects the job of ICC staff which is to reconcile differences of parallel proposals so that the intent of two or more approved similar proposals can both be incorporated in the new code.

The more pertinent committee comment that was not captured was that section language was omitted from the code in the prescriptive section. This oversite has been rectified and there is now better coordination between the prescriptive and mandatory sections of the code in relationship to attics and eave baffles.

Additional cleanup of language in the insulation section was made to make this section whole, while a section was moved to the air barrier side becasue eave baffles are in reality an air barrier inssue adjacent to attic loose fill insulation.

RE47-16

RE50-16
R402.2.4 (IRC N1102.1.4)

Proposed Change as Submitted

Proponent : Cesar Rodriguez, representing Metro Atlanta Inspectors Association (joel.rodriguez@gwinnettcounty.com)

2015 International Energy Conservation Code

R402.2.4 (N1102.2.4) Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. 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.

~~**Exception:** Vertical doors that provide access from conditioned to unconditioned spaces shall be permitted to meet the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.~~

Exceptions:

0.1. Vertical doors providing access from conditioned to unconditioned spaces that comply with the fenestration requirements of Table R402.1.2 for the applicable climate zone specified in Chapter 3 shall not be required to comply with this section.

0.2. Horizontal pull-down stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces shall not be required to comply with this section provided that such hatches have an average maximum U-Factor of U-0.10 or an R-value of not less than R-10, have not less than 75% of the panel area having insulation of an R-value of not less than R-10, have a net area of the framed opening not exceeding 13.5 square feet and have the perimeter of the hatch edge weather stripped. This exception shall not apply where the U-factor alternative in Section R402.1.4 and the total UA alternative in Section R402.1.5 are used.

Reason: It has been our experience that the added insulation requirement in Section N1102.2.4 is frequently achieved with field crafted detachable apparatuses. Unfortunately, over time these are commonly discarded or worse, set aside compressing adjacent ceiling insulation thus defeating the intended benefit. The objective of this proposal is to address this field modification issue and provide for a more permanent installed solution.

During the 2015 ICC code development cycle for the IRC and the IECC an exception was added to the ceiling insulation requirements for vertical doors providing access to attic areas in IRC Section N1102.2.4 and IECC Section R402.2.4. This exception was based on the premise that vertical attic access doors between conditioned and unconditioned spaces can be treated as fenestration. Horizontally positioned attic access hatches are a similar issue. These horizontal hatches are being required to have insulation levels that match the surrounding ceiling which is significantly more stringent than skylight fenestration products located in these same ceiling assemblies.

For example, in Table N1102.1.2 (R402.1.2) Skylights are required to meet a U-factor that ranges from 0.75 in Climate Zone 1 to 0.55 in Climate Zone 8. In addition, Section N1102.3.3 (R402.3.3) allows up to 15 square feet of the fenestration per dwelling unit (which includes skylights) to be exempt from the requirements in Table N1102.1.2 (402.1.2). It does not make sense to require R-30 to R-49 insulation for a pull down stair type access hatch in an insulated ceiling when one can have a skylight up to 15 square feet in area that is exempt from the envelope requirements or that has a *U*-FACTOR of 0.55-0.75 (less than R-2). Insulating pull down stair access hatches to the levels specified in N1102.2.4 (R402.2.4), compared to the skylights insulation requirements is expensive, and in many cases not practical.

In addition, affordable, pre-manufactured pull down stair access systems are not readily available to meet the R-30 to R-49 target. As a result, field customization of access hatches is sometimes employed to achieve these performance levels. Inspection and verification for compliance becomes a challenge. As noted previously long term system performance of these field customized entry devices may also vary. Commonly the field crafted detachable apparatuses are designed to be removed for attic access and placed on the adjacent attic joists. This results in the insulation being compressed thus reducing its effectiveness. Also providing sufficient air sealing around the hatch that remains durable long term is difficult. Finally, removal of the insulated covers for access may present a safety hazard to service personnel, inspectors and building owners having to stand on ladders while removing the hatches.

Quality standardized manufactured pull down stair systems however provide a safer, permanent access with proven performance for the life of the structure. Factory built energy rated access systems provide consistent air sealing performance and ensure consistent energy performance while helping to maintain air quality through reduced air infiltration.

This proposal provides a solution by permitting a reasonable reduction in the insulation values for pull down stair access hatches that are less than or equal to 13.5 square feet (approximately 30" X 64") in attic ceilings. This maximum size accommodates most manufactured products available. The U-value specified at U-0.10 is less stringent than the U-values specified for the insulated ceilings but is far more stringent than those permitted for skylights in all Climate Zones. Too the size limit is more stringent than that permitted for skylights which can have one unit up to 15 square feet in size exempted from the code requirements while all other skylights are less stringent than the pull down stair assembly proposed. Finally, the proposal also does not allow this reduction to be factored into the U-Factor alternative calculation procedure in N1102.1.4 (R402.1.4) or the total UA alternative procedure in N1102.1.5 (R402.1.5). This is consistent with the limitations in Section N1102.2.1 (R402.2.1) for ceilings with attic spaces and in Section N1102.3.3 (R402.3.3) for skylights.

Cost Impact: Will not increase the cost of construction
The reduced cost of field installed apparatuses and insulation will offset the cost of the pull-down stair.

**RE50-16 :
R402.2.4-
RODRIGUEZ12855**

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The practical implications outweigh the minimal loss of insulation R-value. Experience with products that can comply with these requirements is a superior method as compared what has been done in the past and provides for a long term solution.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.2.4 (N1102.2.4) Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. 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.

Exceptions:

1. Vertical doors providing access from conditioned to unconditioned spaces that comply with the fenestration requirements of Table R402.1.2 for the applicable climate zone specified in Chapter 3 shall not be required to comply with this section.

2. ~~Horizontal pull-down stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces shall not be required to comply with this section provided that such hatches have an average maximum U-Factor of U-0.10 or an R-value of not less than R-10, have not less than 75% of the panel area having insulation of an R-value of not less than R-10, have a net area of the framed opening not exceeding 13.5 square feet and have the perimeter of the hatch edge weather stripped.~~Horizontal pull-down stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces shall not be required to comply with this section provided each hatch complies with the following:

2.1 Has an average maximum U-Factor of U-0.10 or an R-value of not less than R-10,

2.2 Has not less than 75% of the panel area having insulation of an R-value of not less than R-10,

2.3 Has a net area of the framed opening not exceeding 13.5 square feet and

2.4 Has the perimeter of the hatch edge weather stripped.

This exception shall not apply where the U-factor alternative in Section R402.1.4 and the total UA alternative in Section R402.1.5 are used.

Commenter's Reason: The text of the approved new exception #2 is dense with requirement and limitation. You almost don't see the limitation that if you are using either of 2 specified design paths, you can't use this exception. We feel that the proposed revision contained in this public comment will improve the understandability of this new provision and lead to better enforced.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Disapprove.

Commenter's Reason: The premise of this proposal is that it is difficult to insulate specific types of attic hatches and doors. Like all components of the building, there are materials that are or simply should not be used to achieve the requirements of code. Pull down stair attic access panels are one of them. They are difficult if not impossible to insulate hence the proposal states that up to 25% of the panel does not need be insulated at all. This is a reduction of approximately 11% in the weighted R-value of a 1000 sqft attic originally insulated to R-38. The reality is that small square footage of poorly insulated or non-insulated sections of the thermal envelope cause big impacts to the energy performance of the structure.

The committee states that "practical implications outweigh the minimal loss of insulation R-value." The most practical solution would be not to allow these types of exceptions. Attics should not be used for storage which drop down stairs promote, and windows are not walls or ceiling and should not be used to access these components. This proposal impacts the Building Thermal Envelope and should be disapproved.

Assembly: Exception #1 RE50 – Climate Zone 5

Component Description	R-value	U-value 1/R	Area	U-value x area+ UA
Wall R-20	R-20	.05	494	24.7
Vertical doors providing access from conditioned to unconditioned spaces U-.32	R3.125	.32	6	1.92

Total area	Total UA
500	26.62

500 / 26.62 = 18.78 This is a reduction of R1.23 approximately 1% not including framing or other wall U-value components like framing

Total area / Total UA = weighted average R-value

Assembly: Exception #2 RE50 –
Climate Zone 5

Component Description	R-value	U-value 1/R	Area	U-value x area+ UA
Ceiling R-38	R-38	..026	986	25.66
Horizontal pull-down stair-type access hatches 75% not insulated R-1	R-10	.1	10.5	1.05
Horizontal pull-down stair-type access hatches 25% insulated to R-10	R-1	1	3.5	3.5

Total area	Total UA
1000	29.16

1000 / 29.16 = 34.29 This is a reduction of approximately R-4 or 11%. This is not including framing or other ceiling U-value components so it is not a whole ceiling calculation.

Total area / Total UA = weighted average R-value

RE50-16

RE51-16

R402.2.5 (IRC N1102.2.5)

Proposed Change as Submitted

Proponent : Matthew Hunter (mhunter@awc.org); Loren Ross, representing American Wood Council (LRoss@awc.org)

2015 International Energy Conservation Code

Revise as follows:

R402.2.5 Mass walls. Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and heavy timber (solid timber~~/~~ , cross-laminated timber, logs), or any other walls having a heat capacity greater than or equal to 6 Btu/ft^2 × °F (123 kJ/m^2 × K).

Reason: Cross-laminated timber (CLT) is a new technology developed in Europe that consists of smaller wood pieces factory glued together to make thick wood sections. It is analogous to large section members currently associated with heavy timber in the current code. In fact, the 2015 IBC already recognizes CLT as heavy timber construction. This proposal adds CLT to the list of mass walls and groups solid timber, CLT, and logs in the more general category of heavy timber to be consistent with the rest of this section.

Cost Impact: Will not increase the cost of construction
This proposal only adds clarity to how CLT should be consider in the residential energy code. No cost increase is anticipated with this code change.

**RE51-16 :
R402.2.5-
HUNTER12424**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The structure of the language is confusing with all the commas and parenthesis. Suggest a Public Comment to present the information is a more clear manner.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Paul Coats, PE CBO, representing American Wood Council (pcoats@awc.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

R402.2.5 Mass walls. Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) ~~and~~ , solid timber/logs, and cross-laminated timber or any other walls having a heat capacity greater than or equal to 6 Btu/ft^2 × °F (123 kJ/m^2 × K).

Commenter's Reason: This public comment attempts to address committee concerns by retaining the existing language except for the inclusion of cross-laminated timber. This is a full replacement proposal which only adds cross-laminated timber to the existing section.

Public Comment 2:

Proponent : Loren Ross, representing American Wood Council (LRoss@awc.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

R402.2.5 Mass walls. Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs, mass timber (cross-laminated timber, structural composite timber), or any other walls having a heat capacity greater than or equal to 6 Btu/ft^2 × °F (123 kJ/m^2 × K).

Commenter's Reason: Cross-laminated timber (CLT) and structural composite timber are new technologies developed in Europe that consist of wood pieces factory glued together to make thick wood sections. They are continuous and homogeneous throughout the wall like solid timber in the current code, so this proposal adds them to the list of mass walls consistent with solid timber/logs.

During the Committee Action Hearings, RE52-16 was passed, which gives performance criteria for the definition of mass walls. These meet the performance criteria, but the following reference material would be needed for the calculation: *ASHRAE Handbook of Fundamentals*, *ANSI/APA PRG 320 Standard for Performance-Rated Cross-Laminated Timber*, *National Design Specification for Wood Construction*, and *Wood Handbook: Wood as an Engineering Material*.

Even with these references, the calculation is not direct or without assumptions such as the wood's equilibrium moisture content. Adding a specific reference to the mass wall list will ease in design without changing the result.

RE51-16

RE52-16
R402.2.5 (N1102.2.5)

Proposed Change as Submitted

Proponent : Martha VanGeem, self, representing Masonry Alliance for Codes and Standards; Theresa Weston, representing DuPont Building Innovations (theresa.a.weston@dupont.com); Emily Lorenz, self, representing self (emilyblorenz@gmail.com)

2015 International Energy Conservation Code

R402.2.5 (N1102.2.5) **Mass walls.** Mass walls for the purposes of this chapter shall be considered above-grade walls complying with one of the following:

1. Constructed of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs~~, or any other walls having~~ .
2. Weighing not less than 35 psf of wall surface area.
3. Weighing not less than 25 psf of wall surface area where the material weight is not more than 120 pcf.
4. Having a heat capacity ~~greater than or equal to 6~~ exceeding 7 Btu/ft^2 × °F.
5. Having a heat capacity exceeding 5 Btu/ft^2 × °F ~~(123 kJ/m^2 × K)~~ where the material weight is not more than 120 pcf.

Reason: The energy-saving benefits of thermal mass are not based on the weight of the wall or the heat capacity, but on the thermal diffusivity of the materials. It is thermal diffusivity or its components of thermal conductivity, specific heat, and density that are entered into simulation software to model thermal mass. A simplification of this to ease code compliance is to list the wall types as currently is done.
This proposal corrects the heat capacity requirement to be based on weight, which is more technically correct, and to align it with what is in the IECC commercial. Items 2 through 5 match what is in the IECC commercial while still maintaining the simplified listing of walls in Item 1.

A paper providing more information has been published on this subject and is available upon request: VanGeem, M.G., "Optimal Thermal Mass and R-Value in Concrete," First International Conference on Concrete Sustainability, Tokyo, May 2013.

Cost Impact: Will not increase the cost of construction
This proposal simply corrects heat capacity requirements to make them more technically correct and align them with waht is already in IECC commercial. There is no change in the code requirements that would impact the cost of construction.

RE52-16 :
R402.2.5-
VANGEEM10454

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: THis proposal adds valuable information needed for material selection.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Disapprove.

Commenter's Reason: The RE52 proposal has a technical problem that has become apparent after the code development hearing. It has included the option of declaring a wall assembly to be a mass wall if it simply weighs more than 35 psf. This is provided as a stand-alone means of qualification in item #2 of the proposal. However, there is at least one common condition where this could result in a mischaracterization and misuse of mass wall R-values and U-factors. For example, a brick veneer on a light frame wall assembly is typically 35 psf or more. Yet, the brick veneer (or other similar facing) does not make a wall behave thermally as a mass wall. These facings are typically separated from (thermally disconnected from) the remainder of the assembly by a vented airspace. Thus, it is inappropriate to allow them to be considered mass walls; but, this proposal would allow it. This is a technical flaw that can result in misapplication of the code and the proposal should be disapproved.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: RE52 should be disapproved because the current proposal creates a loophole that could result in brick veneer being recognized as a "mass wall," with lesser insulation requirements, even though brick veneer would not provide the same thermal benefits of traditional mass walls. This would significantly rollback energy efficiency from the 2015 code.
In the current code, the description of above-grade mass walls specifically excludes brick veneer. However, the proposed new list of options in RE52 (perhaps unintentionally) includes brick veneer walls under the definition of a mass wall. While we do not oppose some of the additional clarity offered in this proposal, option 2 would result in a rollback in efficiency of 4% at the national level for these types of homes:

CZ	Mass Wall
1	-8.8%
2	-6.3%
3	-3.2%
4	-3.4%
5	-1.8%
6	-8.2%
7	-8.8%
8	-9.8%
Nat'l Avg	-4.0%

The table above shows the overall reduction in efficiency that results when brick veneer is treated as a mass wall (which has weaker insulation requirements than wood frame walls). While the reduced insulation requirements for mass walls were presumably set based on an assumption of greater benefits from the characteristics of a mass wall, these benefits cannot be assigned to brick veneer. Thus, by adding brick veneer to the broader category of mass walls, RE52 would bring about a significant reduction in energy efficiency for such walls. Because brick veneer walls can have a weight of 48 psf (per Appendix A of the Florida Building Code), a code user might argue that they qualify as a mass wall under option 2, which includes an option for walls weighing not less than 35 psf of wall surface area. While that may not have been the proponent's intent, it could amount to a substantial loss in energy efficiency. We recommend disapproval of RE52.

RE52-16

RE56-16

R402.4 (IRC N1102.4), R402.4.1.2 (IRC N1102.4.1.2), R402.4.1.2.1 (New) [IRC N1102.4.1.2.1 (New], R402.4.1.2.1.1 (New) [IRC N1102.4.1.2.1.1 (New)], R402.4.6 [IRC N1102.4.6) (New)]

Proposed Change as Submitted

Proponent : Sean Maxwell, representing self (maxwellbuildingperformance@gmail.com)

2015 International Energy Conservation Code

Revise as follows:

R402.4 (N1102.4) Air leakage (Mandatory). 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~~ R402.4.6.

R402.4.1.2 (N1102.4.1.2) 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 Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*.~~ Testing shall be performed at any time after creation of all penetrations of the ~~*building thermal envelope*~~building thermal envelope.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

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 provided to the code official. The written report shall include:

1. The name and place of the business of the party conducting the test.
2. The address of the building which was tested.
3. The floor area of the conditioned space of the dwelling unit.
4. The measured air leakage rate of each testing unit.
5. The date or dates of the test.
6. A certification by the party conducting the test, indicating the accuracy of the test results.
7. The signature of the party who conducted the test.

Add new text as follows:

R402.4.1.2.1 (N1102.4.1.2.1) Alternative testing procedure for buildings with two or more dwelling units within the building thermal envelope. Where two or more dwelling units are located within a building thermal envelope, the following procedure shall be an alternative to testing in accordance Section R402.4.1.2:

For purposes of testing, the following spaces and areas are defined:

1. Each dwelling unit including each occupiable conditioned space other than a dwelling unit within the building thermal envelope shall be considered a testing unit.

2. The enclosure surface area of a testing unit shall be the sum of the areas of all of the following:
   1. Each exterior wall of the testing unit
   2. Each interior wall of the testing unit that abuts another testing unit or units,
   3. Each ceiling of the testing unit that abuts another testing unit or units, or abuts unconditioned space.
   4. Each floor in the testing unit that abuts another testing unit or units, or abuts unconditioned space.

3. The conditioned-space floor area of a dwelling unit shall be calculated in accordance with BOMA Z65.1 or BOMA Z765.1, as applicable. Where either of these standards exclude floor areas having a ceiling height of less than 5 feet (1524 mm), such floor areas shall be included in the calculation of conditioned-space floor area.

Each testing unit shall be tested to verify that the air leakage rate does not exceed 0.3 cubic feet per minute per square foot of the enclosure surface area of the testing unit. Testing shall be conducted in accordance with ASTM E779 or ASTM E1827 using a blower door. Test results shall be reported at a pressure of 0.2 inches w.g. (50 Pascals). Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weather-stripping 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

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 prepared and provided to the code official. The report shall include all of the following:

1. The name and place of the business of the party conducting the test.
2. The address of the building and dwelling unit numbers which were tested.
3. The conditioned-space floor area of each testing unit.
4. The air leakage rate at 0.2 inches w.g. (50 Pascals) of each testing unit.
5. The date or dates of the testing.
6. A certification by the party conducting the tests which indicates the accuracy of the test results.
7. The signature of the party who conducted the tests.

R402.4.1.2.1.1 (N1102.4.1.2.1.1) Alternative testing procedure for buildings with more than seven dwelling units. Where there are more than seven dwelling units within a *building thermal envelope,* and where approved by the code official, the following shall be an alternative to the testing of all dwelling units in accordance Section R402.4.1.2.1*:*

1. Sample sets of not more than seven testing units shall be determined. Each sample set shall include one or more occupiable common conditioned space, other than dwelling units. Each sample set shall be representative of all types of dwelling units and occupiable common conditioned spaces other than dwelling units, within the building thermal envelope.
2. All testing units in the first sample set shall be tested to verify that the air leakage rate does not exceed 0.3 cubic feet per minute per square foot of enclosure surface area of the testing unit, Where all testing units of the first sample set tested do not exceed the leakage rate maximum, only one testing unit of each sample set tested thereafter shall be required to be tested. Where any subsequent test exceeds the air leakage rate maximum, additional testing shall be required in accordance with the following procedure:
    - 2.1. Two additional testing units in the same sample set shall be tested. Where either of those additional testing units fail to comply, the remaining untested testing units in the sample set shall be tested. For testing of the next sample set, all of the testing units in the set shall be tested.
    - 2.2. Where all of testing units of the next sample set tested do not exceed the leakage rate maximum, and where the code official approves a reduction in the number of units to be tested in future sample set testing, the testing procedure shall reset to that in Item 2.

R402.4.6 Dwelling unit and townhouse separation walls (Mandatory). Separation walls and ceilings between two or more dwelling units or between townhouses, all within a *building thermal envelope,* shall be air-sealed in accordance with Section R402.4.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ANSI/BOMA Z65.1-1996 Office Buildings: Standard Methods of Measurement
ANSI/BOMA Z765.1-2003 Square Footage Method for Calculating.

Reason: The 2015 International Energy Conservation Code calls for all buildings or dwelling units to be verified with a blower door as having an air leakage rate not exceeding 3 air changes per hour at 50 Pascals; however, because of the unique challenges of testing multifamily buildings, some modification to the language is necessary. Without it, there are fewer practical ways to enforce this code requirement for multifamily buildings. What is proposed here is a modification that would call for a specific form of testing for multifamily buildings that is easily enforced and would advance the building industry in valuable ways.
New York State recently adopted the residential portions of the 2015 IECC, and it has considered some modifications to allow compartmentalization testing of apartments, a method described below. It is more cost-effective, more easily implemented on a wide basis, and achieves many other benefits for building owners and occupants that other test methods do not. For this reason, this test method called for in many other guidelines such as ASHRAE 62.2-2013, LEED BD+C: Multifamily Midrise, New York State's Multifamily Performance Program, and the EPA's ENERGY STAR® Multifamily High Rise program.

New York State published is proposed 2015 Supplement to the New York State Energy Conservation Construction Code, containing its recommended changes to the blower door test requirements. We recommend similar language be adopted by the IECC.

http://www.dos.ny.gov/DCEA/pdf/2015EnergyCodeSupplementdraft20151106.pdf. (http://www.dos.ny.gov/DCEA/pdf/2015EnergyCodeSupplementdraft20151106.pdf.%20)

Testing Methods

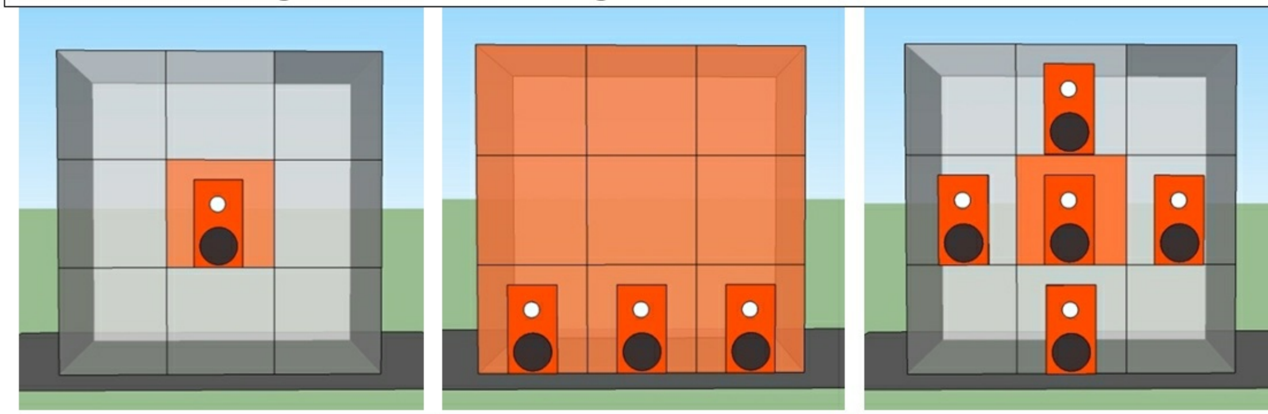
There are several valid ways to test a multifamily building's air leakage with a blower door. Below a few are discussed, but first we will review terminology. The simplest blower door test on a single family home measures only the leakage of the exterior envelope, which can be referred to as "exterior leakage." In multifamily buildings, there are lots of other air leakage pathways besides from the exterior, and a blower door test on a single unit will measure some leakage from outside and some "inter-unit" leakage from other spaces. Multifamily buildings typically have lots of inter-unit leakage, but it's exterior leakage from the outside that relates most directly to energy consumption.

Similar to a single-family home test, **whole-building** leakage testing uses one or more blower door systems to pressurize or depressurize the entire building at once, measuring all the exterior air leakage in one shot. Because all spaces in the building are under the same pressure, inter-unit leakage is negated. An excellent description of the process was given by Don Hynek in Home Energy Magazine in September 2011. For a larger building this method often requires multiple blower doors and experienced technicians to conduct properly. Factors such as building height, design, stage of construction, and especially weather on the testing day can make a whole-building test a challenge. Still, this test is quite popular, particularly in Europe.

Another method is **guarded** blower door testing, which also requires multiple blower doors and experienced technicians to perform. It also aims to measure exterior envelope leakage by manipulating inter-building pressures with multiple fans. Figure 1 illustrates this technique in more detail. It's called guarded testing because it uses secondary "guard" blower doors placed around the target unit. These are maintained at the same test pressure as the target unit, which neutralizes any inter-unit leakage. The result is that only exterior leakage is recorded from the target unit. By moving the doors around a building like a tic-tac-toe board, the exterior leakage of all the spaces can be isolated and recorded. The time-consuming process requires experienced operators, a good plan, and several blower doors even for a small multifamily building. This method is often used for research, but it is also a practical way to test some townhouse building configurations.

By comparison, single-unit or **compartmentalization** testing (the terms are used interchangeably here) is simpler than other methods. A single technician with a single blower door moves around the building and tests each unit individually. Because no steps are taken to nullify leakage from other apartments as in whole-building or guarded testing, this test quantifies leakage from the exterior walls as well as the interior demising walls, floors, and ceilings of a unit. Experienced technicians will tell you that it is common for this inter-unit leakage to rival or even exceed that of the exterior leakage. Because exterior leakage is really what matters for energy use, this test is not very useful for energy cost calculations.

Whole-building and **guarded** blower door testing are two methods that use multiple blower doors to isolate and measure leakage from the exterior envelope only. These methods require multiple blower doors and operators and must be coordinated by an experienced team. **Compartmentalization** of single-unit testing quantifies leakage from the exterior walls as well as the interior demising walls, floors, and ceilings of a unit.



Compartmentalization testing	Whole-building testing	Guarded blower door testing
Single blower door and operator	Requires multiple blower doors and operators	

Which test is best?

Each test has its merits, but when industry professionals including Steven Winter Associates (SWA) were asked to help guide New York State's codes council on testing language in the building code, they specifically recommended single-unit tests. In their opinion, guarded blower door testing is most useful as a research tool, and whole-building testing can be too complicated and expensive to require on a state level. But if single-unit test results are not useful for calculating energy savings, why use them for an energy-focused building code? The reasons are both practical and forward-thinking.

Above all, for a code provision to be beneficial, it needs to be enforceable. More than the other methods, single-unit testing is easiest to introduce on a statewide basis. It requires less training, experience, and equipment than whole-building tests. Many of our nation's network of HERS raters and BPI professionals are all already qualified for it. As described below, the additional cost to builders in many cases will be less for single-unit tests than for other methods when sampling protocols are used.

There are several complications with conducting whole-building tests on a wide scale that make it more troublesome to require by code. First, these large tests have high mobilization costs, and there are fewer companies that own either high-powered fans or multiple blower doors for bigger buildings. Second, the *entire* building has to be prepared (central exhaust registers taped, windows locked, central fans switched off, etc.) before the test can be conducted – for a large building this can take several hours. Workers also cannot enter or leave the building during the test; it must be "locked down." For this reason it is virtually impossible to do a big blower door test early in construction because work on the building cannot stop. Punch list time is ideal because fewer workers are present, but fixing big problems at that stage is much more expensive.

A single-unit test can be more useful to builders – it can be used to check progress and identify problems very early in construction when they are cheaper to fix. A tester can leap-frog and work around other trades in the building, reducing the disruption to regular workflow. If a unit passes the blower door test early on, the job is done; if not, fixes can be applied and a retest can be done in minutes. The possibility of demonstrating compliance early is very attractive because it reduces uncertainty and potential cost at the end of the project. In fact, a higher-volume builder may decide to purchase a blower door kit and self-check periodically. Wouldn't it be a very positive side-effect if the blower door became a common tool of the builders of tomorrow?

One might argue that a compartmentalization test yields a number that is essentially useless for energy models because it measures mostly interior leakage. That is largely true. But the goal of an energy code requirement is to save energy, and requiring and testing compartmentalization will do that. By paying attention to leaks of all types – interior and exterior – the goals of energy conservation will be met.

As for utility incentive programs that reward tight building exteriors, the builder may have to do a whole-building test at the end, but this is a much less worrisome prospect if many smaller tests have been done all along. Alternatively, some attempts have been made to find links between single-unit, guarded, and whole-building blower door test data, and to arrive at "factors" for converting results from single-unit tests to exterior leakage figures that are more useful to energy models. This is as complicated as it sounds, and the best summary of that research is that more research is needed (Faakye, Arena, and Griffiths 2013). One might argue for an alternative compliance option in the code that allows whole-building testing. But compartmentalization is a valuable goal in itself, and whole-building and guarded blower door tests do not take it into account.

Voluminous research indicates the benefits of more airtight apartments. Compartmentalized units are safer in a fire because they reduce transfer of smoke and hot gasses between units. They are healthier because they reduce the transfer of second-hand smoke, odors, and other pollutants between neighbors and attached garages. They are more comfortable because they help to reduce drafts and cold complaints, and reduce sound transfer between units. They offer better control of heating, cooling, and ventilation because uncontrolled air movement is minimized. They also reduce pathways for bugs and vermin to travel between units. Guarded blower door testing and whole-building leakage testing, while they are better at quantifying energy benefits of a tight exterior, turn a blind eye to these benefits.

Part of the impetus for moving in this direction was years of research into ventilation, airflows, and compartmentalization. Because multifamily buildings have complex networks of inter-space airflow, controlling the many pathways becomes very important to ensuring that the air that enters a unit is from a clean, healthy source. It turns out to be extremely hard to get fresh air into apartments when and where you want it if you don't have substantially airtight apartments. According to research from SWA and others, exhaust-only ventilation, the most common design in multifamily buildings, often draws more air from other apartments than it does from fresh sources such as vents in the window or HVAC.

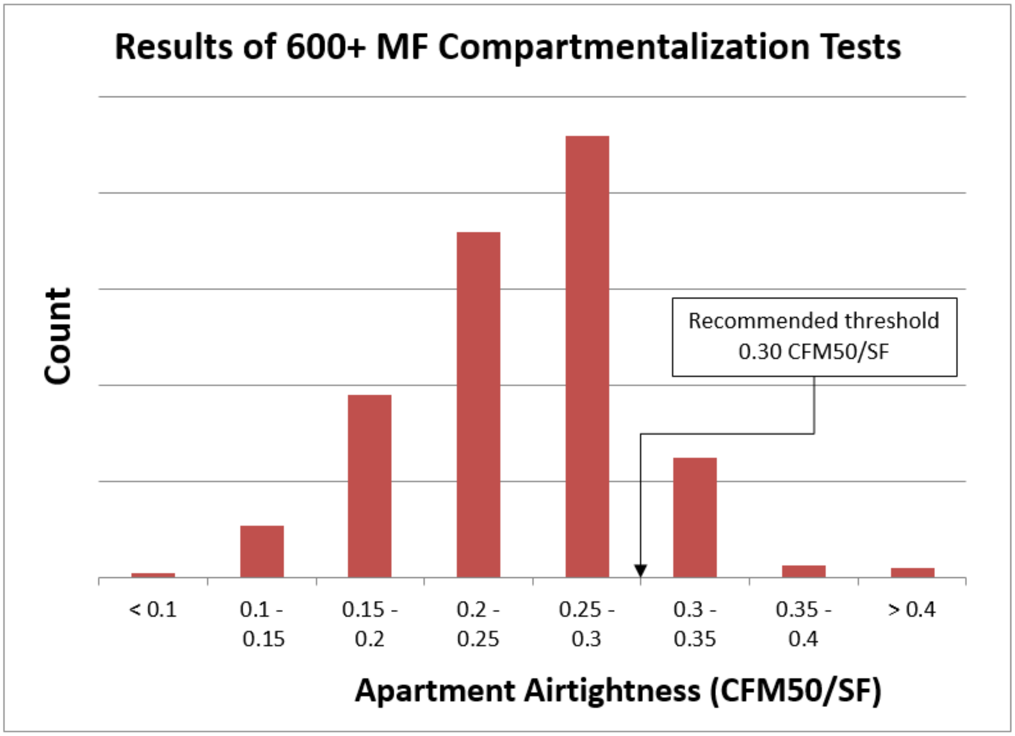
Compartmentalization testing leads the building industry in the right direction. It fosters a natural alliance between fire safety, health, and energy conservation professionals that other test methods may not. It is easy to explain and understand even for someone who has never seen a blower door, and the immediate benefits are apparent to builders, residents, and landlords alike. It also takes the building industry as a whole in a progressive direction by actually quantifying compliance with requirements for unit separation. Currently, enforcement of unit fire-stopping requirements currently relies on visual inspections by code officials, so compliance is in practice somewhat subjective. Testing with a blower door backs that assessment up with a real number that is easy to verify with another test.

It is easy to imagine next steps from here. One obvious step is to require blower door testing of apartments in larger residentially-classified commercial buildings. It is also possible to look forward a decade to when compartmentalization of other major spaces – boiler rooms, trash rooms, and even separate leases in commercial buildings – is verified with a blower door. Who would not like to verify that a boiler room is isolated from the rest of a large building? A quick test with a blower door will do that. This is the direction the industry should go.

Defining an appropriate building code requirement for compartmentalization testing

After reviewing the advantages of compartmentalization testing over other methods, let us review some reasonable language to be considered by codes councils considering its adoption. The language that SWA recommended to the NY Codes Council is largely aligned with language from ASHRAE 62.2-2013, LEED BD+C: Multifamily Midrise, and the EPA's ENERGY STAR® Multifamily High Rise program, which call for a maximum leakage rate of 0.30 cubic feet of leakage per minute at 50 Pascals per square foot of apartment envelope area (0.3 CFM50/SF), which includes the floors, ceilings, and interior and exterior walls of an apartment.

How appropriate is this threshold? Steven Winter Associates maintains a database of multifamily blower door tests that it has conducted over the past five years in the course of certifying thousands of units of green and high-performance housing in New York State, and it shows that this threshold is generally achievable. Figure 3 shows graphically the results of over 600 of these tests. In the database, 88% of units tested in the SWA portfolio meet 0.30 CFM50/SF. While most of the projects participated in some sort of utility program that required compartmentalization, it clearly shows that the threshold is within reach for builders that make an effort.



The changes to the 2015 IECC for New York State's Energy Code were conceived by Steven Winter Associates, Inc., a consulting and research company with offices in New York, Connecticut, and Washington, D.C. The proposal gained the support of many in the building science industry, including the following who signed a letter of support:

James P. Stahl Jr., Specified Technologies Inc. – fire protection expert

Armin Rudd, Principal, ABT Systems LLC – recognized expert in multifamily housing research, member of ASHRAE 62.2 Envelopes Subcommittee, expert in code issues surrounding fire-stopping

Paul W. Francisco, Director, Univ. Illinois Weatherization Training Center – expert in indoor air quality research and a member of ASHRAE 62.2 Envelopes Subcommittee

Terry Brennan, Camroden Associates – expert in building testing and indoor environmental quality; member of ASHRAE 62.2 committee

Richard Leigh, Director of Research, Urban Green Council – leader in green building industry research in New York State for U.S. Green Building Council's New York Chapter

Asa Foss, Director Residential Technical Solutions, U.S. Green Building Council – expert in technical issues for U.S. Green Building Council's Leadership in Energy and Environmental Design

Ellen Tohn, Principal and Founder, Tohn Environmental Strategies – recognized expert in indoor environmental quality research.

Gary Nelson, The Energy Conservatory – inventor of the Minneapolis Blower Door, the widest-selling blower door kit in the United States and a recognized expert in infiltration testing.

Sean Maxwell, Senior Energy Consultant, Steven Winter Associates – lead researcher on several studies of building compartmentalization and ventilation performance for DOE Building America

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LEED: Homes Design and Construction. Version 4. Prerequisite 7. Compartmentalization.

Faakye, L. Arena, D. Griffiths (2013). "Predicting Envelope Leakage in Attached Dwellings." July 2013. Washington, DC; Building America Building Technologies Program, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. http://www.nrel.gov/docs/fy13osti/58669.pdf (http://www.nrel.gov/docs/fy13osti/58669.pdf)

RESNET Sampling Standard.

http://www.resnet.us/rater/Sampling_Standard.pdf (http://www.resnet.us/rater/Sampling_Standard.pdf)

Cost Impact: Will not increase the cost of construction

Cost Comparison

The proposed changes would result in a net cost savings to the construction industry. The reason is that the test methods are simpler, faster, and can be done by a much wider segment of the industry. In many cases, single-unit tests are less expensive than whole-building tests because they require significantly less equipment and fewer personnel. The above mentioned September 2011 article in Home Energy by Don Hynek, a very experienced multifamily professional, gives an example of a whole-building test of a 50-unit building that used five blower doors and six technicians at a cost of about $6,000, or $120 per apartment. Single-unit testing may only cost less than whole-building testing if sampling protocols are used. Defined and carried out correctly, these can be effective and cost-saving. Based on concepts from RESNET's Sampling Standard, SWA recommended a minimum sampling rate of one in seven units after an initial round of successful tests.

Figure 2 below illustrate cost estimates for testing buildings in a mature market with experienced technicians. A cost comparison between whole-building testing and single-unit testing is made, for multifamily buildings with interior-entry (shared hallway) layout and for townhome configuration. The number of man-hours is estimated for a range of building sizes, and a typical cost for a blower door technician of $90 per hour is assumed. A mobilization cost of $200 per blower door per day to account for transportation and setup of equipment is included as well. By these estimates, the cost for testing is lower when using single-unit tests, possibly less than half the cost of whole-building tests for buildings of equivalent size. Of course these are only theoretical figures and vary greatly from project to project, and you are encouraged to make your own estimates.

Costs for Testing Interior-Entry (Shared Hallway) Multifamily Buildings								
	Tested by Whole-Building Test				Tested by Compartmentalization Test (sampling used)			
Units	Man-hours	# of Blower Doors Required	Cost @ $90/hour plus mobilization	Cost per Apt	Man-hours	# of Blower Doors Required	Cost @ $90/hour plus mobilization	Cost per Apt
10	8	2	$1,120	$112	6	1	$740	$74
25	16	4	$2,240	$90	8	1	$875	$35
50	32	8	$4,480	$90	11	1	$1,413	$28
75	44	11	$6,160	$82	14	1	$1,683	$22
100	60	15	$8,400	$84	17	1	$2,153	$22

Costs for Testing Multiple-Entry (Townhouse) Multifamily Buildings								
	Tested by Whole-Building Test				Tested by Compartmentalization Test (sampling used)			
Units	Man-hours	# of Blower Doors Required	Cost @ $90/hour plus mobilization	Cost per Apt	Man-hours	# of Blower Doors Required	Cost @ $90/hour plus mobilization	Cost per Apt
3	6	3	$1,140	$380	3	1	$470	$157
4	8	4	$1,520	$380	4	1	$560	$140
5	10	4	$1,700	$340	5	1	$650	$130
6	12	4	$1,880	$313	6	1	$740	$123
7	14	4	$2,060	$294	7	1	$830	$119
8	16	4	$2,240	$280	8	1	$920	$115

RE56-16 : R402.4 (NEW)-MAXWELL9968

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The standards indicated are not correct for residential buildings. The re is confusion about what size buildings this applies to. There needs to be a better definition of zones.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Sean Maxwell, Efficiency Matrix, representing Efficiency Matrix (sean@efficiencymatrix.com); Gayathri Vijayakumar, Steven Winter Associates, Inc. (gayathri@swinter.com); Asa Foss, representing US Green Building Council (afoss@usgbc.org); Steven Rocklin, representing T.Y. LIN International (steven.rocklin@tylin.com); Michelle Tinner, n/a, representing self; Joseph Hill, representing NYSDOS (Joseph.Hill@dos.ny.gov); Colin Genge, representing Retrotec Inc. (colin@retrotec.com); Kohta Ueno, representing Building Science Corporation (kohta@buildingscience.com); Steven Winter, Steven Winter Associates, Inc., representing Steven Winter Associates, Inc. (sw@swinter.com); Steven Rocklin, T.Y. Lin International (srocklin@nycap.rr.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4.1.2 ~~(N1102.4.1.2)~~ 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 Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. During testing:

1. Exterior windows and doors, 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~~ inlets or outlets 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

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 provided to the code official. The written report shall include:

1. The name and place of the business of the party conducting the test.
2. The address of the building which was tested.
3. The floor area of the conditioned space of the dwelling unit.
4. The measured air leakage rate at 0.2 inches w.g. (50 Pascals) of each testing unit.
5. The date or dates of the test.
6. A certification by the party conducting the test, indicating the accuracy of the test results.
7. The signature of the party who conducted the test.

R402.4.1.2.1 ~~(N1102.4.1.2.1)~~ Alternative testing procedure for buildings with ~~two~~ three or more dwelling units within the building thermal envelope. Where ~~two~~ three or more dwelling units are ~~located~~ contained within one contiguous building unit, within a single building thermal envelope, the following procedure shall be an alternative to testing in accordance with Section R402.4.1.2:

For purposes of testing, the following spaces and areas are defined:

1. Each ~~dwelling unit including each occupiable conditioned space other than a~~ dwelling unit within the building thermal envelope shall be considered a testing unit.

2. The enclosure surface area of a testing unit shall be the sum of the areas of all of the following:
   1. Each exterior wall of the testing unit
   2. Each interior wall of the testing unit that abuts another testing unit or units,
   3. Each ceiling of the testing unit that abuts another testing unit or units, or abuts unconditioned space.
   4. Each floor in the testing unit that abuts another testing unit or units, or abuts unconditioned space.

3. The conditioned-space floor area of a dwelling unit shall ~~be~~ calculated in accordance with ~~BOMA Z65.1 or BOMA Z765.1, as applicable~~ any nationally recognized standard for systematic measurement of multi-unit residential buildings. Where ~~either of these standards exclude~~ the standard excludes floor areas having a ceiling height of less than 5 feet (1524 mm), such floor areas shall be included in the calculation of conditioned-space floor area.

Each testing unit shall be tested ~~to verify that the~~ and verified as having an air leakage rate ~~does~~ not ~~exceed~~ exceeding 0.3 cubic feet per minute per square foot of the enclosure surface area of the testing unit in Climate Zones 1 through 8. Testing shall be conducted in accordance with ASTM E779 or ASTM E1827 using a blower door. Test results shall be reported at a pressure of 0.2 inches w.g. (50 Pascals). Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weather-stripping 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~~ inlets or outlets 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

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 prepared and provided to the code official. The report shall include all of the following:

1. The name and place of the business of the party conducting the test.
2. The address of the building and dwelling unit numbers which were tested.

3. The conditioned-space floor area of each testing unit.
4. The air leakage rate at 0.2 inches w.g. (50 Pascals) of each testing unit.
5. The date or dates of the testing.
6. A certification by the party conducting the tests which indicates the accuracy of the test results.
7. The signature of the party who conducted the tests.

R402.4.1.2.1.1 ~~(N1102.4.1.2.1.1)~~ Alternative testing ~~procedure~~ protocol for buildings with more than seven dwelling units. Where there are more than seven dwelling units within a *building thermal envelope,* and where approved by the code official, the following shall be an alternative to the testing of all dwelling units in accordance Section R402.4.1.2.1*:*

1. ~~Sample sets of not more than seven testing units shall be determined. Each sample set shall include one or more occupiable common conditioned space, other than dwelling units. Each sample set shall be representative of all types of dwelling units and occupiable common conditioned spaces other than dwelling units, within the building thermal envelope.~~
1. Sample sets of not more than seven testing units shall be determined. Each sample set shall be representative of all types of dwelling units within the building thermal envelope.
2. All testing units in the first sample set shall be tested to verify that the air leakage rate does not exceed 0.3 cubic feet per minute per square foot of enclosure surface area of the testing unit, Where all testing units of the first sample set tested do not exceed the leakage rate maximum, only one testing unit of each sample set tested thereafter shall be required to be tested. Where any subsequent test exceeds the air leakage rate maximum, additional testing shall be required in accordance with the following procedure:
    2.1. Two additional testing units in the same sample set shall be tested. Where either of those additional testing units fail to comply, the remaining untested testing units in the sample set shall be tested. For testing of the next sample set, all of the testing units in the set shall be tested.
    2.2. Where all of testing units of the next sample set tested do not exceed the leakage rate maximum, and where the code official approves a reduction in the number of units to be tested in future sample set testing, the testing procedure shall reset to that in Item 2.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

Commenter's Reason: 2015 IECC requires that buildings or dwelling units be tested for air leakage, less than 3 or 5 ACH50, depending on climate zone. In a multifamily building, there is a choice to test the building or the dwelling unit. Unit-level testing provides an alternative that is lower cost than whole-building testing and has added indoor air quality and health benefits, since surfaces shared with adjacent dwelling units are included in the test. In a whole-building test, air leakage between units is not tested. It is important to note that this proposed language is similar to the language adopted by the 2016 Supplement to the New York State Energy Code and has the support of various national multifamily program administrators interested in the inherent value in testing air leakage of dwelling units.
The original RE56-16 proposal introduced an alternative metric and threshold (0.30 CFM50/ft2) as an option for testing the dwelling units of multifamily buildings. This surface area-based metric is used by other programs, like LEED and ENERGY STAR, and standards like ASHRAE 62.2-2013, to evaluate the air leakage of individual units, rather than buildings. The test procedure remains the same, but the metric refers to the air leakage of a dwelling unit enclosure, not the building enclosure.

The original RE56-16 proposal introduced language that was meant to clarify the definition of the envelope area of a dwelling unit when calculating the leakage of that unit. It also introduced language for sampling of units for testing, as this is a reliable method to minimize costs. A definition of a sampling procedure is necessary as there are often questions related to the number of dwelling units that must be individually tested in a multifamily building to demonstrate code compliance.

The proposed language allows testing that has an additional benefit relating to sound transmission between units. The IRC (Appendix K) and IBC (1207) sections on Sound Transmission specifically call for sealing of penetrations. Unlike testing building air leakage, testing dwelling unit air leakage would actually help confirm that the sealing required for the sound transmission portions of the code has been completed.

In response to Committee Comment, "The standards indicated are not correct for residential buildings":

The standards originally stated by the proposal were not directly intended for residential buildings. These are ANSI/BOMA Z65.1-1996 , which is written for office buildings; and ANSI/BOMA Z765.1-2003 which is intended for measurement of single family dwelling and townhouse measurement. Neither of these standards are directed at multiple family dwelling units, which IS the intent of the code proposal. There is a standard measurement of multifamily buildings, ANSI/BOMA Z65.4-2010, but this standard is new to the IECC so cannot be included in the Public Comment phase of the process. A general reference to a measurement standard is made instead.

In response to Committee Comment, "There is confusion about what size buildings this code change will apply to":

The language referring to which spaces within a building are subject to testing and the number of units was confusing. The proposal should apply to buildings with three or more units. This avoids confusion regarding application of the IRC, which deals with one and two family dwelling units. The proposed language describes the intended application better, and is more specific about the size of buildings which are affected by the proposal.

In response to Committee Comment, "There needs to be a better definition of zones":

This comment likely refers to climate zones to which this proposeal would apply. It is intended for all climate zones. The basis of this proposed code change is utilized in three published Standards, which are ENERGY STAR MFHR, LEED for Homes Midrise, and ASHRAE 62.2-2013. Each of these standards have very similar air leakage requirements which do not vary based on Climate Design Zone. The ENERGY STAR MFHR compartmentalization requirement is: "A maximum air leakage rate of 0.30 CFM50 per square foot of enclosure is allowed." LEED for Homes Midrise has a mandatory requirement that matches the ENERGY STAR MFHR compartmentalization requirement. ASHRAE 62.2-2013 orginally required 0.2 CFM50 per ft2 of the dwelling unit envelope area, but in Addenda D to ASHRAE 62.2-2013, they increased that requirement to 0.3 CFM50, with this explanation "This change accounts for recent data showing what level of air sealing between units is reasonably achievable in new multifamily construction, while still providing reasonable protection from contaminants orginating in neighboring units."

The following organizations have expressed their support for this proposal:

New York State Department of State, Division of Building Standards and Codes

New York State Energy Research and Development Authority (NYSERDA) Low-rise Residential and Multifamily New Construction Programs

US Green Building Council

T.Y. Lin International

Efficiency Matrix

The Energy Conservatory

Steven Winter Associates

Analysis: The strike out of the "N11XX.XX" section numbers of each section of this public comment indicates that the sections will not be included in Chapter 11 of the International Residential Code.

Proponent : Robb Aldrich, representing Steven Winter Associates (raldrich@swinter.com) requests Approve as Submitted.

Commenter's Reason: Mandating compartmentalization can provide substantial comfort, IAQ, and energy benefits above and beyond whole-building air tightness. Testing and verification of compartmentalization is also much more practical and affordable than whole building tests.

Proponent : John Brochu, representing self requests Approve as Submitted.

Commenter's Reason: Hello,
I can speak to the benefits of a compartmentalization test of a single unit rather than running a guarded or whole-building test. In addition to reducing stack effect, noise and odor pollution, there are many staging issues that are easily resolved by testing for compartmentalization of a unit rather than waiting until the end of a project to test the exterior wall only. As someone who conducts compartmentalization tests almost daily, I'd confirm that the writer identifies some real challenges and that come with running this test, primarily being the alignment of performance tests with construction schedules that allow for actual improvements to be made. Since these tests are <u>meaningless</u> unless we can properly correct identified probelms we must allow for testing in a way that will allow for improvements that are cost effective, actually effective (in stopping leaks), and that enable buildings and contractors.

In nearly every project (new or rehab) where air sealing is an afterthough or for whatever reason is not addressed starting at pre-drywall and continuously throughout construction, leakage in demising <u>and exterior walls</u> are a really big problem. Here are some reasons why.

Penetrations are inevitably located behind mechanical systems and in corners that are impossible to reach once construction is substantially complete. This leads to.

- Project construction teams re-entering a clean finished space and desperately trying to apply whatever type of sealant possible.
- Significant waste of sealant material. Since the product cannot be easily applied, contractors typically will inefficiently use

a foam can (or four) on a fairly small area in need of sealing, as they awkwardly try to reach around a mechanical system to reach a leak.
- Sloppy application of a product will ultimately lead to gaps with dried foam or caulking in place and the air leak still not stopped.

This is a great recipe for wasted man-hours, sealing product, less then ideal sealing, and headaches without failure at every project. If encouraged to find air leaks throughout construction, sealing can be done quickly, cheaply, and most importantly, effectively.

The writer points out some ways which compartmentalization of a single unit is a much more user friendly approach. Not only can several "progress" tests be done, but as more and more builders opt to purchase their own blower door kits, this provides a truly effective tool for contractors to use every day, rather than waiting for a third-party team to arrive with the equipment. I can speak from experience that teams I work with that invest in this equipment build better buildings and are happy to take much of the unknown out of what is an already challenging process.

I've found it only takes one time where contractors have to tear out the ceiling of a nicely finished apartment in search of some leaky hole before they're ready to purchase a blower door and do whatever sealing is needed at all stages in order to prevent failing leakage tests.

In summary, I think we need to allow for processes that are as user-friendly (or builder-friendly) as possible to allow for these problems to be easily and effectively resolved. Given the time and budget crunch that is inevitable on all contruction projects we cannot wait until the end of a project to run our first blower door tests. The best, if not only, way to achive the highest quality building with the best testing performance results is to fully integrate the builder and trades into this process and enable them to address building leakage step-by-step. The only thing worse than creating needelessly cumberesome testing proceedures is to set ourselves up to not be able to address problems when we find them!

Proponent : Steve Klocke, representing self (sklocke@swinter.com) requests Approve as Submitted.

Commenter's Reason: I am writing to voice my support for Sean Maxwell's proposal supporting compartmentalization testing (0.30 CFM50/ft2) as an alternative to the 3 ACH50 test. I have inspected and tested hundreds of multifamily units, and my experience is consistent with the justifications for compartmentalization listed in Mr. Maxwell's proposal. Thank you for your consideration.

Proponent : MAUREEN MAHLE, representing Self (MMAHLE@SWINTER.COM) requests Approve as Submitted.

Commenter's Reason: Compartmentalization testing will be instrumental in accurately and fairly assessing attached homes and multifamily dwellings. This approach has been well-vetted in high performance building programs including LEED for Homes, LEED for Homes Multifamily Midrise, ENERGY STAR Homes, ENERGY STAR Multifamily Midrise, and Passive House Institute US.

Bibliography: Maureen Mahle has certified over 8,000 units of high performance housing under the LEED rating system.

Proponent : Carmel Pratt, representing self requests Approve as Submitted.

Commenter's Reason: By allowing this test, the same goals of energy efficiency will be met with additional benefits like improved indoor air quality, ventilation, and fire resistance, reduced transmission of toxins, sounds, and pests, as well as aligning with language from ASHRAE 62.2-2013 and various high performance building rating systems. New York State has already adopted similar language to IECC 2015 and many building science professionals endorse this proposal.

Proponent : Gayathri Vijayakumar, Steven Winter Associates, Inc., representing self (gayathri@swinter.com) requests Approve as Submitted.

Commenter's Reason: I agree that multifamily buildings, subject to residential code, should have an alternative testing option. While some may choose to conduct a whole building test and meet the 3 ACH50, compartmentalization testing is very valuable for reasons beyond energy efficiency and is required by multiple high performance multifamily building programs. Code should support that by offering this alternative test procedure.

RE58-16

R402.4 (IRC N1102.4), R402.4.1.1 (IRC N1102.4.1.1), R402.4.1.2 (IRC N1102.4.1.2), R402.4.1.3 (New) [IRC N1102.4.1.3 (New)], R402.4.1.4 (New) [IRC N1102.4.1.4 (New)]

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

R402.4 (N1102.4) Air leakage ~~(Mandatory).~~ *No change to text.*

R402.4.1.1 (N1102.4.1.1) Installation (Mandatory). *No change to text.*

R402.4.1.2 (N1102.4.1.2) Testing (Mandatory). 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 Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8.~~ Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Add new text as follows:

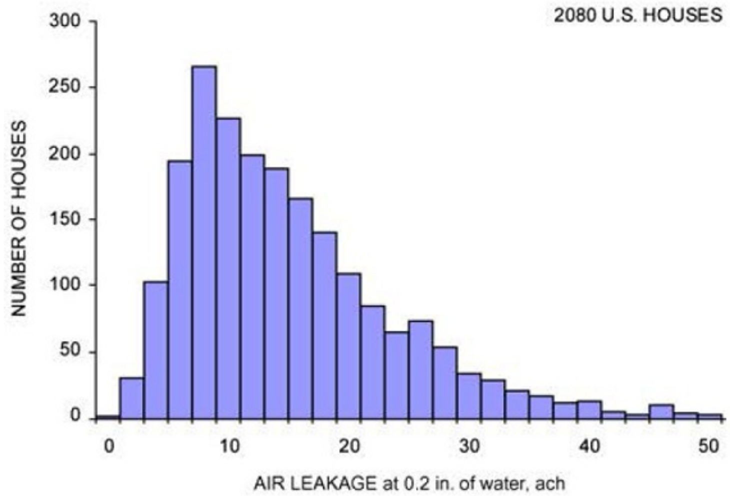
R402.4.1.3 (N1102.4.1.3) Maximum Air Leakage Rate (Mandatory) The maximum Air Leakage permitted using the Performance Alternative from Section R405 shall be 6 ACH in Climate Zones 1 and 2, and 5 ACH in Climate Zones 3 through 8 when tested in accordance with Section R402.4.1.2.

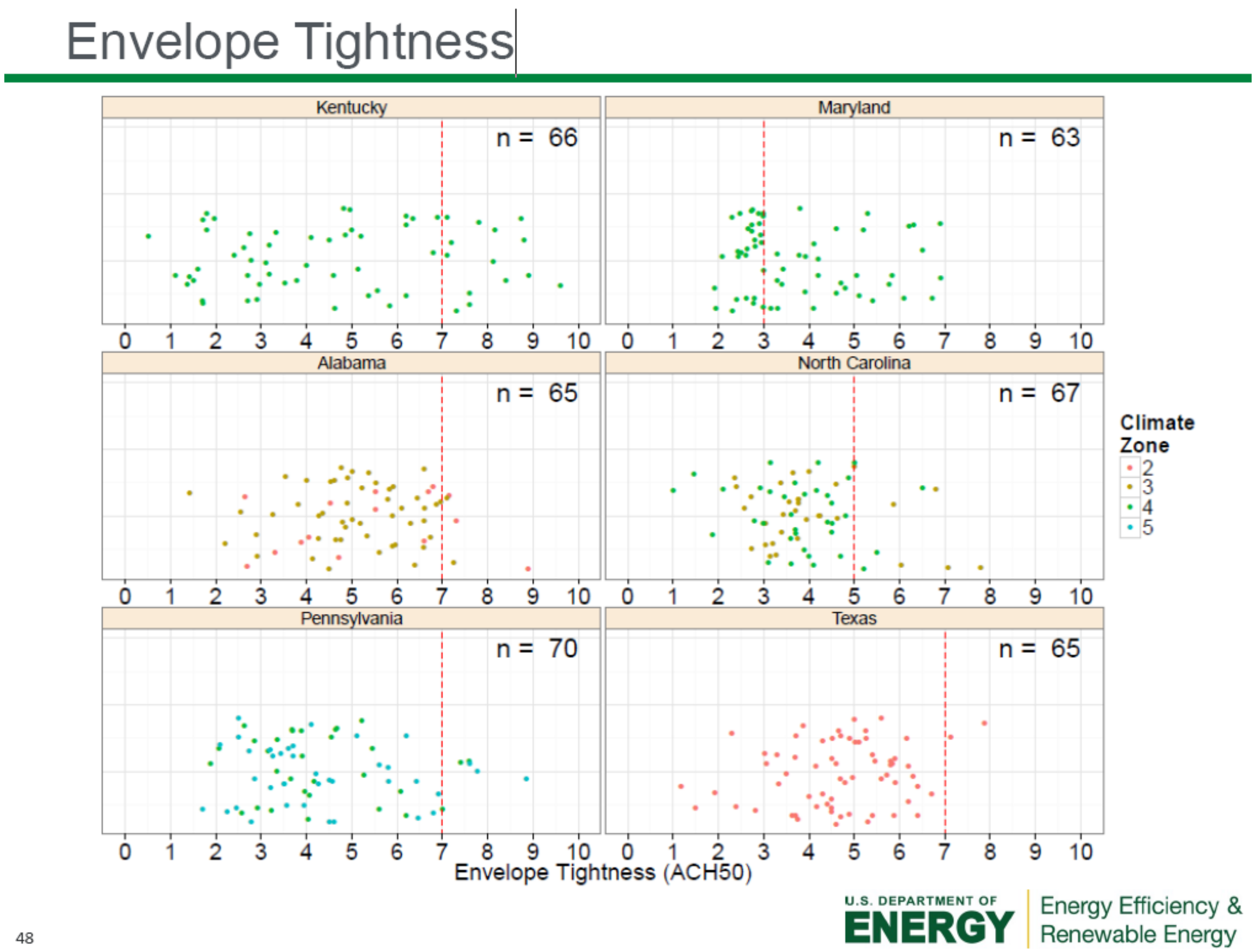
R402.4.1.4 (N1102.4.1.4) Leakage Rate (Prescriptive) The building or dwelling unit shall have an air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

Reason: These modifications remove the mandatory maximum air-tightness requirement and provide designers and builders the flexibility to trade off building tightness with other performance path measures while also providing a limit to that flexibility. Currently the building tightness requirement is mandatory and the 3 and 5 ACH tightness levels, even under ideal circumstances, are very difficult to achieve. This will provide energy neutral tradeoffs for expensive and sometimes unattainable requirements with other building improvements. This proposal does not change the stringency or efficiency of the code; it only increases the flexibility.

DOE has verified that achieving 3 ACH50 is problematic, even in Maryland who has had a 3 ACH requirement for over 3 years (see chart below).

2013 ASHRAE Handbook—Fundamentals





Cost Impact: Will not increase the cost of construction

This performance option provides flexibility in meeting the air tightness requirements and would allow less expensive alternatives for recovering from an unexpected air tightness test failure.

RE58-16 : R402.4-SURRENA12449

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: A leakage limit of 3 ACH in small houses is problematic to achieve. The energy savings attained by 3 ACH is very small. A 5 ACH is not a problem to achieve. Flexibility is needed especially where party walls and spinklers are involved.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4 (N1102.4) 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 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1 ~~and R402.4.1.2~~ through R402.4.1.4. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.3 (N1102.4.1.3) Maximum Air Leakage Rate (Mandatory) The maximum Air Leakage permitted using the Performance Alternative from Section R405 shall be 6 ACH in Climate Zones 1 and 2, and 5 ACH in Climate Zones 3 through 8 when tested in accordance with Section R402.4.1.2.

Commenter's Reason: This proposal should be modified as proposed in this public comment. We believe that the current version is inadvertently technically flawed and must be corrected.

The original proposal adds two new subsections to section R402.4.1. However, the new subsections added by this code change are not included in the list of sections in the charging section (Section R402.4.1), which could lead some to believe that they are not required in all circumstances. This proposed modification corrects this omission, which we believe is inadvertent. It is possible that these issues could be addressed by ICC staff editorially, but we believe it is important that they be fixed so we have submitted this public comment for a modification.

Public Comment 2:

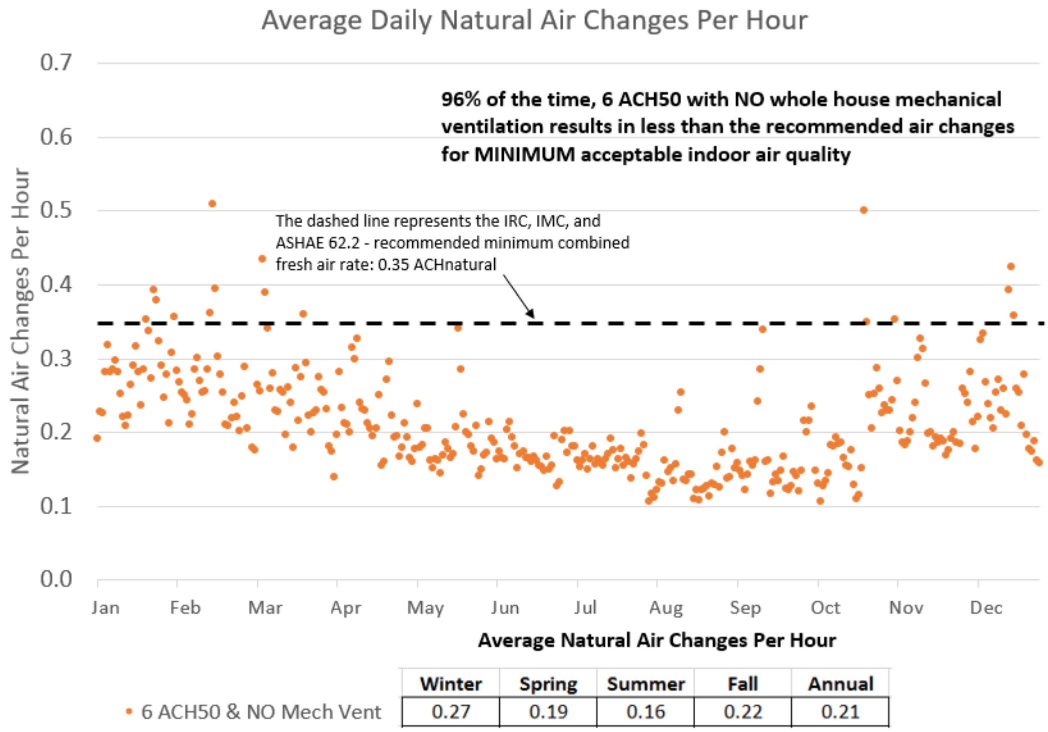
Proponent : Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Residential Code

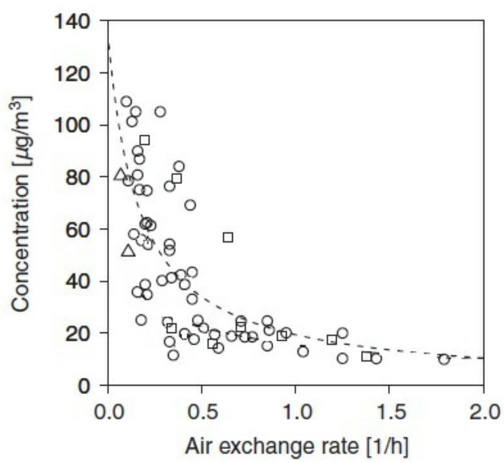
R303.4 Mechanical ventilation. Where ~~the~~ a dwelling unit's thermal envelope is constructed to limit air ~~infiltration rate of a *dwelling unit* is 5 air changes per hour or less where tested with a blower door at a pressure of 0.2 inch w.c (50 Pa)~~ leakage in accordance with Section ~~N1102.4.1.2~~ N1102.4, the *dwelling unit* shall be provided with whole-house mechanical ventilation in accordance with Section M1507.3.

Commenter's Reason: Since 2012, the air tightness requirements of the IECC and the mechanical ventilation requirements of the IRC have been aligned, ensuring that all dwelling units that are air sealed in accordance with N1102.4 are also provided with whole house mechanical ventilation for MINIMUM acceptable indoor air quality. As submitted, RE58 will sever this link by still requiring dwelling units to be built very tight (i.e., 6 ACH50 or tighter), but not ensuring that these tightly built dwelling units are provided with whole house mechanical ventilation. Without whole house mechanical ventilation, homes with leakage rates of 6 ACH50 will fall far short of the natural air changes historically supported by the IRC, IMC, and ASHRAE 62.2 for providing MINIMUM acceptable indoor air quality. Following is a graph that illustrates the daily fresh air changes that can be expected for a typical 2,600 square foot, single family home in a climate zone 2 location (i.e., much of Texas, Florida, and the Gulf Coast states) with an air tightness of 6 ACH50. The chart was created using U.S. DOE's EnergyPlus software and shows that 96% of the time, occupants are not expected to experience MINIMUM acceptable indoor air quality.



This modification to RE58 ensures that builders get a break with respect to meeting the stringent blower door test, but not at the cost of poor indoor air quality and the associated risk to public health.

Finally, following is a graph that shows the increase in formaldehyde levels in new homes from a study of actual homes conducted by Lawrence Berkeley National Laboratory (Hult et. al). When the fresh air exchange rate falls below the historically-targeted 0.35 air changes per hour, formaldehyde concentrations are seen to spike significantly, exceeding recommended exposure limits and placing the occupants' health at risk. Approval of RE58 as modified by this public comment would ensure that occupants have the primary tool necessary to reduce exposure to such harmful pollutants (i.e., a whole-house mechanical ventilation system).



Bibliography: Hult EL, Willem H, Price PN, Hotchi T, Russell ML, and Singer BC. 2015. Formaldehyde and acetaldehyde exposure mitigation in US residences: in-home measurements of ventilation control and source control. Indoor Air 25:523-535.

Analysis: The Section R303.4 in this Public Comment is located in the International Residential Code.

Proponent : Jeremy Field, representing Building Efficiency Resources requests Disapprove.

Commenter's Reason: Nearly every other code proposal to weaken the energy code has been disapproved. There is no reason to accept this proposal. The failure to achieve a modest level of air tightness at 3 or 5 ACH50 that has been a Mandatory measure in the code for 2 cycles has more to do with poor planning and execution than cost. The failure by production builders to meet this Mandatory rate has more to do with poor previous expectations of attentoin to detail and supervision of subcontractors who were used to haphazardly making holes throughout the building envelope with no consequences.

It could be argued that previously going from 7 ACH50 to 3 ACH50 was a mistake, and that a proposal such as this may have been a more rational step back in the 2012 energy code cycle, but now we are 6 years and 2 codes past this requirement going into effect. Most builders who were not previously able to meet this threshold are now able to at minimum additional cost. Greater attention to subs poking holes in the house and superior building products becoming more widely available and utiliized by home builders makes this rollback entirely unnecessary.

Furthermore, by rolling back this provision, there will now be a new unintended consequence of making the Performance code substantially easier to meet; whereas the Performance code already allowed signficiant tradeoffs in envelope performance such that code climate builders are still able to achieve compliance with 2x4 R-15 walls, weakening this provision will have a significant effect in weakening the Performance code which already allows for signficiantly reductions in stringency of building performance compared to the Prescriptive code.

With a growing interest and execution of Passive House levels of air tightness at 0.5-1 ACH50, there is simply no reason why home builders need a weaker code that allows them to build homes that are 5-10 leakier in 2018.

RE58-16

RE60-16

R402.4 , R402.4.1, R402.4.1.1, R402.4.1.2, R402.4.1.3 (New), R402.4.2, R402.4.3, R402.4.4, R402.4.5 (IRC: N1102.4 ,N1102.4.1, N1102.4.1.1, N1102.4.1.2, N1102.4.1.3 (New), N1102.4.2, N1102.4.3, N1102.4.4, N1102.4.5)

Proposed Change as Submitted

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

R402.4 (N1102.4) Air leakage ~~(Mandatory)~~. *No change to text.*

R402.4.1 (N1102.4.1) Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1, R402.4.1.2, and ~~R402.4.1.2~~ R402.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 (N1102.4.1.1) Installation (Mandatory). *No change to text.*

R402.4.1.2 (N1102.4.1.2) Testing (Mandatory). The building or dwelling unit shall be tested ~~and verified as having an~~ to determine envelope air leakage ~~rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8~~. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Add new text as follows:

R402.4.1.3 (N1102.4.1.3) Envelope air leakage (Prescriptive) Envelope air leakage, when tested in accordance with Section R402.4.1.2, shall not exceed 5.0 air changes per hour in Climate Zones 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8.

Revise as follows:

R402.4.2 (N1102.4.2) Fireplaces (Mandatory). *No change to text.*

R402.4.3 (N1102.4.3) Fenestration air leakage (Mandatory). Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m^2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m^2), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and *listed* and *labeled* by the manufacturer.

Exception: Site-built windows, skylights and doors.

R402.4.4 (N1102.4.4) Rooms containing fuel-burning appliances (Mandatory). 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, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than 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 a minimum of 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*.

R402.4.5 (N1102.4.5) Recessed lighting (Mandatory). Recessed luminaires installed in the *building thermal ~~envelope~~* envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

Reason: This proposal increases flexibility by giving builders compliance options for homes with higher envelope air leakage. Because the existing air leakage requirements are mandatory, builders have limited recourse if a finished home fails to meet the required leakage level. By allowing air leakage to be traded off through the performance path, builders have the option of improving other envelope elements to offset higher air leakage, or simply hedging against failed leakage tests by implementing modest improvements elsewhere in the home.

Energy Savings: The proposal is designed to be energy neutral.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC (https://www.energycodes.gov/development/2018IECC).

Cost Impact: Will not increase the cost of construction
Because tradeoffs with air leakage are optional, there is no direct cost impact.
Cost-effectiveness: This change is cost-effective in that it is expected to provide neutral energy impact, and is optional.

RE60-16 : R402.4-WILLIAMS12243

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This topic was already addressed by RE58-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4.1.4 Envelope air leakage (Mandatory) Envelope air leakage, when tested in accordance with Section R402.4.1.2, and used in Section R405 or R406, shall not exceed 6.0 air changes per hour in Climate Zones 1 and 2, and 5.0 air changes per hour in Climate Zones 3 through 8.

Commenter's Reason: RE60-16 was disapproved in deference to another similar proposal (RE58-16). This public comment modifies RE60-16 to include mandatory trade-off limits on envelope air leakage when using the Simulated Performance Alternative (R405) or Energy Rating Index Compliance Alternative (R406). These mandatory limits are consistent with those approved by the Committee in RE58-16.

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Submitted.

Commenter's Reason: RE60-16 was disapproved in deference to another similar proposal (RE58-16). DOE stands on its original Reason statement for RE60-16.

RE60-16

RE63-16

Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Howard Ahern, representing self (howarda58@msn.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	<u>Expanding foam shall not be used to seal penetrations of the air barrier by refrigerant piping</u>
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: Vibration problems of refrigerant piping is well known and is addressed in the International Mechanical Code but not for sealing of these penetrations .The Department of Energy recommends using only in non -friction areas, as material can become dry and powdery over time. Constant friction from vibration of the refrigerant piping will degrade and destroy the foam producing leakage and for this application it should not be used for a sustainable sealing method for this type of penetration. There are plenty of other materials and methods already being used for this application such as a variety of caulking, sealing, and gaskets materials. Polyurethane, expandable spray foam is a great product for sealing other pipe penetrations that do not vibrate or have vibration problems and this change applies only to the sealing of the refrigerant pipe penetrations.

Bibliography: Department of Energy
energy.gov

Caulking

http://www.energy.gov/energysaver/caulking

Cost Impact: Will not increase the cost of construction
Will not increase cost . There are plenty of other materials and methods already being used such as a variety of caulking, sealing, and gaskets materials. Will save cost associated with air leakage of refrigerant piping penetrations.

RE63-16 : TABLE R402.4.1.1-AHERN11653

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: A prohibition for sealing penetrations in an insulation installation column is not appropriate. The proposed language just says what to not do and not what to do.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Howard Ahern, representing Airex Mfg requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA

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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed. Sealing shall allow for expansion and contraction of dissimilar materials and mechanical vibration.	~~Expanding foam shall not be used to seal penetrations of the air barrier by refrigerant piping~~
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: Based on the Committees comments the language has been moved to the first column or "Air Barrier Criteria" and the language modified to "Sealing shall allow for expansion and contraction of dissimilar materials and mechanical vibration". CE08-16 with the same language for Air Barrier Construction in C402.5.1.1 "Sealing shall allow for expansion and contraction of dissimilar materials and mechanical vibration" was approved as modified by the Commercial Energy committee. The same language will harmonizes the sealing requirements and for both residential and commercial penetrations of the air barrier.

RE63-16

RE69-16

R202 (IRC N1101.6), Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) GENERAL DEFINITIONS

ADIABATIC.

A condition where there is assumed to be no gain or loss of energy across a building assembly.

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Common adiabatic walls, floors and ceilings	An air barrier shall be installed at the perimeter connections of these walls, floors and ceilings to the exterior or unconditioned space. Air barrier details described in Table R402.4.1.1 that are adjacent to these walls, floors and ceilings shall be installed and sealed.	The installation of any cavity insulation in these walls, floors and ceilings, for any purpose including that required for the fire resistance rating of the assembly, shall be to a grade 1 installation quality level.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: The primary reason attached housing is finding it difficult to achieve the air leakage requirements of the IECC is due to leakage associated with common adiabatic walls, floors, ceilings. These assemblies were removed from this table but they need attention. Research performed by IBACOS through the Building America Program has indicated that UL already allows solid air barrier material to be placed in the gap created in shaft wall assemblies. UL has indicated that air sealing is allowed as well. Treating common adiabatic walls, floors, ceilings just like any other assembly that is located to the exterior or to an unconditioned space ensures that air sealing and air barriers are installed when tubs, fireplaces, drop ceilings and other details are built adjacent to them.

The same principals of insulation installation are required when insulating common adiabatic walls, floors, ceilings. The insulation needs to fully fill the framed cavity and be split around any obstruction in the cavity. As there is a significant amount of exterior air flowing through these assemblies proper insulation techniques is needed from an efficiency perspective. In addition, sound flows and is retarded by the same air pockets that retard the flow of energy. Therefore the SDC rating of the assembly also requires proper installation of insulation.

Lastly, there continues to be a significant disconnect between fire code and energy code. Re-introducing this section to the code will continue to push the two groups toward a dialog and or Building America and other research organizations to figure out solutions to the issues these assemblies create.

Cost Impact: Will increase the cost of construction

Properly addressing common adiabatic assemblies will add to the cost of construction but will allow builders to successfully meet the air leakage requirements of the IECC. Currently air barrier and air sealing details are not being uniformly applied to common adiabatic assemblies. This proposal would require that be done so the cost associated with this would be for air barrier materials and labor. It is estimated that the cost would be in the $100-$500 range per unit.

RE69-16 : TABLE R402.4.1.1-SCHWARZ13046

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The language is not clear. This forces this building official and fire official to work together to come up with a solution (versus the code stating a requirement.) There are issues with rated wall assemblies and air sealing. Grade 1 insulation is not defined by the code. There is a second sentence in the middle column that is redundant with another part of the table.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R202 (N1101.6) General Definitions

ADIABATIC. A condition where there is assumed to be no gain or loss of energy across a building assembly that separates one adjacent dwelling unit's conditioned space from another adjacent dwelling unit's conditioned space.

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Common adiabatic walls, floors and ceilings	~~An air barrier shall be installed at the perimeter connections of these walls, floors and ceilings to the exterior or unconditioned space.~~ Fire blocking and air sealing shall be installed at a dwelling unit's perimeter connections of common adiabatic walls, floors, and ceilings, adjacent to other dwellings and between walls, floors, and ceilings separating one dwelling unit's conditioned space from another adjacent dwelling unit's conditioned space. Fire blocking and air sealing shall also be installed at a dwelling unit's walls, floors, and ceilings adjacent to the exterior and to unconditioned space. Air barrier details described in Table R402.4.1.1 that are adjacent to these walls, floors and ceilings shall be installed and sealed.	~~The installation of any cavity insulation in these walls, floors and ceilings, for any purpose including that required for the fire resistance rating of the assembly, shall be to a grade 1 installation quality level.~~ Common adiabatic walls, floors, and ceilings shall be insulated as required by the UL or SDC ratings and insulation shall be installed according to manufacturer's instructions within the framed cavity of the assembly.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committee was not able to hear the floor modification which increased confusion on the proposed code addition

The committee felt that the 2nd section in the air barrier table was redundant. "Air barrier details described in Table R402.4.1.1 that are adjacent to a common adiabatic wall, floors, and ceilings shall be installed and sealed against the adiabatic assembly." The reality is that most home builders do not understand that the adiabatic assembly, although adjacent to another unit, behaves more like an exterior wall than an interior wall. Therefore, it is important, in order to meet the air leakage requirements of the code, to treat the adiabatic assembly as an exterior wall and apply all the air barrier techniques of the table to the assembly. This sentence offers that guidance to ensure success.

All UL listings allow solid fire blocking material to be installed in the fire rated assembly. In a traditional shaft liner assembly an example of this would be installing 1" sheet rock in the gap between the fire rated two layers of gypsum and the interior stud wall held off the gypsum with a clip. UL has also stated that the two layers of gypsum is the fire rated assembly, and therefore the gaps between fire blocking and other members in the assembly can be sealed. The proposal has been updated to ensure that there is consistency between UL forelocking requirements ad air sealing requirements of the IECC.

RE69-16

RE70-16

Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	<u>Where required to install fire sprinkler systems outside the building thermal envelope, the insulation tenting shall be installed so as to limit the disruption to the integrity and continuity of the buildings thermal envelope.</u> - <u>Where possible, the fire sprinkler systems shall be installed inside the building thermal envelope to ensure that the integrity and continuity of the building's thermal envelope is maintained.</u>

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: There continues to be a significant disconnect between fire code and energy code. The current air barrier criterion for sprinkler installation is more of a recommendation than a fast requirement. Its goal is to promote a tighter building envelop while not superseding the fire code. In the same way the insulation criteria is designed to ensure that designers think more about the place of the fire suppression system and the possible alternative systems that are available. In addition, the proposal begins to allow some level of inspection of the quality of the installation of the insulation that is being installed around the sprinkler system. Currently, our experience is that the tenting installation is horrendous and there is little or nothing that can be done to address the situation. If nothing else this proposal will begin a dialogue that can continue for a three year cycle when maybe more impactful can be proposed.

Cost Impact: Will increase the cost of construction
There may be minimal cost implications associated with this proposal as some inspectors should be requiring re-installation of the tenting insulation based off of this language. Re-installation fees may be charged and re-inspections fees may occur.

RE70-16 : TABLE R402.4.1.1-SCHWARZ13042

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The language is unenforceable. This is a specific issue that does need to be addressed. Section R403.4.1 already requires protection of insulation.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA

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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	

Concealed sprinklers	When 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.	~~Where required to install fire sprinkler systems outside the building thermal envelope, the insulation tenting shall be installed so as to limit the disruption to the integrity and continuity of the buildings thermal envelope.~~ ~~Where possible, the fire sprinkler systems shall be installed inside the building thermal envelope to ensure that the integrity and continuity of the building's thermal envelope is maintained.~~ When fire sprinklers are installed in areas subject to freezing they shall be protected from freezing so as to maintain the integrity of the *Buildings Thermal Envelope.* Three methods for Insulating the fire sprinkler piping, so as to ensure that piping is on the conditioned space side of the insulation, shall be allowed. 1. Box in the sprinkler line, to move the thermal envelope around the sprinkler line, so the bottom edge of the box is uninsulated drywall adjacent to the conditioned space. Install insulation adjacent to the attic side air barrier of the box, in accordance with table R402.1.2 ceilings. 2. Place an insulation tent around the sprinkler line. The tent shall be installed so the gap created between the pipe and the conditioned space below is no wider than 6 times the diameter of the sprinkler line used. The tenting material shall come down and contact the air barrier of the ceiling below within the defined diameter distance and gaps in the insulation material shall be filled with loose fill attic insulation in accordance with table R402.1.2 ceilings. 3. Bring the sprinkler line completely within the buildings thermal envelope.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: As the committee stated the pervious language was unenforceable but the issue needs to be addressed. NFPA 13D offers some guidance but it also does not give the code official a code that can be inspected to. This language maintains the balance between ensuring that the fire sprinkler system will not freeze and the integrity of the buildings thermal envelope. It is based on sound concepts promoted by NFPA and now Code officials can look at the installation and say that the installation passes or fails.

http://buildingsciencetech.com/blog/?p=72

Sprinkler Insulation
A Literature Review
Brian Merrifield
Fire Protection Research Foundation
© July 2011

RE70-16

RE72-16

Table R402.4.1.1 (IRC N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.

Electrical/phone boxes on exterior walls	~~The~~ An air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	Spaces behind electrical/phone boxes on exterior walls shall be insulated or filled by insulation that on installation readily conforms to the available cavity space.
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: This proposal is made for clarification and to ensure a common understanding of the requirment to properly insulate behind electrical boxes.

Cost Impact: Will not increase the cost of construction
There is no cost implication associated with this proposal as the proposed language change clarifies what already is required for insulation behind electrical boxes. The space behind electrical boxes is the same as the insulation requirement in narrow cavities. These cavities are largely being insulated now this language adds additional clarity.

RE72-16 : TABLE R402.4.1.1-SCHWARZ13037

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Sealing around electrical boxes with spray foam could violate the electrical code because it has been observed where foam has entered and filled boxes.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Submitted.

Commenter's Reason: The committee was concerned with foam or other materials getting in the electrical box during installation. Currently, foam, insulation, and other construction materials end up in electrical boxes every day during the construction process. If this is a jurisdictional concern, then the code official should fail the home until the material is cleaned out of the electrical box. In addition, the comment did not specifically address an aspect of the proposal. The proposal does not say to foam the penetrations where the wires enter the electrical box, thus allowing for the potential of foam to enter into the box. It says an air barrier shall be installed behind the box.

RE72-16

RE73-16

Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

Shower/tub <u>and fireplaces</u> on exterior wall	The air barrier installed at exterior walls ~~adjacent to showers and tubs~~ shall separate the~~m~~<u>exterior wall</u> from ~~the~~ showers<u>,</u>~~and~~ tubs<u>,and fireplaces.</u> <u>Tub and shower drain trap penetrations through the subfloor shall be sealed.</u>	Exterior walls adjacent to showers<u>,</u>~~and~~ tubs<u>, and fireplaces</u> shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: During the last code cycle fireplace cavities dropped off this air barrier and insulation table. This proposal adds the fireplace back in and clarifies that there must be separation between the exterior wall and the void cavities created by shower, tub, or fireplaces. The proposal also adds a detail that will enhance house tightness and reduce condensation and moisture build up on the underside of the tubs and shower pans.

Cost Impact: Will increase the cost of construction
Air sealing and air barrier installation is already occurring in these locations. Small additional cost is expected if builders stopped installing air barriers in fireplace cavities which in the Colorado market has not happened. In addition, some additional cost may occur in order to seal the drain trap penetration. However the benefit of this additional air sealing and it alignment with the intent of the code would outweigh any additional cost.

RE73-16 : TABLE R402.4.1.1-SCHWARZ13035

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Tub/shower drain can be a fire code issue. The text shouldn't read fireplaces but flue shafts.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA

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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub and fireplaces on exterior walls	The air barrier installed at exterior walls shall separate the exterior wall from showers, tubs,and fireplaces. Tub and shower drain trap penetrations through the subfloor shall be fire blocked and air sealed.	Exterior walls adjacent to showers, tubs, and fireplaces shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	

Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committee felt that the proposal shouldn't read fireplaces but rather flue shafts. RE76 deals specifically with flue shafts in another section of this table. Exterior walls behind fireplaces are not specifically addressed and that is what this proposal points out. Fireplaces assemblies are over framed and the drywall air barrier that covers the interior side, the visible side, of the fireplace assembly is not in alignment with the insulation at the exterior wall behind the fireplace. This is a defect in the Buildings Thermal Envelope that needs to be addressed.

The second comment addresses the need to seal drain traps under tubs and showers. We are seeing infiltration from this location as well as air movement that is causing repeated wetting on the back of tubs and shower pans caused by condensation of water vapor carried with air through these openings.

The committee also mentioned that they felt that traps "can" be a fire issue. Sealing traps in rated floor assemblies must be protected with fire rated listed material which will also stop air movement. In non-rated floor they currently only need to be draft stopped. This proposal would force a move from air permeable draft stopping to air impermeable draft blocking all of which is allowed by the fire code. Language has been added to ensure both fire and air are addressed.

Analysis: For buildings covered by the International Building Code, "fire-blocking" at penetrations of rated floor assemblies is regulated by Section 714 of the International Building Code. For buildings covered by the International Residential Code, "fire-blocking" at penetrations of rated floor assemblies is regulated by Section R302 of the International Residential Code.

RE73-16

RE74-16

Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing,~~and~~ wiring, and other obstructions.	Penetrations through the air barrier shall be sealed	Batt insulation shall be cut neatly to fit around wiring,~~and~~ plumbing, and other obstructions in exterior walls, floors, and ceilings. Alternatively,where~~or~~ insulation that on installation readily conforms to available space is used, the insulation shall either extend behind, or shall encapsulate piping, ~~and~~ wiring and any other obstructions in insulated cavities.

Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: Plumbing, wiring, and other obstructions penetrate the buildings thermal envelope and where that happens the penetration must be sealed. When these obstructions are within an insulated cavity the insulation should fully encapsulate the obstruction as required by the insulation manufacture. This proposal ensures a clearer common understanding of how to successfully build with these conditions.

Cost Impact: Will not increase the cost of construction
There is no cost implication associated with this proposal as it is primarily clarifying already codified requirements found elsewhere in the code.

RE74-16 : TABLE R402.4.1.1-SCHWARZ13033

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The existing section language fully describes what is required. There isn't any reason to change it.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing, wiring, and other obstructions.	All ~~P~~ penetrations through the air barrier shall be sealed	Batt insulation shall be cut neatly to fit around wiring, plumbing, ~~and~~or other obstructions in exterior walls, floors, and ceilings, or ~~Alternatively,where~~ insulation that on installation readily conforms to the available space ~~is used, the insulation~~ shall ~~either~~ extend behind or ~~shall encapsulate~~completely surround piping, wiring ~~and any~~, or other obstructions in ~~insulated cavities.~~ exterior walls, floors, and ceilings
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committee states that, " There isn't any reason to change" this section of code. There are many things that penetrate the building envelope between conditioned space and unconditioned space that are not specifically called out. The general section of this table states that breaks and joints in the air barrier need to be sealed but it does not talk specifically about penetrations by obstruction such as pipes or wiring. In order to ensure that the air leakage targets are attainable this table is being used in the field as a guide to what needs to be sealed. It is our experience that it is almost an excellent guide. Things such as gas lines, blocking, strapping, etc. are neglected, so being crystal clear that every penetration must be sealed is only prudent.

RE74-16

RE76-16

Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, ~~and~~ flue shafts opening, <u>or other similar penetrations</u> to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: This proposal is made strictly for clarification and understanding for those practitioners or the code that utilize this table.

Cost Impact: Will not increase the cost of construction
There is no cost implication associated with this proposal, as the requirements of the code are not proposed to change, rather the proposed language clarifies the intent of the current code.

RE76-16 : TABLE R402.4.1.1-SCHWARZ13030

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: What are similar penetrations? It is not known.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Submitted.

Commenter's Reason: The committee focused on the language "other similar penetrations". It can be construed that all similar penetrations have been addressed in this table already. Pipe, wiring, etc. However, in the field we see holes to nowhere, gas lines, low voltage wiring, decorative wall bump outs, nooks, arched entries, and more that create a direct path or shaft from conditioned space to unconditioned space. Being crystal clear that every penetration must be sealed is only prudent.

RE76-16

RE77-16

R402.2.11 (IRC N1102.2.11), Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Delete without substitution:

~~**R402.2.11 (N1102.2.11)Crawl space walls.** As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code* or *International Residential Code*, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.~~

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in <u>vented or</u> unvented crawl spaces shall be covered with a Class I vapor retarder in accordance with the *International BuildingCode* or *International Residential Code*, as applicable. ~~with overlapping joints taped~~ <u>Seams and edges of the vapor retarder shall overlap by 6 inches (153 mm) and shall be sealed. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall of the foundation and shall be sealed to the stem wall, or other potential obstructions in the space.</u>	~~Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.~~ <u>As an alternative to insulating floors over crawl spaces where the crawl space is not vented to the outside, crawl space walls shall be insulated.</u> <u>Crawl space wall insulation shall be permanently fastened to the wall and extend from the crawl space floor to the sill plate attached to the top of the foundation.</u>

Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: Delete Section R402.2.11 Crawl Space walls as the prescriptive crawl space provisions of the IECC were essentially being reproduced in this mandatory table. The reality is that they should be mandatory for all pathways through the code to ensure that the intent of the code is maintained. This proposal puts the provisions in the correct place and clarifies some areas that have been confusing to practitioners of the code for years. For example, in the past the code required that the crawl wall insulation extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches. I have never seen the insulation installed in this fashion and code officials and builder alike never understood if the finished grade referred to the interior grade of the crawl space or the exterior finished grade. This proposal clearly states how the wall insulation needs to be installed.

Cost Impact: Will increase the cost of construction
There could be a small cost implication associated with this proposal. This proposal takes this prescriptive requirement and makes it mandatory which will have minimal to no cost implication as crawl spaces are being insulated now. This language clarifies the current intent of the code and does not add additional significant cost burdens. If there are any cost burdens it would be in the $100 range to do what they need to correctly.

RE77-16 : R402.2.11-SCHWARZ13027

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: It is preferred to keep provisions in section language. People have been trained to understand section language.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.2.11 Crawl space walls. <u>As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside.</u>

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in vented or unvented crawl spaces shall be covered with a<u>n air barrier/</u>Class I vapor retarder in accordance with the *International BuildingCode* or *International Residential Code*, as applicable. <u>All joints, s</u>eams<u>,</u> and edges of the <u>air barrier/</u>vapor retarder shall overlap by 6 inches (153 mm) and shall be sealed. The edges of the <u>air barrier/</u>vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall of the foundation and shall be sealed to the stem wall, or other ~~potential~~ obstructions in the space.	~~As an alternative to insulating floors over crawl spaces where the crawl space is not vented to the outside, crawl space walls shall be insulated.~~ <u>Crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside.</u> Crawl space wall insulation shall be permanently fastened to the wall and extend from the crawl space floor to the sill plate attached to the top of the foundation.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committees primary comment was that people are trained to understand section language. Section language only pertains to the prescriptive path of the code and some of that language needs to be carried out regardless of the pathway chosen. Per the committee's direction, this public comment addresses this point by keeping the section language that is pertinent to the prescriptive paths of the code while moving the language that should apply to all pathways to a mandatory section of the code so that it addresses all pathways in the code. Language was modified to make it more clear.

RE77-16

RE78-16

Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

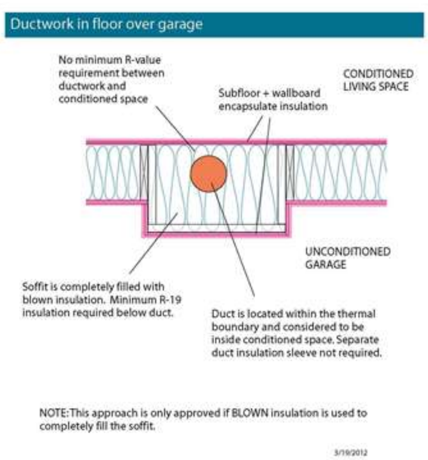
COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope.The exterior thermal envelope contains a continuous air barrier.Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.

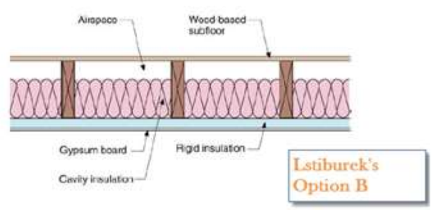
Floors (including above garages, ~~and~~ cantilevered floors, and vented crawl space floors)	Floor systems shall have a continuously sealed~~The~~ air barrier ~~shall be~~ installed at any exposed edge or perimeter framing members~~of insulation~~.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking so as to maintain insulations designed loft or readily fill the available cavity space. ~~or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.~~ Where any obstruction, such as a duct or pipe, is installed in the floor cavity, floor cavity insulation shall be installed in accordance with one of the following methods: Method A: The insulation shall be installed to be in permanent contact with the underside of the subfloor decking. The insulation shall fully encapsulate the obstruction. The insulation shall be in permanent contact with the underside of the obstruction and provide an R-value of not less than R-19 between the obstruction and the unconditioned space below the obstruction. Method B: The insulation shall be installed so that the required thickness of insulation extends from the bottom edge of the floor framing members up towards the subfloor decking, provided that both of the following are installed: 1. Continuous insulation having an R-value of not less than R-5 is installed across the bottom edge of the floor framing members, and supports the insulation within the floor cavities. 2. Any exterior rim joists or exterior wall sheathing exposed to floor framing cavities shall be provided with insulation having an R-value of not less than that required for the exterior walls of the building, for the full height of the floor framing cavity.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: Floor systems over unconditioned spaces are notoriously difficult to insulate so they perform to meet the occupant's expectation and the efficiency goals of the code. This proposal begins by ensuring that all floor systems over unconditioned spaces are clearly defined. Next, floor systems being walls that are laid flat, this proposal ensures that a continuous air barrier system is incorporated with in the components of the buildings thermal envelope created by the floor system. Lastly, the proposal ensues that batt insulation is not overly compressed by stay wire used to hold the insulation against the surface it is intended to insulate (the subfloor). In addition, the proposal clarifies how to build a floor system that performs well when obstructions, such as ducts, are installed in the system. Option A describes the way the code traditionally has dealt with obstructions in the prescriptive path utilizing footnote "G" of the R-value table R402.1.2. Option B better explains Joe Lstiburek' s codified method (since the 2015 IECC) of allowing a space for the obstruction between the insulation and the subfloor if continuous insulation is installed on the underside of the floor system and insulation fully extends from the bottom to the top of all vertical perimeter floor framing members.
See attached detail from the City of Fort Collins for option A





Cost Impact: Will not increase the cost of construction
This proposal would not add additional cost as it merely more clearly describes what is already required.

RE78-16 : TABLE R402.4.1.1-SCHWARZ13021

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is dealing with a nuance that is better off in a user's guide, not the code.

Assembly Action: **None**

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.2.8 Floors. Floor framing-cavity insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

- ~~**Exception:** The floor framing-cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall *R*-value in Table 402.1.2 and that extends from the bottom to the top of all perimeter floor framing members.~~

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.

Floors (including above garages, cantilevered floors, and vented crawl space floors)	Floor systems shall have a continuously sealed air barrier installed at any exposed ~~edge or~~ perimeter framing members and on all six sides of the framed floor cavity.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking so as to maintain the insulations designed loft or readily fill the available cavity space, or floor framing cavity insulation shall be permitted to be in contact with the top side of the sheathing below, or continuous insulation shall be installed on the underside of floor framing, minimum R-10, when combined with cavity insulation that meets or exceeds the minimum floor R-value in table 402.1.2. Whenever floor cavity insulation is not in contact with the subfloor it must extend from the bottom to the top of all perimeter floor framing rim joist members and meet or exceeds the minimum wood frame wall *R*-value in Table 402.1.2 Where any obstruction, such as a duct or pipe, is installed in the floor cavity, floor cavity insulation shall be installed in accordance with one of the following methods: Method A: The insulation shall be installed to be in permanent contact with the underside of the subfloor decking. The insulation shall fully ~~encapsulate~~ surround the obstruction. The insulation shall be in permanent contact with the underside of the obstruction and provide an R-value of not less than R-19 between the obstruction and the air barrier/sheathing below, sperating the cavity from unconditioned space. ~~below the obstruction.~~ Method B: Floor framing insulation shall be permitted to be in contact with the exterior sheathing at the bottom of the insulated cavity at the minimum R-value required in table R402.1.2 for floors, when the obstruction is held completely above the installed insulation and where insulation extends from the bottom to the top of all perimeter floor framing members and meets or exceeds the minimum wood frame wall *R*-value in Table 402.1.2. ~~The insulation shall be installed so that the required thickness of insulation extends from the bottom edge of the floor framing members up towards the subfloor decking, provided that both of the following are installed:~~ ~~1. Continuous insulation having an R-value of not less than R-5 is installed across the bottom edge of the floor framing members, and supports the insulation within the floor cavities.~~ ~~2. Any exterior rim joists or exterior wall sheathing exposed to floor framing cavities shall be provided with insulation having an R-value of not less than that required for the exterior walls of the building, for the full height of the floor framing cavity.~~

Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committee was unable to hear a floor modification for this proposal so additional confusion was created. There is not a clear path and there was not enough time to developing a user guide as an appendix in the code as recommended by the committee, so I have chosen to resubmit as modified including language that should have shown up in the original floor modification but did not..

Currently the code clumsily addresses the nuances of insulating a floor system. Since the language is confusing and it is unclear how to implement the exceptions allowed in section R402.2.8, a floor modification was worked on in collaboration with Joe Lstiburek that sought to better clarify the intent of the exception he was able to place into the code in 2015. Because of this I believe the committee is incorrect that this section belongs in a user's guide, it is in the code now but few is any understands how to use it. On the contrary, I believe the modified language clarifies how to build a floor assembly that performs to the intent of the code and is placed to clearly denote that all pathways need to comply with the requirements if the option is utilized.

Section language in R402.2.8 now remains in this proposal as floors should continue to be referenced there. This public comment shortens Section R402.2.8, the section language, in order to make it clear that there are prescriptive and mandatory requirements/options when dealing with floor assemblies.

RE78-16

RE79-16

Table R202 (New) [N1101.6 (New)], Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) ENCAPSULATED. Where insulation has been surrounded on all sides by a continuous air barrier.

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include ~~the~~an air barrier.	The insulation for rim joists shall be encapsulated ~~insulated~~.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: Insulation traps pockets of air, and the stagnate pocket or air retards the flow of heat from warm to cold. If air permeable insulation it not encapsulated it cannot trap a stagnate pocket of air. More often than not, rim joist insulation is installed without being encapsulated. This section of code is clarified by this proposal as it takes away confusion by clearly stating that an air barrier is needed for air tightness and encapsulation is needed for the insulation to function. In the past, most did not know what to do. Batts were placed in the rim joist and that component of the buildings thermal envelope continued to be weak.

Encapsulated: Reason Statement:

Six sided encapsulation has become the terminology that is used by inspectors to explain to builders and insulators how air permeable insulation needs to be installed inside of building cavities. The code as well as programs such as EnergyStar have been defining and requiring cavity insulation installs that are encapsulated on all six sides for years now. Examples from IECC table R402.4.1.1 include the requirement to install an air barrier behind a tub or fireplace on an exterior wall. In these applications, where the drywall is not continuously run in alignment with the air permeable insulation, additional air barrier installation is needed to get encapsulation of the insulation. Why is this needed? Insulation creates its ability to retard the movement of heat by trapping pockets of air. By encapsulating the insulation in a six sided cavity insulation is able to create a stagnate pocket of air that functions as the manufacture intended to retard heat flow.

Cost Impact: Will increase the cost of construction
There is likely to be a small cost implication with this proposal as Builders determine the most cost effective way to encapsulate the insulation in the rim joist. The easiest way to achieve this would be to use blown foam but more cost effective means will be developed as builders and insulators concentrate on the issue. It is expected that the short term cost impact would be between $100- 500 as the average cost of spray foam is $1/lineal sqft. If there is 200 feet of rim joist that would be $200.

RE79-16 : TABLE R402.4.1.1-SCHWARZ13018

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This proposal would increase the cost of construction, contrary to what the proposal cost impact states. There is insufficient information regarding the benefit of doing this.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~**R202 (N1101.6) ENCAPSULATED.** Where insulation has been surrounded on all sides by a continuous air barrier.~~

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include an air barrier.	<u>Rim joist</u> ~~The~~ insulation ~~for rim joists~~ shall be ~~encapsulated.~~<u>enclosed by an air barrier on all six sides of the insulated cavity.</u>
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	

HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committee felt that the proposed definition in this and other proposals were problematic, so the definition has been removed as well as the language in the proposal that I originally felt warranted the new definitions.

Insulation that is not enclosed by an air barrier clearly does not perform. Infrared imagery demonstrates this time and again.

The committee did not agree with my cost statement that the incremental cost for installing a proper air barrier in the assembly would be between $100-500. The pricing I received from insulators in my climate zone is that spray foam cost is $1 per lineal foot. One 4800sqft home we worked on recently has 360 feet of rim joist area which should cost $360 to spray with 1" of closed cell foam and $720 to spray with 2". Insulating with an R-19 batt would cost approximately $250, so the incremental cost increase would be $470. Very close to my estimate.

Just because this detail may cost more than anticipated does not mean that it is not the correct thing for the code to require to ensure that the building performs to the levels that are required. Unlike the past, there are now multiple option which a builder can choose from to accomplish this detail, so the most cost effective option can be chosen for any specific project. Insulated rim board, spray foam, foil faced polyisocyanurate, TJ® Insulated Rim Board, High-Rim insulated rim joist, and others.

Contrary to the committee's statement, "nsufficient information regarding the benefit of doing this", Building Science Corporation, Building America solution center, and other research and publications document the importance of properly sealing an insulating the rim joist.

http://buildingscience.com/documents/information-sheets/critical-seal-spray-foam-at-rim-joist (http://buildingscience.com/documents/information-sheets/critical-seal-spray-foam-at-rim-joist)

https://basc.pnnl.gov/resource-guides/garage-rimband-joist-adjoining-conditioned-space (https://basc.pnnl.gov/resource-guides/garage-rimband-joist-adjoining-conditioned-space)

RE79-16

RE81-16

R202 (New) [IRC N1101.6 (New)], Table R402.4.1.1)IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) **ENCAPSULATED.** Where insulation has been surrounded on all sides by a continuous air barrier.

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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 rim board to the sill plate and the subfloor shall be sealed. The junction of the bottom plate to the subfloor on exterior walls shall be sealed The junction of the top plate and drywall adjacent to unconditioned spaces the top of exterior walls shall be sealed. Knee walls shall be encapsulated and sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.

Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Reason: DOE Building America and other studies continually demonstrate that air sealing of the specific wall components added in this proposal help to ensure a tight enclosure. In order to reach the code required air leakage targets more specific direction needs to be given in this table with regards to the criteria that is required to seal. We are seeing that air tightness is not only important to attain our goals of durability, comfort, health and safety, as well as efficiency, but is achievable when more clear and precise direction is given.

New Definition

Encapsulated: Where insulation has been surrounded on all sides by a continuous air barrier.

Six sided encapsulation has become the terminology that is used by inspectors to explain to builders and insulators how air permeable insulation needs to be installed inside of building cavities. The code as well as programs such as EnergyStar have been defining and requiring cavity insulation installs that are encapsulated on all six sides for years now. Examples from IECC table R402.4.1.1 include the requirement to install an air barrier behind a tub or fireplace on an exterior wall. In these applications, where the drywall is not continuously run in alignment with the air permeable insulation, additional air barrier installation is needed to get encapsulation of the insulation. Why is this needed? Insulation creates its ability to retard the movement of heat by trapping pockets of air. By encapsulating the insulation in a six sided cavity insulation is able to create a stagnate pocket of air that functions as the manufacture intended to retard heat flow.

Cost Impact: Will increase the cost of construction
The code requires that the home is air tight and these are the areas of the home that specifically help ensure that the level of tightness is achievable. Therefore cost increases associated with this proposal should be minimal as these features will be part of a total air sealing package that is already happening. That being said, the clarifications of the required areas to be sealed, point out areas that have not been addressed well due to the poor language previously used and therefore some cost increase will be caused by this proposal. It is estimated that the cost for materials and labor would be in the $50 - $150 range and the benefit would be consistent passage of the air leakage requirements of this code.

RE81-16 : TABLE R402.4.1.1-SCHWARZ13010

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The definition is problematic. Suggest a public comment to make the proposal specific to knee walls.

Assembly Action: **None**

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~**R202 (N1101.6) ENCAPSULATED.** Where insulation has been surrounded on all sides by a continuous air barrier.~~

TABLE R402.4.1.1 (N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
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/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~~ Seal the foundation ~~and~~ to the sill plate. ~~shall be sealed~~. ~~The junction of~~ Seal the rim board to the sill plate. ~~and the~~ Seal the rim board to the subfloor ~~shall be sealed.~~ The junction of the bottom plate to the subfloor on exterior walls shall be sealed ~~The junction of~~ Seal the top plate adjacent to~~and drywall adjacent to~~ unconditioned spaces ~~the top of exterior walls shall be sealed.~~to the drywall. Seal the bottom plate to the subfloor on exterior walls. Knee walls shall be ~~encapsulated~~ enclosed and sealed with an air barrier on all six sides of the framed/insulated caviity.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Commenter's Reason: The committee felt that the proposed definition, added for clarification, was problematic, so the definition has been removed as well as the language in the proposal that I originally felt warranted the definitions.

This proposal addresses the high and low side holes in the continuous air barrier system of the building that are most problematic by clarifying the ambiguous language that is currently written. The committee recognized that a second attempt was needed and suggested limiting the changes to knee walls, but this proposal was not only about knee walls. I believe that nobody knows what is meant by current language "the junction of the top plate and the tope of exterior walls shall be sealed." This revised proposal addresses the committees concern as well as clarifies the language of what needs to happen to address these problem leakage areas in building.

RE81-16

RE82-16

R202 (New) (IRC N1101.6 (New)], Table R402.4.1.1 (IRC Table N1102.4.1.1)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) ENCAPSULATED. Where insulation has been surrounded on all sides by a continuous air barrier.

R202 (N1101.6) GRADE 1 INSULATION INSTALLATION. An insulation installation method defined in the RESNET/ICC Standard 301 that aligns with all manufacturer's installation instructions to limit the reduction in R-value caused by poor installation of the insulation system.

Revise as follows:

TABLE R402.4.1.1 (N1102.4.1.1))
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building's thermal envelope. ~~The exterior thermal envelope contains a continuous air barrier.~~ Breaks or joints in the air barrier shall be sealed. A continuous air barrier shall be provided throughout the *building thermal envelope*. The air barriers shall be located on the inside or outside of the building envelope, within the assemblies comprising the envelope, or any combination thereof.	Air-permeable insulation shall not be used as a sealing material. Air- permeable insulation shall be *encapsulated* inside an air barrier[b]. All insulation installation shall be in accordance with manufacturer instructions and Grade 1 insulation installation to limit the reduction of R-value. Verification and certification of insulation installation shall be in accordance with Section R303
Ceiling/attic	The air barrier in any dropped ceiling/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	

Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

b. Insulation shall not be required to be encapsulated in unconditioned attic spaces.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ANSI/RESNET/ICC 301-2014 Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using the HERS Index, March 7, 2014 (Republished January 15, 2016)

Reason: Air barrier Criteria
Air barriers are not necessarily one component of the thermal envelope and may not be located in one location. The continuous air barrier location language is brought over from C402.5.1 to help better define that air barriers are part of an assembly that can be located anywhere in the assembly.

Insulation Installation Criteria

The term encapsulated is defined below. It is a term that is easily understood and one that ensure air barrier and thermal barrier alignment. Similarly Grade 1 installation is becoming a nationally acceptable way of quickly and easily explaining how insulation needs to be installed in accordance with manufacturing instructions. In addition is offers additional guidance for modeling of the insulation for section R405 and R406.

We are seeing more insulation installation methods being developed that do not properly mark the R-value of the material. Therefore, it becomes more important that the R-value of the installed insulation is certified by the installer who is the only one who often knows the installed R-value of the material. Documentation needs to be provided for inspection.

Encapsulated

Six sided encapsulation has become the terminology that is used by inspectors to explain to builders and insulators how air permeable insulation needs to be installed inside of building cavities. The code as well as programs such as EnergyStar have been defining and requiring cavity insulation installs that are encapsulated on all six sides for years now. Examples from IECC table R402.4.1.1 include the requirement to install an air barrier behind a tub or fireplace on an exterior wall. In these applications, where the drywall is not continuously run in alignment with the air permeable insulation, additional air barrier installation is needed to get encapsulation of the insulation. Why is this needed? Insulation creates its ability to retard the movement of heat by trapping pockets of air. By encapsulating the insulation in a six sided cavity insulation is able to create a stagnate pocket of air that functions as the manufacture intended to retard heat flow.

Grade 1 Insulation Installation

Few if any code officials, Builders, or installers read the manufactures instructions for how to install insulation. Yet, with regard to how insulation is installed, the sole requirement within the IRC and the IECC is that insulation be installed in accordance with manufacture instructions. The RESENT standard for insulation installation is being used in the filed as a quick and understandable way of relating how insulation needs to be installed. The standard, in alignment with manufacture instructions, simply lays out the important aspects of manufacture instructions and recaps them in a manageable way. What the standard really adds is a means to quantify if the installation has met the installation requirements. This qualification points out that insulation does not have to be installed absolutely perfectly but it does need to be installed perrty darn well in order for it to work as intended by the code. So when a field superintended or insulator hears that the insulation has not or has been installed to a Grade 1 they know right away what is meant. Lastly, Grade 1 offers modeling guidance for Energy Raters who are implementing Section R406 the Energy Rating Index path of the code.

RESENT Grade 1 - from RESNET/ANSI Standard 301-2014

"Grade I" shall be used to describe insulation that is generally installed according to manufacturer's instructions and/or industry standards. A "Grade I" installation requires that the insulation material uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging), and is split, installed, and/or fitted tightly around wiring and other services in the cavity.

To inspect, probe in, around, or through the insulation and/or vapor retarder in several places to see whether these requirements are met. Replace or repair the vapor retarder and insulation as necessary. During inspection (typically before drywall is installed), if the exterior sheathing is visible from the building interior through gaps in the cavity insulation material, it is not considered a "Grade I" installation.

To attain a rating of "Grade I", wall insulation shall be enclosed on all six sides, and shall be in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity.

Exception: the interior sheathing/enclosure material is optional in climate zones 1-3, provided insulation is adequately supported and meets all other requirements.

For rim or band joist insulation, use the inspection guidelines under "Walls—Insulation value" to assess "Grade I", "Grade II", or "Grade III" installation.

Exception: the interior sheathing/enclosure material is optional in all climate zones, provided insulation is adequately supported and meets all other requirements.

For exterior applications of rigid insulation, insulation shall be in firm contact with the structural sheathing materials, and tightly fitted at joints to be considered a "Grade I" installation.

For faced batt insulation, Grade I can be designated for side-stapled tabs, provided the tabs are stapled neatly (no buckling), and provided the batt is only compressed at the edges of each cavity, to the depth of the tab itself, and provided it meets the other requirements of Grade I.

For sprayed or blown-in products, density shall be sufficient that the fill material springs back when compressed slightly with a hand or finger, and provided it meets the other requirements of Grade I.

Cost Impact: Will not increase the cost of construction
The code requirement of this section are not changing, rather the language clarifies the intent of the current code and offers more direction on how to successfully implement what is being asked for through manufactures instructions.

Analysis: A review of the standard(s) proposed for inclusion in the code, ANSI/RESNET/ICC 301-2014 (Republished January 15, 2016), with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016.

RE82-16 : TABLE R402.4.1.1-SCHWARZ12698

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Consistent with action on RE81-16 regarding the issue with the definition.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~**R202 (N1101.6) ENCAPSULATED.** Where insulation has been surrounded on all sides by a continuous air barrier.~~

~~**R202 (N1101.6) GRADE 1 INSULATION INSTALLATION.** An insulation installation method defined in the RESNET/ICC Standard 301 that aligns with all manufacturer's installation instructions to limit the reduction in R-value caused by poor installation of the insulation system.~~

TABLE R402.4.1.1 (N1102.4.1.1))
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA[c]
General requirements	A continuous air barrier shall be installed in the building's thermal envelope. Breaks or joints in the air barrier shall be sealed. ~~A continuous air barrier shall be provided throughout the *building thermal envelope*. The a~~ Air barriers shall be permited to be located on the inside or outside of the building envelope, located within the assemblies comprising the envelope, or any combination thereof.	Air-permeable insulation shall not be used as a sealing material. Air- permeable insulation shall be ~~*encapsulated*~~enclosed inside an air barrier[b]. All insulation installation shall be in accordance with manufacturer instructions ~~and Grade 1 insulation installation~~ to limit the reduction of R-value. ~~Verification and certification of insulation installation shall be in accordance with Section R303~~
Ceiling/attic	The air barrier in any dropped ceiling/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 of R-3 per inch minimum. 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 window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends 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.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by 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 drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them 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 or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When 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.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

b. Insulation shall not be required to be ~~encapsulated~~ enclosed on all sides by an air barrier in unconditioned, ventilated attic spaces.

c. Verification, certification and installation of insulation shall be in accordance with section R303

Commenter's Reason: The committee felt that the proposed definitions that were added for clarification were problematic, so the definitions have been removed as well as the language in the proposal that I originally felt warranted the new definitions. In addition, a section on verification and certification was moved to a new footnote (c) where it belongs.

We now have a code change proposal that is more concise and to the point that defines the integration of air barrier and insulation installation in the Buildings Thermal Envelope.

Using the term building's thermal envelope brings the criteria in the air barrier section in alignment with the approved CE4 definition of the Building Thermal Envelope. In addition, the air barrier location aspect of the proposal is in alignment with the approved CE3 modified definition of an Air Barrier.

RE82-16

RE85-16

R202 [IRC N1101.6], R402.4.1.2 [IRC N1102.4.1.2]

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) DWELLING UNIT ENCLOSURE AREA The total shell area of the dwelling unit's basement walls, exterior walls, floors, ceilings, roofs and any other building elements assemblies that enclose a dwelling unit or provides a boundary between a dwelling unit's conditioned space and unconditioned space or an adjacent dwelling unit's conditioned space.

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. ~~The building~~

Detached buildings or dwelling ~~unit~~ units shall be tested and verified as having an air leakage rate not exceeding ~~five~~ 1.1 square inches equivalent leakage area/100 square feet of d*welling unit enclosure area* (ELA/100sqft of shell area).

Attached buildings or dwelling units shall be tested and verified as having an air ~~changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8~~ leakage rate not exceeding 1.3 square inches equivalent leakage area (Area/100 square feet of *dwelling unit enclosure area* (ELA/100sqft of shell area).

Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Reason: This proposal is tackling three issues. First, it recognizes the fact that tight housing, regardless of the climate zone the home is built in, is important. Tight houses ensure control and predictability of the air in the home which benefits durability, comfort, and efficiency (the complete intent of the code) in the house regardless of whether the house is built in cooling or heating dominated climates. Efficiency use of heating and cooling energy is important.

Second, the reality is that the current air leakage measurement, ACH50, penalized attached housing and smaller houses due to its being based on house volume size. The proposed new matrix for compliance, ELA/100sqft of shell area, eliminates volume from the equation and therefore the bias against small houses and apartment units. In addition, attached housing is treated more fairly as this standard of measurement incorporates leakage through adiabatic walls, ceilings, and floors. Thus compartmentalization, as well as air leakage to the outdoors, is promoted and ensured.

Third, Separate air leakage targets have been developed for attached (single family) homes and attached housing in order to first recognize the difficulty in attaining the current levels of required air tightness for attached housing, and second to offer an air leakage target for both attached and detached housing that is attainable and creates a well performing, tight, energy efficient home. Both targets are in alignment with the energy saving goals of the IECC.

The data set used to evaluate where to set the air leakage ELA/100sqft target shows that setting the number at 1.3 square inches per 100 sqft of shell area for attached housing will offer a more reasonable but still impactful target equivalent to the 5 ACH target currently in place for climate zones 1 and 2. For detached housing the target of 1.1 is in alignment with the current level of achievable air tightness for single family homes.

Our data is also showing that detached homes are consistently performing bellow 1.1 ELA/100 (3 ACH50) and that attached homes are currently averaging at 3.52 ACH50 or better than 1.3 ELA/100

Detached target:

1.1(ELA/100)x3 (ach50)/1.09 (ELA/100) = 3.03 ACH 50

Attached target

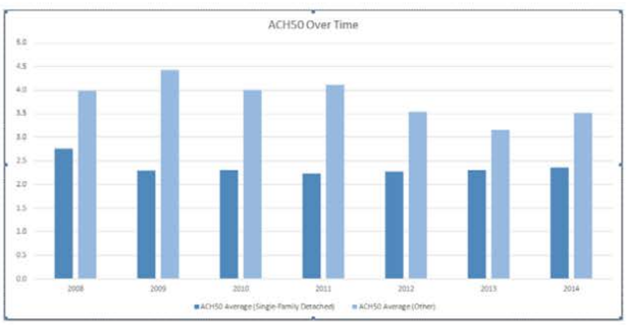
1.3(ELA/100) x 4.93(ach50)/1.3 (ELA/100) = 4.93 ACH 50

See attached data

See attached data

REM Type	Type	Count 2014-2015	Avg CFM50	Avg ACH50	Avg ELA	Avg ELA100	Avg Specific Leakage Area
1	Single-family detached	4598	1415.3	2.32	77.7	0.98	0.000144
2	Townhouse, end unit	240	1179.7	3.00	64.8	1.09	0.000191
3	Townhouse, inside unit	227	1115.6	3.51	61.2	1.23	0.000221
4	Apartment, end unit	440	687.0	4.52	37.7	$\boxed{1.21}$	0.000276
5	Apartment, inside unit	116	845.5	5.34	46.4	$\boxed{1.40}$	0.000324
7	Duplex, single unit	424	1208.1	3.07	66.3	1.19	0.000188

Year	ACH_{50} Average (Single-Family Detached)	ACH_{50} Average (Other)
2008	2.75	3.98
2009	2.29	4.42
2010	2.30	4.00
2011	2.23	4.12
2012	2.27	3.53
2013	2.31	3.15
2014	2.35	3.52



Cost

Cost of construction in climate zones 1 and 2 is expected to go up due to this proposal but will not go up in climate zones 3 - 8 as the leakage targets are essentially the same as the proposal is merely changing the reporting matrix. Warmer climate zone builders will gain efficiency and performance benefits.

Cost Impact: Will increase the cost of construction
Cost of construction in climate zones 1 and 2 is expected to go up due to this proposal but will not go up in climate zones 3 - 8 as the leakage targets are essentially the same as currently in place. The proposal is merely changing the reporting matrix. Warmer climate zone builders will gain efficiency and performance benefits but cost will increase as they learn to tighten their

building envelopes from the 2015 IECC requirements of 5 ACH50 to what would be required by this proposal which is approximately 3 ACH50. It is estimated that the cost increase to tighten the building envelope in climate zones 1 and 2 to those levels required in climate zones 3-8 would be small as section R402.4.1.1 currently requires that the items listed in table R402.4.1.1 be carried out in all climate zones. The reality is that they are not, but assuming that they should, it is estimated that the construction cost would increase between $1000 - $2000, only in climate zones 1 and 2 to bring them in par with the rest of the nation.

RE85-16 : R402.4.1.2-SCHWARZ13480

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Detached buildings don't seem to belong. A detached building could be a horse barn where energy is not being used.

We already have a widely used testing standard that is still not completely understood. To bring in another testing standard is going to be confusing to what is already being done..

The new defintion is unecessary. The terms of building thermal envelope and conditioned space are how we describe what we are talking about. This new term doesn't add clarity.

It is unclear what is meant by attached and detached buildings within the scope of this section.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4.1.2 (N1102.4.1.2) Testing. Single family detached buildings or *dwelling units* shall be tested and verified as having an air leakage rate not exceeding ~~five air changes per hour in Climate Zones 1 and 2, and~~ three air changes per hour in Climate Zones ~~3~~ 1 through 8, or 0.24 cubic feet per minute at 50 Pascals/100 square feet of d*welling unit enclosure area*.

Attached multifamily buildings or *dwelling unit*s shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 through ~~and2~~ 8, ~~and three air changes per hour in Climate Zones 3 through 8~~ or 0.30 cubic feet per minute at 50 Pascals/100 square feet of d*welling unit enclosure area*.

Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Commenter's Reason: Single family detached building are distinctly different from multifamily attached buildings whether they are townhouses, duplexes, or three stories high. This Language was added to the proposal to clearly distinguish between attached and detached buildings as suggested by the confusion of the committee. In addition, the floor modification presented in Louisville which was ruled out of order created additional confusion. This reworded proposal addresses the fundamental reason for the floor modification and the confusion expressed by the committee. It changed the alternative air leakage matrix from ELA/100sqft of shell area to a more understandable and widely used matrix of CFM at 50 Pascals/100 square feet of d*welling unit enclosure area.*

The committee did not see the benefit of having a distinction between single family detached and multifamily attached air leakage testing standard. This is the crux of the mater. Single family homes are successfully achieving a 3 ACH air leakage rate across the country while multifamily attached units from townhomes to three story apartment units are not. This proposal addresses the disparity in being able to comply with the code head on by establishing less restrictive and achievable air leakage rates for multifamily attached buildings. It takes into account leakage across building assemblies that enclose a dwelling unit or provides a boundary between a dwelling unit's conditioned space and unconditioned space or an adjacent dwelling unit's conditioned space. Per the committee's suggestion additional language was added to ensure that it is clear that a detached building did not refer to a horse barn.

Contrary to the committee's statement that the construction industry is confused about the testing standard or what they are being held to, the reality is that they are simply not able to consistently achieve the requirement of the code. This is not due to misunderstanding the standard this is due to the complexity of multifamily attached buildings. This proposal keeps a widely accepted testing methodology/standard while broadening the matrix that can be used to demonstrate compliance. ACH50 is still allowed but now CFM at 50 Pascals/100 square feet of d*welling unit enclosure area is also allowed.* The current air leakage measurement matrix, ACH50, penalizes multifamily attached buildings and smaller houses due to its being based on house volume size. The proposed new optional matrix for compliance, CFM50/100 square feet of d*welling unit enclosure area*, eliminates volume from the equation and therefore the bias against small houses and multifamily attached buildings. In addition, multifamily attached buildings are treated more fairly as this standard of measurement incorporates leakage through adiabatic walls, ceilings, and floors. Thus this proposal realizes that compartmentalization, as well as air leakage to the outdoors, is a reality and ensures that it is dealt with properly. In other words, the proposal gives the option to utilize a compliance matrix that recognizes that the most cost effective testing method, using a single blower door, will measure leakage across adjacent dwelling units as well as from the outside. By so doing a threshold of allowable air leakage is permitted that promotes efficiency as well as compartmentalization.

Defining dwelling unit enclosure area is a crucial portion of this proposals main point. In multifamily attached buildings a portion of the leakage is coming from connections between attached dwelling units. In order to calculate the surface area of the dwelling unit it must be defined. This ultimately give an attainable testing threshold for multifamily attached buildings and justifies the need for the new definition.

A number of different groups have recognized the need to allow a CFM50 /100 square feet of *dwelling unit enclosure area matrix to quantify the air leakage of a residential building. This includes the following:*

- The Building America program
- Green Building advisor
- USGBC LEED Multifamily High rise
- Army Corp of Engineers
- Energy Star Multifamily High-rise
- City of Fort Collins Colorado
- National Renewable Energy Laboratories

Johnathan Scott at EnergyLogic looked at all of EnergyLogic's ratings from 2015 and the relationship between volume and shell area. The relationship was tighter than he had thought. Our goal in doing this exercise was to try and determine a relationship between a measurement taken and expressed as XXX cubic feet per minute at 50 Pascals/100 square feet of *dwelling unit enclosure area and our traditional code matrix for expressing house infiltration Air Changes Per Hour at 5o Pascals of pressure.*

Looking at the Formulas below:

Formula A can be used to to specify a volume and get a shell estimate

Shell area = 1,832 + 0.1643*Volume

Formula B can be used to specify a shell area and estimate the volume.

Volume = -8,704 + 5.754*Shell area

Through this exercise we had anticipated greater variation between the two approaches but we believe we have proven this wrong.

We looked directly at the blower door data for homes that EnergyLogic rated in 2015, and calculated ACH50 and CFM50/ft^2, shown below. (is this sqft of shell or conditioned space?)

The orange line shows the proposed target, 0.192 CFM50/ft^2. This line shows that there would be a different ACH50 for homes with different geometry (range from about 2 to 4 ACH50 for all homes with CFM50/ft^2 measurement around 0.192)

Also, from the trend line you'll see that **for homes around the 0.192 CFM50/ft^2 standard, the average ACH50 number is 2.6**. Meaning, this is the target that you'd be asking builders to meet if you propose a 0.192 CFM50/ft^2 target.

Using the trend line from the observations in the second chart, we generated the table below showing what the ACH50 equivalent would be for different CFM50/ft^2 targets. We believe that 0.192 CFM50/ft^2 is an ambitious target as this target came from commercial buildings that have relatively little shell area for the volume, since they're typically large box-shaped buildings. We are proposing two targets based on the table below that are more suited for residential attached and detached buildings. The targets are not exactly aligned with the current code requirements because this proposal is requiring the same tightness limits in all climate zones.

Attached 0.30 CFM50/ ft^2 of shell area

Detached 0.24 CFM50/ ft^2 of shell area

CFM50/ft^2	ACH50
0.10	1.2
0.11	1.4
0.12	1.5
0.13	1.7
0.14	1.8
0.15	2.0
0.16	2.1
0.17	2.3
0.18	2.4
0.19	2.6
0.20	2.7
0.21	2.9
0.22	3.0
0.23	3.2
0.24	3.4
0.25	3.5

0.26	3.7
0.27	3.8
0.28	4.0
0.29	4.1
0.30	4.3
0.31	4.4
0.32	4.6
0.33	4.7
0.34	4.9
0.35	5.0
0.36	5.2
0.37	5.3

RE85-16

RE86-16

R402.4.1.2.1 (New) [IRC N1102.4.1.2.1 (New)]

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

R402.4.1.2 (N1102.4.1.2) 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 Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Add new text as follows:

<u>**R402.4.1.2.1 (N1102.4.1.2.1) Testing garage separation.** Testing shall be performed to ensure that an attached garage is separated from the house.</u>

1. <u>While conducting the air leakage test as described in Section R402.4.1.2 the separation between the house and the garage shall be tested to ensure that the house in reference to the garage is not less than 45 pascals of pressure when the house is held at 50 Pascals of pressure in relationship to outside. All operable garage openings to the outside shall be closed during this test.</u>
2. <u>The test required by Item 1 shall be repeated with the overhead garage door open, The test shall verify that the results are not more than 6 percent higher than the original results.</u>

Reason: The energy code like all code is about health, safety, comfort, durability, as well as efficiency. The garage is the largest source of pollutants and carbon monoxide in the house and it has been codified in table R402.4.1.1 to ensure that the garage is air sealed and separated from the house. Unfortunately, as is the case in most situations, there is no way to be sure that separation has been achieved, in this location, unless that separation has been tested. Fortunately testing for separation between the house and garage is very simple and is made even more practical due to the mandated blower door test for every house.

To ensure that there are not false positive results of the test Building America research has determined that the test requires two steps to ensure that a false positive does not reveal itself in the first step. First, while the house is at 50 Pascals of pressure with regards to outside during the blower door test a zonal pressure test is performed by installing a tube between the house and the garage. (Usually under the door between the house and the garage) If the garage is clearly outside, the measurement between the house and the garage should also be 50 Pascals of pressure. The closer the measurement is to zero the more connected the garage is to the house. This test is performed when all opening between the garage and the outside are closed. Second, this test is repeated with the overhead vehicle door open. If the results of the second test are greater than 6% the connection between the house and the garage tests fails.

If we continue to mandate separation between the house and the garage we must also test for it to ensure that the health and safety intent of the code is maintained. Programs such as the EPA Indoor Air Plus and the DOE Zero Energy Ready Home program have incorporated protocols to test for this separation. In addition, Jurisdictions around the country, such as Fort Collins Colorado have amended the IECC to require this test.

People have asked if this is really an issue. The problem is that one cannot know unless one tests. The complexities of the assemblies separating the house and the garage, with dropped ceilings, pipe, ducts, wiring and who knows what else penetrating the buildings thermal envelope and air barrier systems, make it an extremely difficult part of the house to seal. What we do know is that automobiles are the largest source of carbon monoxide in our home and they are parked in attached garages. We also know that other pollutants such as gasoline, pesticides and paints are stored in attached garages. Therefore, to not test is clearly against the health and safety intent of the code and ultimately places builders and homebuyers at risk. Lastly, there a numerous studies that have documented that pollutants from the garage are capable of migrating into the house. This test will ensure that this possibility is lessoned,

Bibliography: Resources:

US Department of Energy Building Technologies Office

Building America Program

"Air Leakage and Air Transfer between Garage and Living Space"

Armin Rudd Building Science Corporation

September 2014

EnergyLogic Study:

EnergyLogic tested 344 homes of which 145 passed this test and 199 failed. This indicates that 59% of the homes failed to fully separate the house from the garage. These homes were tested as part of an existing home audit program. The age of the homes varied widely but this study is an indication of the historic difficulty is separating the house from the garage.

Cost Impact: Will increase the cost of construction

The cost implication of this proposal is small as this test must be performed at the same time as the blower door test described in section R4052.4.1.2. The garage separation test will add approximately 15 minutes to the testing that is already being performed so may add between $25 and $50. If the test fails it is an indication that already required code air sealing scopes of work are not being performed properly. This should require greater attention to detail rather than additional cost from the air sealing contractor.

RE86-16 : R402.4.1.2-SCHWARZ13050

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The garage-to-conditioned space separation is required to be sealed. Testing of the garage seems to be more of a health and safety issue that isn't something that the energy code should be involved with.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4.1.2.1 (N1102.4.1.2.1) Testing garage separation. Testing shall be performed to ensure that an attached garage is separated from the house as required in Table R402.4.1.1.

1. While conducting the air leakage test as described in Section R402.4.1.2 the separation between the house and the garage shall be tested to ensure that the house in reference to the garage is not less than 45 pascals of pressure when the house is held at 50 Pascals of pressure in relationship to outside. All operable garage openings to the outside shall be closed during this test.
2. The test required by Item 1 shall be repeated with the overhead garage door open, The test shall verify that the results are not more than 6 percent higher than the original results.

Commenter's Reason: Yes, the garage to conditioned space is required to be sealed in Table R402.4.1.1, yet there is no way to tell if one has been successful at meeting this requirement unless the connection is tested. In the same way the code requires that ductwork, plumbing, and building thermal envelope be sealed and there is no way to ensure that this has been done without testing. The code requires testing of duct work, plumbing, and envelope because you cannot visually determine if one has been successful at sealing them up. This is true for garage separation as well.

It is true that this is a health and safety concern but a leaky connection between the house and the garage is also an energy penalty. If the code is, as suggested, strictly only about energy then references to ventilation and vapor retarder, for example should not be there. In addition, section R402.4.4 Rooms containing fuel burning appliances should be struck because it is largely about ensuring combustion safety. The reality is that building science has taught us that our houses are integrated systems and the efficiency, safety, health, durability, etc. are all part of the energy codes as well as the other codes. Just look at the conflict between energy and fire codes. If they were not related and interactive there would be not conflict.

RE86-16

RE87-16

R402.4.1.2 (IRC N1102.4.1.2), Table R405.5.2(1) [IRC Table N1102.5.2(1)]

Proposed Change as Submitted

Proponent : Donald Surrena, National Association of Home Builders (dsurrena@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) 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 Zones 1 and 2, and ~~three~~ four air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 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 *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, 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.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

TABLE R405.5.2 (1) [N1105.5.2 (1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Air leakage rate of 5 air changes per hour in climate zones 1 and 2 and ~~3~~4 air changes in climate zones 3 through 8 at a pressure of 0.2 inches w.g. (50Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same asa in the proposed design, but no greater than 0.01 x CFA + 7.5 x (Nbr +1) where: CFA = conditioned floor area Nbr = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences the measured air exchange rate[a]. The mechanical ventilation rated shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed

Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed
Service water heatingd, [e, f, g]	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2 , 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2 , 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official* , testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals* , or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

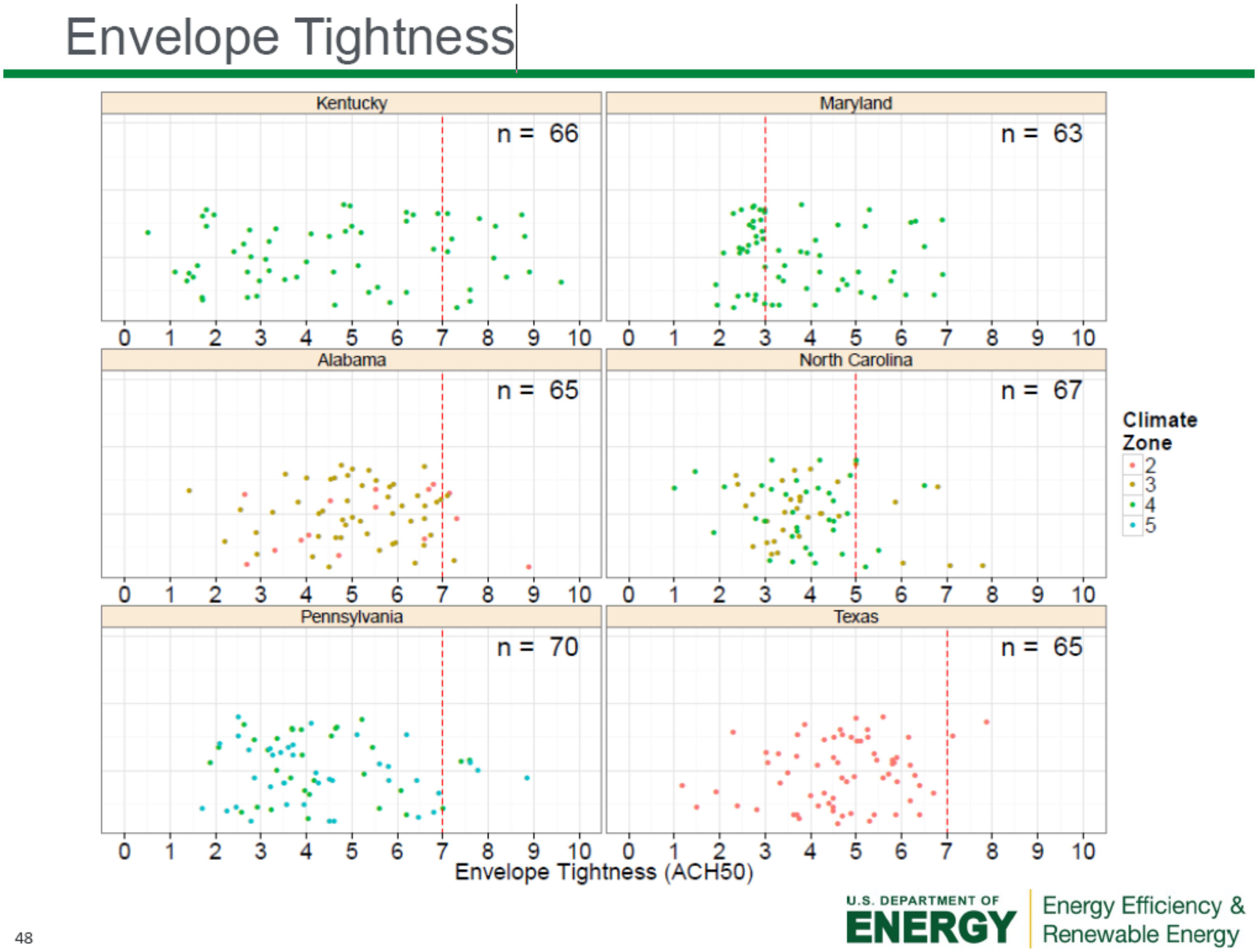
g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_S \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

Reason: Building tightness is an important part of an energy-efficient and comfortable house. However, 3 air changes(ACH) per hour at 50 Pascals is an extremely low target tightness, especially for smaller homes. The ASHRAE Handbook of Fundamentals shows that around 8% of U.S. homes achieve 3 ACH or less, 13% achieve 4 and less than 23% achieve 5. The proposed 5 ACH while still an aggressive tightness level will provide a tight, comfortable, energy-efficient home. To further show the stringency of this requirement, 12 of 16 states have amended the tightness requirement.

1. Delaware – amended
2. DC- amended
3. Idaho- amended
4. Illinois- amended
5. Iowa- amended
6. Maryland- NO
7. Massachusetts- NO
8. Minnesota- NO
9. Montana- amended
10. Nevada- amended
11. New Jersey- NO
12. Rhode Island- amended
13. Utah- amended
14. Vermont- amended
15. Virginia- amended
16. Washington- amended

DOE has verified that achieving 3 ACH50 is problematic, even in Maryland who has had a 3 ACH requirement for over 3 years (see chart below).



Cost Impact: Will not increase the cost of construction

The code change proposal reduces stringency to avoid extra costs for not being able to comply with the requirements that 12 of 16 states have already amended to reduce costs.

RE87-16 : R402.4.1.2-SURRENA12456

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Approval of this proposal would be in direct conflict with the Committee's approval of RE58-16.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Craig Drumheller, representing National Association of Home Builders (CDrumheller@nahb.org) requests Approve as Submitted.

Commenter's Reason: There was confusion by the Residential Energy Committee on how this proposal would work with RE58-16. It is clear that this change is not in conflict and the Code Correlation Committee would understand that wherever the 3 ACH 50 requirement was moved, the requirement would be changed to 4 ACH 50. This reason statement will further reinforce the intent.

It is also important to reiterate the difficulty to achieve 3 ACH 50 on a regular basis on all types of homes. The IECC is a minimum standard of care and 3 ACH 50 is well beyond what should be considered a minimum requirement. Meeting the 3 HAC 50 threshold is problematic and increasing the allowable leakage to 4 ACH 50 would provide a much more reasonable, yet still challenging, tightness requirement. This change would also be inline with amendments made by most of the states which have adopted the 2012 or 2015 IECC.

RE87-16

RE89-16
R402.4.2 (IRC N1102.4.2)

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

R402.4.2 (N1102.4.2) Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces ~~listed and labeled in accordance with UL 127,~~ the doors shall be tested and listed for the fireplace in accordance with UL 127. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

Reason: The existing text is poorly structured and it implies that the fireplaces are listed and labeled in accordance with UL127. The standard applies to the doors and not the fireplaces.
This proposal was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at:
http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Cost Impact: Will not increase the cost of construction
The proposal is an editorial clarification. It has no impact on the technical requirements of the code and therefore will not affect cost.

**RE89-16 :
R402.4.2-
COLLINS11559**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The UL Standard is applicable to the fireplace, not the tight-fitting door.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4.2 (N1102.4.2) Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers ~~or doors,~~ and shall be provided with outdoor combustion air. ~~Where using tight-fitting doors on factory-built fireplaces the doors shall be tested and listed for the fireplace in accordance with UL 127. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.~~

Commenter's Reason: RE90 was approved and deleted the final sentence. The IMC and the IRC already address the door requirements, including reference to UL127, in Sections 903.4 and R1004.5, respectively. This allows the IECC requirement to be reduced to the existing requirements that such fireplaces shall have a tight fitting flue damper and must be provided with outdoor combustion air. This change in conjunction with RE90 eliminate the potential of the code setting up conflicts between the installation and the listing requirements.

The SEHPCAC discussed whether this section – even after being reduced as proposed in this public comment is needed at all. It really is restating requirements found elsewhere in the family of codes. The SEHPCAC may consider a proposal to delete the second in the 2019 cycle.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments.   Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

RE89-16

RE92-16

R402.4.4 (N1102.4.4)

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Delete without substitution:

~~**R402.4.4(N1102.4.4) 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, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than 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 a minimum of 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*.~~

Reason: This was a new section to the 2015 IECC and has proven to be confusing and is being misinterpreted.

- No data was shown verifying a problem existed
- No energy savings potential was shown.
- No cost data was provided to justify the increase to the cost of construction.
- A study was done by Home Innovation Research Labs that finds the cost of meeting this requirement would be $878 for a home with space heating or water heating equipment in the basement.

Cost Impact: Will not increase the cost of construction
This proposal has the potential to reduce the cost of construction by not requiring unnecessary construction.

RE92-16 : R402.4.4-SURRENA12468

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The Department of Energy stated that this is an "energy-neutral" proposal. This subject matter should already be covered by the IFGC/IMC so having this in IECC is not necessary.

Assembly Motion: **Disapprove**
Online Vote Results: **Successful**
Support: 59.7% (160) Oppose: 40.3% (108)
Assembly Action: **Disapproved**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Approve as Submitted.

Commenter's Reason: These requirements, originally proposed for deletion and appearing for the first time in the 2015 edition of the IECC, do not save energy and do not belong in the IECC. The "Committee Reason" for disapproval claims that the provisions save energy, but in Committee discussion, no evidence or data was identified to support that claim. In fact, the U. S. Department of Energy "determinations" report covering changes implemented by the 2015 edition, performed by Pacific Northw est National Laboratory (PNNL), classified the proposal leading to this change as "Not Applicable to Residential Energy Efficiency" and is one of five such proposals so classified that w ere promulgated as new requirements in the 2015 edition. Of the four states adopting the 2015 edition of the IECC, one state (Illinios) has removed this coverage by amendment for residential occupancies. A full account for adopting states w ill be presented at the April hearing. In any case, adoption experience to date has show n that local jurisdictions have not seen this provision as reasonable or justified for an energy code, The IECC w ould be well advised to elimnate this provision. .Also, the "Cost Impact" cited in the IECC monograph states that, "The code change proposal w ill increase the cost of construction, w hile it w ill reduce the energy consumption and cost throughout the life of the home." This finding is contradicted by the PNNL analysis on the basis of energy savings not realized and by independent analysis by Home Innovations Labs in its evaluation of 2015 IECC Code changes on the basis of cost effectiveness. Finally, the original proposal for the code change cited professed combustion appliance safety concerns. Such concerns should be addressed to the International Fuel Gas Code and National Fuel Gas Code processes w here combustion safety is addressed, not w ithin the IECC.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: RE92 should be disapproved because it eliminates a key set of efficiency requirements for rooms containing fuel-burning appliances, constituting a rollback in energy efficiency. These rooms typically have open vents for the purpose of combustion safety, yet might only be separated from conditioned space (if at all) by an interior door. These requirements were added in the 2015 IECC with broad support from building code officials, and we note that a floor motion for "Disapproval" of RE92 was successful in this cycle. In addition, CE115 Part 1, which would have deleted that section of the commercial code, was disapproved by the Commercial IECC Committee.

This section of the IECC provides critical instructions for building code officials that will ultimately save energy. We disagree with the Residential IECC Committee Reason Statement that claims these requirements "should already be covered in the IFGC/IMC so having this in the IECC is not necessary." These requirements are energy conservation requirements, and to our knowledge are not outlined anywhere else in the I-codes. The IECC is the most appropriate location for them.

If proponents have concerns with specific parts of Section R402.4.4, a better approach might be to propose specific changes. However, the proponents simply propose deleting the whole section, based on an unnamed study of costs, but do not provide any other justification for deleting the whole section. RE92 should be disapproved in order to maintain this clear set of requirements in the IECC and ensure that the efficiency of these rooms is maintained.

Proponent : Assembly Motion requests Disapprove.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Disapprove was Successful by a vote of 59.7% (160) to 40.3% (108) by eligible members online during the period of May 11 - May 26, 2016.

RE92-16

RE94-16
R402.4.5 (IRC N1102.4.5)

Proposed Change as Submitted

Proponent : Phillip Norman, representing self (pjnorman@gmail.com)

2015 International Energy Conservation Code

Revise as follows:

R402.4.5 (N1102.4.5) Recessed lighting. Recessed luminaires installed in the ~~*building thermal envelope*~~ building thermal envelope shall be sealed to ~~limit~~ stop all air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and ~~*labeled*~~labeled as ~~having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential~~ airtight. ~~All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.~~

Reason: Any luminaire air leakage whether in a manufactured can or in gaps of installation, is not allowed by Table 402.4.1.1. This section must not contradict the table.
Zero leakage is a reasonable and easily attainable condition. Any allowed leakage is not really measurable as test vs. a limit. Practical can lights, not air-tight in violation of the Table, may pass much less leakage than installation gaps not testable. I have never seen an airtight can installed airtight, but often with very large gaps not amenable to sealing with a silly foam gasket sometimes-found and never to survive for more than a few years in ineffective service. Can light installers are often non-professional construction initiates, including untrained builders and homeowners, and can not be relied upon to have a proper method and material of caulking. Foam caulks are never suitable for can to drywall annuli. the correct sealing point. Many caulks will not bridge the found clearances, or are incompatible with texture and paint processes. Suitable caulk materials are available, as for example, my flexible grout (http://plasterrepairhowto.blogspot.com/), readily available for freely-licensed manufacture or user preparation, always-ready for the installer, with indefinite pot life and no-mess workability as texture repair. There are possible sealing means for continued can installation. In a better future, we will stop setting luminaires in cans. In this near future, low-voltage technicians, not licensed electricians, will install lights as 24 vdc push and pluck gems in pendants or airtight ceiling receptacles, to serve forever. Advance to this future is helped by not fudging on stupid can lights.

Cost Impact: Will not increase the cost of construction
We would not encourage a painter to economize by not using caulk. This sealing, of recessed light ceiling annuli, is not more difficult or expensive.

RE94-16 : R402.4.5-NORMAN11833

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The language is not enforceable. Sealing of can lights could be a violation of the listing for the product. Leakage is being checked on the whole house.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R402.4.5 (N1102.4.5) Recessed lighting. Recessed luminaires installed in the ~~building thermal envelope~~*building thermal envelope* shall be sealed to ~~stop all~~ limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and ~~labeled as airtight~~ shall have a label affixed indicating that the air leakage rate is not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

Commenter's Reason: As documented in NEMA LSD 58-2010 Air Infiltration Ratings for Recessed Luminaires, the lighting industry has maintained a voluntary labeling program for products tested and found compliant with ASTM E283 - 2.0 CFM at 75 Pa. This program has successfully been in place for over 15 years and has a history of providing the necessary indication of compliance. Changing the wording in the second sentence aligns the code with what is established industry practice.

RE94-16

RE96-16
R402.5 (IRC N1102.5)

Proposed Change as Submitted

Proponent : Thomas Culp, Birch Point Consulting LLC, representing self (culp@birchpointconsulting.com)

2015 International Energy Conservation Code

Delete without substitution:

~~**R402.5 (N1102.5) Maximum fenestration *U*-factor and SHGC (Mandatory).** The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 1 through 3 shall be 0.50.~~

Reason: By definition, trade-offs are energy neutral, so these mandatory "hard limits" save no energy, but set artificial constraints that limit design flexibility and innovation. Practically speaking, the vast majority of "normal" windows already meet these criteria, so this section has little real impact, and only serves to (a) add confusion between these numbers and the real requirements in Table R402.1.1, and (b) cause compliance problems for unique or special applications.

DOE recently presented results from its residential energy code field study, with compliance data from Alabama, Kentucky, Maryland, North Carolina, Pennsylvania, and Texas. The results showed that **99%** of windows were compliant with the prescriptive U-factor requirements (and only 0.2% were not compliant with the hard caps), and **98%** were compliant with the prescriptive SHGC requirements (and only 0.4% were not compliant with the hard caps). In other words, window compliance is extremely high, the hard caps are doing nothing, and this whole debate is moot.

This section does nothing but waste space in the code, create artificial barriers, and cause confusion and unnecessary headaches for code officials and builders. It should be removed.

Bibliography: Residential Energy Code Field Study, U.S. DOE Building Energy Codes Program, Webinar Dec 2015, https://www.energycodes.gov/sites/default/files/documents/Field_Study_120715_Final.pdf (https://www.energycodes.gov/sites/default/files/documents/Field_Study_120715_Final.pdf) slides 40-47.

Cost Impact: Will not increase the cost of construction
Field data show this section has almost no impact, so there is no impact on cost, and could decrease cost of construction by increasing flexibility for some special applications.

RE96-16 : R402.5-CULP12656

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Consistency with Committee's prior action on RE96-16.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Thomas Culp, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com) requests Approve as Submitted.

Commenter's Reason: The committee was split with a narrow 6-5 vote on RE95 / RE96, in part as a result of confusion regarding this window "backstop" in relation to other backstops proposed for the entire envelope in other proposals. RE134 and RE156 were recommended for approval as modified by the committee, and include new more comprehensive backstops on the overall envelope U-factor and window SHGC when using performance trade-offs. The backstops in RE134 and RE156 are actually more comprehensive by addressing the U-factor of the entire envelope, not only the windows, and are *more* stringent on SHGC by lowering the SHGC backstop by 25% from 0.50 to 0.40. For these reasons alone, the window backstop in R402.5 (N1102.5) should be removed to avoid having double backstops that are inconsistent, less stringent, and cause for confusion.

Additionally, the evidence from the recent DOE Residential Energy Code Field Study shows that the window backstops are not actually doing anything. (See reference in proposal reason statement.) The field study found that 99% of windows were compliant with the *prescriptive* U-factor requirements, and 98% were compliant with the *prescriptive* SHGC requirements. Some tried to claim that this was evidence that the backstops were working, but that is incorrect. The data shows that all windows are already complying with the *prescriptive* requirements, and therefore, not even using trade-offs or backstops. If anything, this data demonstrates that windows have higher field compliance than any other component, and have the least need for a separate backstop. If the code body feels it is important to have a backstop on envelope performance, then they should approve the more comprehensive backstops in RE134 and RE156, and remove this outdated and unnecessary one. We ask you to Approve RE96 as Submitted.

RE96-16

RE98-16

R202, R403.13 (New) [IRC N1103.13 (New)]

Proposed Change as Submitted

Proponent : Charles Foster, representing Steffes Corporation (cfoster20187@yahoo.com)

2015 International Energy Conservation Code

R202 (N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

ENERGY STORAGE SYSTEM

Equipment that is designed for and capable of receiving, storing and discharging energy. Common examples of energy storage systems include chemical batteries, flywheels, and thermal storage systems.

Add new text as follows:

R403.13 (N1103.13) Energy storage Where an energy storage system is installed, the following information shall be submitted to the code official:

1. A narrative describing the operation of the energy storage system including information such as the building end use loads being supplied by the energy storage system and the storage medium used.
2. A list of components of the energy storage system.
3. A calculation report that indicates the maximum charge level in kilowatt-hours (kWh), the maximum electric charge rate in kilowatts (kW) and the electric or thermal discharge rate in kilowatts (kW) of the system.
4. Identification of the utility, independent servce operator (ISO), or regional transmission organization (RTO) that will control the energy storage system.
5. An indication of how the energy storage system is to be dispatched by the serving grid operator, or micro-grid operator for the purposes of frequency regulation, renewable integration, or grid stabilization.

Reason: This proposal would add specifications for use of energy storage systems in a residence. Currently, no such specifications are included in the IECC.
In the last code cycle, identical language was approved for inclusion in the IGCC.

For additional information on energy storage:

See article at:
http://www.pjm.com/about-pjm/exploring-tomorrows-grid/electricity-storage.aspx?p=1 for information on the value of ETS in the PJM
Interconnection service territory.

See article at
http://www.sustainablebusinessoregon.com/articles/2012/04/bonneville-power-calls-for-first -wind.html?page=all for information on
Bonneville Power curtailment of wind generation amounting to almost 100,000 MWH's in 2011.

See Kema Consulting report (Commissioned by the U.S. Department of Energy under the supervision of Sandia National Laboratory) noting significant reduction in carbon emissions at http://prod.sandia.gov/techlib/access-control.cgi/2008/088229.pdf.

See http://www.steffes.com/off-peak-heating/ets.html for more information on utility benefits of WTS, including energy savings associated with thermal storage and frequency regulation.

See Sandia National Laboratory website at http://www.sandia.gov/ess/ for information on the contributions of energy storage to electric grid stability.

For a detailed description of frequency regulation in North America see Department of Energy / National Energy Technology Laboratory Report Frequency Instability Problems in North American Interconnections, DOE/NETL-2011/1473, Final Report dated May 1, 2011 found at http://www.netl.doe.gov/energy-analyses/pubs/TransmissionFreqProb.pdf

Cost Impact: Will not increase the cost of construction
This proposal does not add any requirements to the IECC and thus will not add to the cost of construction.

**RE98-16 :
R403.13 (NEW)-
FOSTER13434**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There could be unintended consequences created by this proposal. What is the obligation of the builder after submissionof the information? Does there need to be a RTO or ISO? This topic is still too new to be brought into the IECC.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R403.13 (N1103.13) Energy storage Where an energy storage system is installed, the following information shall be submitted to the code official:

1. A narrative describing the operation of the energy storage system including information such as the building end use loads being supplied by the energy storage system and the storage medium used.
2. A list of components of the energy storage system.
3. A calculation report that indicates the energy savings, the maximum charge level in kilowatt-hours (kWh), the maximum electric charge rate in kilowatts (kW) and the electric or thermal discharge rate in kilowatts (kW) of the system.
4. ~~Identification of the utility, independent servce operator (ISO), or regional transmission organization (RTO) that will control the energy storage system.~~
5. ~~An indication of how the energy storage system is to be dispatched by the serving grid operator, or micro-grid operator for the purposes of frequency regulation, renewable integration, or grid stabilization.~~

Commenter's Reason: This modification will make this proposal easier to enforce (in case the system is installed in an area that is not currently being served an ISO or RTO, or the system is not being controlled by a utility).
It also requires that the building designer calculate the energy savings associated with the system.

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Submitted.

Commenter's Reason: The market for energy storage is growing rapidly to accomodate increasing amounts and manage greater amounts of renewable energy.
This proposal would add specifications for use of energy storage systems in a residence. Currently, no such specifications are included in the IECC. In the last code cycle, identical language was approved for inclusion in the IGCC. For additional information on energy storage:

See article at: http://www.pjm.com/about-pjm/exploring-tomorrows-grid/electricity-storage.aspx?p=1 for information on the value of ETS in the PJM Interconnection service territory.

See article at http://www.sustainablebusinessoregon.com/articles/2012/04/bonneville-power-calls-for-first -wind.html?page=all for information on Bonneville Power curtailment of wind generation amounting to almost 100,000 MWH's in 2011.

See Kema Consulting report (Commissioned by the U.S. Department of Energy under the supervision of Sandia National Laboratory) noting significant reduction in carbon emissions at http://prod.sandia.gov/techlib/accesscontrol.cgi/2008/088229.pdf.

See http://www.steffes.com/off-peak-heating/ets.html for more information on utility benefits of WTS, including energy savings associated with thermal storage and frequency regulation.

See Sandia National Laboratory website at http://www.sandia.gov/ess/ for information on the contributions of energy storage to electric grid stability.

For a detailed description of frequency regulation in North America see Department of Energy / National Energy Technology Laboratory Report Frequency Instability Problems in North American Interconnections, DOE/NETL-2011/1473, Final Report dated May 1, 2011 found at http://www.netl.doe.gov/energy-analyses/pubs/TransmissionFreqProb.pdf

RE100-16

R403.3 (IRC N1103.3), R403.3.6 (New) [IRC N1103.3.6 (New)], R403.3.7 (New) [(IRC N1103.3.7 (New)]

Proposed Change as Submitted

Proponent : Craig Drumheller, National Association of Home Builders (CDrumheller@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

R403.3 (N1102.3) Ducts. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through ~~R403.3.5~~ R403.3.7.

R403.3.6 (N1103.3.6) Ducts buried within ceiling insulation Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1) The supply and return ducts have insulation of an R-value not less than of R-8.

2) At all points along each duct, the sum of the ceiling insulation R-values against and above the top of the duct, and against and below the bottom of the duct is not less than R-19, excluding the R-value of the duct insulation.

3) In climate zones 1A, 2A and 3A, the supply ducts are completely buried within ceiling insulation, are insulated to an R-value of not less than R-18 and are in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 or the *International Residential Code*, as applicable.

Exception: Sections of the supply duct that are less than 3 feet from the supply outlet shall not be required to comply with these requirements.

R403.3.7 (N1103.3.7) Ducts located in conditioned space For ducts to be be considered as inside a conditioned space, the ducts shall comply with either of the following:

1. The duct system is located completely within the continuous air barrier and within the building thermal envelope.

2. The ducts are buried within ceiling insulation in accordance with Section R403.3.6 and all of the following conditions exist:

2.1 The air handler is located completely within the continuous air barrier and within the building thermal envelope.

2.2 The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.4, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of conditioned floor area served by the duct system.

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

Reason: In addition to allowing ducts to be buried within attic insulation, this proposal sets alternate requirements for ducts to be considered within conditioned space. The DOE Zero Energy Ready Home defines ducts inside conditioned space as, "Duct distribution systems located within the home's thermal and air barrier boundary or optimized to achieve comparable performance." Item "1)" under R403.3.7 provides for the traditional code definition of being within conditioned space. However, item "2)" in the proposal provides the DOE comparable performance alternative for extremely tight ducts with a full complement of insulation, and with provision for condensation avoidance for humid climates.

Research has shown that virtually all of the benefit of locating ducts inside conditioned space can be achieved by locating the air handler in conditioned space and tested, very low leakage insulated ducts in a vented attic buried under ceiling insulation. R403.7 provides for these conditions in that: The air handler must be located completely within the continuous air barrier and the building thermal envelope; and the ducts must be tested to an extremely low but still measurable level of leakage. The sum of the duct R-value and the ceiling insulation immediately above the duct is unchanged from the amount of prescriptive or proposed ceiling insulation that would have otherwise been installed.

Bibliography: DOE Zero Energy Ready Home National Program Requirements (Rev. 04). May 11, 2015.
http://energy.gov/sites/prod/files/2015/05/f22/DOE%20Zero%20Energy%20Ready%20Home%20National%20Program%20Requirements
%20Final_0.pdf
(http://energy.gov/sites/prod/files/2015/05/f22/DOE%20Zero%20Energy%20Ready%20Home%20National%20Program%20Requirement

%20Final_0.pdf)

Cost Impact: Will not increase the cost of construction
This proposal provides a new option that will likely reduce the cost of construction and increase the energy efficiency of a house with ducts in an attic. Burying ducts in insulation and tightly sealing the ducts is a less expensive and more energy efficient solution than creating a conditioned attic. Additionally, it is often a more practical and homeowner friendly solution than installing bulkheads in the ceiling to keep ducts in conditioned space.

RE100-16 :
R403.3-
DRUMHELLER13073

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

R403.3.6 (N1103.3.6) Ducts buried within ceiling insulation Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1) The supply and return ducts have insulation of an R-value not less than of R-8.

2) At all points along each duct, the sum of the ceiling insulation R-values against and above the top of the duct, and against and below the bottom of the duct is not less than R-19, excluding the R-value of the duct insulation.

3) In climate zones 1A, 2A and 3A, the supply ducts are completely buried within ceiling insulation, are insulated to an R-value of not less than ~~R-18~~ R-13 and are in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 or the *International Residential Code*, as applicable.

Exception: Sections of the supply duct that are less than 3 feet from the supply outlet shall not be required to comply with these requirements.

Committee Reason: The modification was made to be in alignment with the Committee's prior modification action on RE99-16. The proposal as modified was approved because this adds to the language that RE99-16 added so that testing can consider the ductwork being inside of the thermal envelope.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: RE100 should be disapproved because it creates an unsupported special loophole for ducts buried in ceiling insulation that will lead to reduced energy efficiency, by: (i) specifying testing duct leakage for these ducts to the outdoors (instead of specifying testing of total leakage, which is the standard for testing duct leakage in all other circumstances) and (ii) treating these ducts as "inside conditioned space" (allowing a substantial amount of duct leakage outside the building thermal envelope that otherwise would not occur if the ducts were actually located inside conditioned space). Further, the adoption of RE100 would create inconsistencies and confusion in code compliance and enforcement. We note that the same proponent has proposed another special compliance feature for these ducts in another code proposal that was also recommended for approval by the committee. We are concerned that adding both special treatments would provide too much credit for this building practice to trade-off against other efficiency measures.

First, testing total duct leakage is the appropriate method to help ensure that conditioned air reaches the intended destinations within the building; that is why the code currently requires all ducts outside of conditioned space to meet duct leakage requirements based on a total duct leakage test. Testing leakage to outdoors does not address the common scenario of a duct system that leaks substantial amounts of conditioned air near the air handler (often into a furnace room or basement). When conditioned air does not reach bedrooms or other occupied areas of the home, occupants often adjust the thermostat to either heat or cool the building more – using more energy and costing the homeowner more money. Testing total leakage will help avoid that situation, and will help ensure that heating and cooling equipment operates as efficiently as intended.

Second, RE100 would have the code treat these ducts as "located inside conditioned space," even though portions will be located in the attic. The IECC applies less stringent requirements to ducts located entirely inside conditioned space because if there is any leakage, the air is leaking into some portion of the conditioned space. RE100 presents the likely scenario where conditioned air may still be leaked into the unconditioned attic and outside conditioned space. This would lead to reduced duct efficiency (as compared to the current IECC), as demonstrated below:

% savings lost by treating ducts as in conditioned space as compared to ducts with leakage at 1.5 CFA

CZ	**Energy Losses from Ducts Outside Conditioned Space at 1.5 CFA**
1	1.4%
2	1.2%
3	1.0%
4	1.1%
5	1.4%
6	1.6%
7	2.1%
8	2.8%
Nat'l Avg	1.2%

The table above compares the overall energy use of the building with 1.5cfm/sq.ft. duct leakage (as required by the proposal) versus a building with all ducts located inside conditioned space. On a national average basis, we found roughly a 1.2% reduction in the overall efficiency associated with this difference.

For these reasons, we recommend disapproval of RE100.

RE100-16

RE101-16
R403.3.2, (IRC N1103.3.2)

Proposed Change as Submitted

Proponent : Mark Smith, GreenSeam Industries, representing GreenSeam Industries (msmith@greenseamind.com)

2015 International Energy Conservation Code

Revise as follows:

R403.3.2 (N1102.3.2) Sealing (Mandatory). Duct construction and installation shall be in accordance with the *International Mechanical Code* or the *International Residential Code*, as applicable. Ducts, air handlers and filter boxes shall be sealed. ~~Joints~~ Longitudinal and transverse joints, seams and connections of supply and return ducts shall ~~comply~~ be securely fastened and sealed with ~~either~~ welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes installed in accordance with the manufacturer's instructions. ~~*International Mechanical Code* or *International Residential Code*, as applicable.~~

- **~~Exceptions~~Exception:**
    ~~1.~~ Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
    ~~2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.~~
-

Reason: The reason for this code change proposal is two-fold.

FORMATTING ISSUES:

This proposal clarifies that the exception should not be exception to the energy code requirements for duct sealing but keeps it in the mechanical code for residential.

There are inconsistencies in the IECC, IRC and IMC between the formatting of the sections on duct sealing and as such, are confusing and difficult to enforce consistently.

TECHNICAL ISSUES:

The sealing requirements within the IECC (R403.3.2) and the IRC (N1103.3.2) should be clear and easy to understand. This revised text will result in a decrease in failed duct leakage tests for energy conservation and energy efficiency of operation of the HVAC system.

Protection against such leakage is essential to energy efficiency. When ducts leak because they are not sealed or otherwise not properly installed, unconditioned air leaks into the return side (negative pressure) and conditioned air leaks out of the supply side (positive pressure) of the HVAC system. The unconditioned air leaking into the HVAC system causes the system to run longer in order to heat or cool the air mass to satisfy the comfort settings. The conditioned air leaking out of the HVAC system causes the system to run longer because an insufficient amount of air is delivered to the occupied zone of the building.

Where higher energy efficiency is required, particularly for post installation or modifications of the HVAC system, duct sealing requirements are essential.

The exception to the requirement for sealing ducts in low pressure duct systems to better placed in the residential mechanical code. The IRC already sends the code user to Section IRC (M)1601.4.1 for exceptions for duct sealing of joints and seams. The exception to the sealing or closure systems that applies to continuously welded seams and joints, and also for locking-type longitudinal joints and seams in low-pressure duct systems should be retained in the mechanical sections only.

Cost Impact: Will not increase the cost of construction
The cost impact to this code change proposal is neutral. The requirements for duct sealing, including any permitted exceptions, are already in the mechanical section of the IRC and the residential section of the IMC. This proposal directs the user to those code books.

**RE101-16 :
R403.3.2-
SMITH13281**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The current language is straight forward. There is no need to have a laundry list. Let the IMC/IRC-M be the experts on how to seal ductwork,

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Mark Smith, DMI Companies, representing DMI Companies (msmith@dmicompanies.com) requests Approve as Submitted.

Commenter's Reason: This public comment requests that the proposal be Approved as Submitted.

The IECC-R requires the duct system to meet stringent duct leakage requirements. The suggested proposal clarifies the code language while providing the increased level of sealing necessary to achieve the duct leakage test results required by the code.

Protection against duct leakage is essential to residential energy efficiency. When ducts leak because they are not sealed or otherwise not properly installed, unconditioned air leaks into the return side (negative pressure) and conditioned air leaks out of the supply side (positive pressure) of the HVAC system.

The IRC (mechanical provisions) sets the minimum requirements for duct sealing. However, the IECC (residential energy provisions) should provide additional sealing requirements for maximum equipment and system performance, and also energy efficiency. Nearly every duct system installation is customized. Not requiring the sealing of all joints and seams will result in inconsistent duct leakage test results at best, but most likely recurring failures.

This proposed language modifies the current text because the current language requires the inspector to determine the operating pressure of the duct system. This information is not readily available to the inspector at the time of inspection. This proposal takes that judgment call off of the inspector. The current language also requires the inspector to be able to identify the different types of joints, which many inspectors cannot do, and it is difficult (nearly impossible) to determine after duct system installation. This proposal also removes another judgment call from the inspectors, all of which ensure more consistent enforcement of the duct sealing requirements.

The IRC Mechanical Code Section (M)1601.4.1 permits an exception for duct sealing in unconditioned spaces. However, this exception results in the unconditioned air leaking into the HVAC system which causes the system to run longer in order to heat or cool the air mass to satisfy the comfort settings. The conditioned air leaking out of the HVAC system causes the system to run longer because an insufficient amount of air is delivered to the occupied zone of the building. The mechanical code does not address system efficiency.

Where higher energy efficiency is required, particularly for post installation or modifications of the HVAC system, duct sealing requirements are essential.

Analysis: Proposal RE102-16 was AS and did not receive any public comments. Therefore, RE102-16 on the consent agenda. That proposal deleted all of the exceptions of this section which will result in RE101-16 having not impacting the exceptions (they are deleted.)

RE101-16

RE103-16

R403.3.3 (IRC N1103.3.3), R403.3.4 (IRC N1103.3.4)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

R403.3.3 Duct testing and maximum leakage (Mandatory). ~~Ducts~~ The ductwork in a building or dwelling unit shall be ~~pressure~~ tested ~~to determine~~ for air leakage. The maximum total air leakage ~~by one~~ rate for ducts in any building or dwelling unit under any compliance path shall not exceed 8 cfm (226.5 L/min) per 100 square feet (9.29 m^2) of conditioned floor area. Testing shall be conducted at the rough-in stage or post-construction. Total duct 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 if installed at the time 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.~~

test. All registers shall be taped or otherwise sealed during the test. Where required by the code official, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*.

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:

1. Rough-in test: The total leakage shall be less than or equal to 4 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 test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

Reason: The purpose of this proposal is to reinstate a mandatory duct tightness test requirement, but also to set the backstop at half the level of tightness required under the current prescriptive requirement, and to apply it to all homes. Under the 2012 IECC, all ducts (except those in conditioned space) were required on a mandatory basis to meet the current 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. With extra-leaky ducts, 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 in an effort to heat or cool areas (by adjusting the thermostat) with an inadequate distribution of conditioned air.

Cost Impact: Will increase the cost of construction

The addition of a mandatory duct leakage target half as stringent as the prescriptive path requirement should not increase the cost of construction. However, in those limited cases where the ducts are currently not being tested, and where the ducts and air handler are not located inside the building thermal envelope, there would be an increased cost of duct testing and the cost of any remedial efforts.

RE103-16 : R403.3.3-FAY12772

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal reduces flexibility for meeting requirements. There isn't any evidence of widespread issues of contractors taking advantage of not having a high leakage number as a "backstop".

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 38.2% (89) Oppose: 61.8% (144)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: This proposal should be approved as submitted because it would restore a reasonable mandatory maximum limitation on duct leakage, helping to ensure at least a minimal level of duct efficiency in every new home. Reasonable duct efficiency is critical for efficient homes, particularly to ensure that the conditioned air ultimately flows to all locations in the home as designed.

The 2009 IECC required as a mandatory measure that every home be tested for air leakage at a rate no higher than 8 cfm//100sq. ft.; the 2012 IECC strengthened this value to 4 cfm. In the 2015 IECC, each building must be tested and the prescriptive requirement remains the same; however, the duct tightness requirement is no longer designated as "mandatory." This change went too far in our view, in that it permits code users to completely trade-off duct tightness against the efficiency of other building components – with no limitation whatsoever under either the Performance Path compliance approach or the ERI. This is a particularly large problem in the context of the Energy Rating Index, where code users are permitted to trade efficiency among many elements of the building, including equipment, appliances, and lighting.

This proposal establishes a realistic mandatory limitation on duct tightness trade-off. It would still allow *double* the amount of duct leakage in a trade-off than the amount required in the Prescriptive Path. This would be consistent with other mandatory trade-off maximums, which can be set to allow some trade-off room, but still require a minimum level of performance for all buildings. Most importantly, this proposal would help ensure that much of the conditioned air reaches the intended location in the home. Not only will this improve energy efficiency and comfort, but will also help maximize heating and cooling system performance. This important proposal should be approved as submitted.

RE103-16

RE104-16
R403.3.3 (IRC N1103.3.3)

Proposed Change as Submitted

Proponent : Eric Makela, Cadmus Group, representing RESNET

2015 International Energy Conservation Code

Add new text as follows:

R403.3.3 **(N1103.3.3)** **Duct testing (Mandatory).** Ducts shall be pressure tested in accordance with BRS/RESNET/ICC 380 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*.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

BRS/RESNET/ICC 380-2015 Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems. Republished January 2016. Addendum A-2015 and Addendum B-2015.

Reason: R403.3.3 Duct testing, currently provides no guidance for testing duct systems to determine if they meet the maximum duct leakage rate. The current code language sets a duct leakage metric and essentially leaves it up to those that are testing the system to determine how to arrive at the results. The lack of guidance can lead to inconsistent test results from house to house. This code change proposal solves this problem by requiring testing to conform to ANSI/RESNET/ICC Standard 380 - Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems. This standard provides a standardized methodology that is currently in use throughout the industry. The methodology will provide consistent results that can be replicated by testing organizations and enforcement personnel.
Why RESNET/ICC Standard 380 Instead of Other Standards. RESNET/ICC Standard 380 has been developed to provide a consensus national standard for consistent measurement of several air-flow related residential building metrics. It builds off of existing American National Standards to provide standard procedures essential to the evaluation of the energy performance of residential buildings energy. Other standards are in existence but are more suitable for research and not code enforcement. For example, ASTM Standard E1554-13 describes 4 different test methods (A, B, C, and D) for performing a duct leakage test. Method A requires multi-point testing of both the enclosure and the distribution system at a range of 5 to 50 Pa in 5 Pa increments using both pressurization AND depressurization of the building enclosure AND distribution system. Method B requires a physical separation of the supply and return distribution systems and that each are tested separately at a 25 Pa pressure difference, while measuring the pressure difference between any buffer zones and the outside. This procedure requires several iterations of each test (supply, return, buffer zone). Method C measures distribution system leakage to the outside using a 25 Pa pressure difference across the building enclosure with reference to the outside using a location sheltered from wind and sunshine. The distribution system is tested at a 25 Pa pressure difference with reference to the outside and the recording of inside temperature, outside temperature, and barometric pressure at the start and end of each test. This method requires testing under pressurization, while Standard 380 allows pressurization or depressurization (field conditions may require depressurization in order to maintain seals on the supply outlets and return inlets). Method D measures total distribution system leakage at a 25 Pa pressure difference with reference to the outside without using a fan (blower door) to create a 25 Pa pressure difference across the building enclosure to isolate leakage to the outside. Conditions of integrated mechanical ventilation dampers are not mentioned in E1554, while Standard 380 provides explicit instructions regarding mechanical ventilation systems integrated with the distribution system. ASTM E1554 also has extensive reporting requirements including calibration of air flow meter, a tabular listing of all air leakage data (air flows, time, all pressures), and floor areas and volumes of building (conditioned floor area, attic, basement, and crawlspace).

Cost Impact: Will not increase the cost of construction
The protocol for duct testing described in Standard 380 is consistent with the testing protocols presented in RESNET certifications for HERS raters and also with the Duct and Envelope Testing (DET) training sessions that are being deployed in several states to meet the testing needs of the IECC. This protocol is considered industry standard and will not increase the time for testing ductwork, so the cost of testing will not increase, but will lead to more compliant duct systems for duct testing professionals that may not be following a protocol. The protocol does not change the target duct air leakage rate so there are no additional costs to seal the duct system to make it code compliant.

Analysis: A review of the standard proposed for inclusion in the code, BRS/RESNET/ICC 380-2016, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016)

RE104-16 : R403.3.3-MAKELA12645

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There are problems in RESNET 380 with mandatory language. The scope of that standard doesn't fit well with multi-family dwellings having common areas.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Eric Makela, representing RESNET (eric.makela@cadmusgroup.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R403.3.3 (N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested in accordance with ~~BRS~~ ANSI/RESNET/ICC 380 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*.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

Commenter's Reason: R403.3.3 Duct testing, currently provides no guidance for testing duct systems to determine if they meet the maximum duct leakage rate. The current code language sets a duct leakage metric and essentially leaves it up to those that are testing the system to determine how to arrive at the results. The lack of guidance can lead to inconsistent test results from house to house. This code change proposal solves this problem by requiring testing to conform to ANSI/RESNET/ICC Standard 380-2016 - Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems. This standard provides a standardized methodology that is currently in use throughout the industry. The methodology will provide consistent results that can be replicated by testing organizations and enforcement personnel.
This proposal was disapproved at the 2018 IECC Code Change Hearings for the following reasons:

1. Unenforceable language was found in Standard 380 during a review of the standard even after the ICC staff review

reported:

"Appears to be written in enforceable language. Does not appear to require proprietary materials or agencies. Promulgated according to a consensus procedure."

2. It was felt that there should be more than one testing option available for compliance with the code, and
3. The standard did not address multi-family buildings.

Unenforceable Language. The RESNET Standards committee reviewed and addressed the few instances in question in the Standard. Standard 380 was republished in June, 2016 with the corrections.

Testing Options. Standard 380 includes a reference to Test Method A from ASTM E1554-13 as an alternative duct leakage test method. ASTM E1554-13 is for testing air distribution systems in low-rise residential and commercial buildings. This allows the user to follow either test method for duct leakage testing.

Multi-family Buildings. Section 2 Scope of Standard 380 states

"The procedure for measuring the airtightness of heating and cooling air distribution systems is also ***applicable to dwelling units in multifamily buildings,*** where each dwelling unit has its own duct system separate from other dwelling units."

It is very common for each dwelling unit to have its own duct system separate from other dwelling units in low-rise multi-family as they typically install a separate heating and cooling system for each apartment. The IECC has special provisions for HVAC systems serving multiple dwelling units. Section R403.8 requires that systems serving multiple dwelling units must comply with Section C403 Building Mechanical Systems. Section C403 contains requirements for Duct and Plenum insulation and Sealing (Section C403.2.9) which includes Duct Construction (Section C403.2.9.1).

ASTM E1554-13, which applies to low-rise residential and commercial buildings, can be used to test duct systems in the non-dwelling unit areas of multi-family buildings e.g. offices, lobbies, common areas, etc.

Why ANSI/RESNET/ICC Standard 380 Instead of Other Standards. ANSI/RESNET/ICC Standard 380 has been developed as an American National Standard under the auspices of ANSI to provide a consensus-based national standard for consistent measurement of several air-flow related residential building metrics. It builds on existing American National Standards to provide standard procedures essential to the evaluation of the energy performance of residential buildings energy. It also references ASTM Standard E1554-13 which allows 4 different test methods (A, B, C, and D) for performing duct leakage tests.

RE104-16

RE106-16

R403.3.3 (IRC N1103.3.3), R403.3.4 (IRC N1103.3.4)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

R403.3.3 (N1103..3.3) Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage ~~by one of~~ to 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.~~

outdoors. A written report of the results of the ~~test~~ tests shall be ~~signed by the party conducting the test and~~ provided to the *code official*.

The leakage test shall be performed post construction. Leakage to outdoors shall be less than or equal to 4 cubic feet minute (113.3L/min) per 100 square feet (9.29 m^2) of conditioned floor area served, (4cfm/100 ft^2), when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure, with a blower door and duct leakage testing device. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct leakage to outside test shall not be required where the ducts and air handlers are documented, at a rough stage of construction, to be located entirely within the building's air barrier and thermal envelope.
2. Where the HVAC duct work system is serving not more than 1200 square feet of conditioned floor area, the allowable duct leakage to outside target shall be 60 CFM regardless of the calculated 4 cfm/100 ft^2 calculations.
3. If a total duct leakage test is performed, a measurement of the 60 cfm or less can be used instead of testing for duct leakage to outside in any software calculations demonstrating compliance with this energy code if that level of duct leakage demonstrates compliance with the code.

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

1. ~~Rough-in test: The total leakage shall be less than or equal to 4 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 test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.~~
2. ~~Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.~~

Reason: Currently having both mandatory and prescriptive requirements is confusing. Duct leakage to outside (LTO) testing specifically addresses the energy component of duct leakage which is the primary intent of the IECC. There are many benefits and reasons why one should test total Duct leakage that are in alignment with the life safety, durability, comfort intent of the code. However, efficiency of the duct system is only measured by duct leakage to the outside. If one test is all the code can dictate then this is the correct test to choose.

- The exception to LTO testing should still stand if all ducts are within the buildings thermal envelope. However, we have added a definition of how to determine if the ducts are inside the buildings thermal envelope and air barrier system. This is greatly needed to ensure that there is a common understanding of when the exception can and should be used. For example, ducts within the floor system of a floor over a garage would now be defined to be within the air barrier of the home and testing for LTO would not be required. Currently this distinction is lacking.
- The 4 cfm/100sqft of floor area target currently penalizes small units, so we have introduced a fix that was first developed by the Energy Star program. **Currently the duct** Total leakage targets at rough-in or final is based on amount of conditioned floor area, regardless of total floor area served. **In this proposal** a 'floor' has been added to the duct leakage limits. By 'floor', we mean a lower limit that doesn't decrease as the space gets smaller and smaller.
  - Energy Stars target floor is 40 CFM. We have used 60 CFM as it is a more reasonable target for small systems in our

current state of installation and sealing expertise.

Cost Impact: Will not increase the cost of construction
Switching from Total duct leakage to Duct leakage to outside only, would actually save money as the test would not have to be performed on every house. In addition, the test is performed at the same time as the blower door test so addition visits to the house could be reduced is the testing agency was doing a unique visit just for total duct leakage testing services. As the requirement for testing is still being proposed some fee, presumably at least the same fee as was charged for Total Leakage, would be charged.

RE106-16 : R403.3.3-SCHWARZ13068

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Leakage is measured to outdoors only.The code does not need to be concerned with loss of energy inside the thermal envelope or comfort.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jeremy Field, representing Building Efficiency Resources requests Approve as Submitted.

Commenter's Reason: I fully support this proposal. As an experienced HERS rater and energy code field verifification professional, there are unintended consequences of the code requiring "Total Duct Leakage". The Committee ruled in the preliminary hearings that:
"Leakage is measured to outdoors only The code does not need to be concerned with loss of energy inside the therma envelope or comfort"

This statement shows that the Committee members may not fully grasp what the Proposal intends to change, and the problem with the current code requirement. The current code requires that if any portion of the duct system is outside of the buidling thermal envelope, the entire duct system needs to be tested for "Total Duct Leakage". Thus, if a home has 90% of ducts inside the envelope, and 10% of ducts outside of the envelope, 100% of the system still must be tested for Total Duct Leakage.

The problem with this is that Total Duct Leakage DOES count the leakage of the ENTIRE system... meaning the leakage associated with the 90% of ducts that are inside the house is in addition to the leakage associated with the 10% of ducts. Thus, whereas the Committee states that the code only needs to be concerned with the energy penalty of ducts leaking to outdoors and not comfort/air distribution issues of ducts leaking inside the house,the current code language DOES NOT realize this intent - it causes duct systems that are both inside and outside to be tested for its entire leakage.

The only way to test ducts only for the energy penalty of leakage to outside is to require the system to be tested for Duct Leakage to Outside - not Total Duct Leakage. This Proposal - by requiring only Duct Leakage to Outside testing - does just that - it would require a test that only deal with ducts leaking outside of the house and its associated energy penalty.

I urge the Committee to seek guidance from experienced diagnostic testing professionals such as HERS raters, the manufacturer of testing tools such as The Energy Conservatory, or other professionals who actually do these tests. Without doing that, the Committee may rule in errant on this issue and miss a golden opportunity to improve the code.

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Submitted.

Commenter's Reason: In this case the Committee got it completely wrong. Leakage is not measured to the outdoors only as stated in the committee reason statement. In fact, section R403.3.3 and R403.3.4 specifically say that the test if for **total** duct leakage. I believe the committee may not have had the knowledge to know that there are two kinds of duct leakage test. Total duct leakage measures duct leakage that is leaking both inside and outside the building envelope. Duct leakage to the outside, the second type of test that can be performed, only measures that portion of the leakage that is flowing through the system to outside the building envelope. Duct Leakage to outside is the only measurable energy penalty that can be associated with leaky ductwork.

As the committee stated, "the code does not need to be concerned with loss of energy inside the thermal envelope". This is absolutely true and therefore Total duct leakage should not be the matrix that is used to assess an energy penalty or reward associated with duct leakage. There are very valid reasons to test total leakage that are addressed in other proposals.

RE106-16

RE107-16

R403.3.3 (IRC N1103.3.3), R403.3.4 (IRC N1103.3.4)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

R403.3.3 (N1103.3.3) Duct testing (Mandatory).

Ducts shall be pressure tested to determine ~~air~~ both total leakage ~~by one of~~ and leakage to 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.~~

outside. A written report of the results of the ~~test~~ tests shall be ~~signed by the party conducting the test and~~ provided to the *code official*.

1. Total duct leakage rough-in test or post construction test:The total leakage shall not exceed 4 cfm (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 test. Where the air handler is not installed at the time of the test, the total leakage shall not exceed 3 cfm (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. Where the HVAC duct work system serves less than 1200 square feet of conditioned floor area, the allowable total duct leakage target shall be 60 cfm regardless of the calculated 4 cfm/100 sq ft calculation.
2. Where the total duct leakage measurement is 60 cfm or less, a duct leakage to outside the building thermal envelope test shall not be required. Such actual leakage measurement can be used as the number entered into any software calculations demonstrating compliance with this code for the performance path duct leakage to outside penalty or tradeoff, where the measured number demonstrates compliance with the code in the software calculation.

2. Duct leakage to outside post construction test: Leakage to outside the building thermal envelope shall not exceed 4 cfm (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area served when tested at a pressure differential of 0.1 w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure, with a blower door and duct leakage testing device. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct leakage to outside test shall not be required where the ducts and air handlers are documented, at a rough-in stage of construction, to be located entirely within the building's air barrier and thermal envelope.
2. Where the HVAC duct work system serves less than 1200 square feet of conditioned floor area, the allowable duct leakage to outside shall be 60 cfm or less.

Delete without substitution:

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

1. ~~Rough-in test: The total leakage shall be less than or equal to 4 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 test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.~~
2. ~~Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.~~

Reason:

- Currently having both mandatory and prescriptive requirements is confusing. Duct leakage testing is needed and needs to just be required to ensure efficiency, durability, safety, and comfort. All are the intent of the IECC.
- Both of the current testing paths use the wrong matrix from an energy perspective. In order to ensure the intent of the IECC is maintained it makes sense to keep the total duct leakage requirement as it deals with very important issues that are byproducts of energy efficiency; durability, safety, and comfort. Adding a Duct leakage to outside (LTO) testing requirement specifically addresses the energy component of duct leakage which is also the intent of the IECC.
- The exception to LTO testing should still stand if all ducts are within the buildings thermal envelope. However, we have added a definition of how to determine if the ducts are inside the buildings thermal envelope and air barrier system. This is greatly needed to ensure that there is a common understanding of when the exception can and should be used. For example, ducts within the floor system of a floor over a garage would now be defined to be within the air barrier of the home and testing for LTO would not be required. Currently this distinction is lacking.
- The 4 cfm/100sqft of floor area target currently penalizes small units, so we have introduced a fix that was first developed by the Energy Star program. **Currently the duct** Total leakage targets at rough-in or final is based on amount of conditioned floor area, regardless of total floor area served. **In this proposal** a 'floor' has been added to the duct leakage limits. By 'floor', we mean a lower limit that doesn't decrease as the space gets smaller and smaller.
    - Energy Stars target floor is 40 CFM. We have used 60 CFM as it is a more reasonable target for small systems in our current state of installation and sealing expertise.

Bibliography: The Energy Conservatory

Duct Leakage to Outside Testing Instructions

Pages 25 through 31

http://energyconservatory.com

Cost Impact: Will increase the cost of construction

Currently Total duct leakage testing is required. Duct leakage to outside is also required for IECC code sections R405 simulated performance and R406 ERI pathways. Duct leakage to outside is a tradeable feature and is an input in the modeling software used to demonstrate compliance with the code when using sections R405 and R406. Therefore, the code in essence is currently requiring both tests for these pathways through the code. Price would increase for those who are using the prescriptive path but should remain the same for those using the simulated performance path or the ERI path for compliance.

Duct leakage to outside is performed at the same time the blower door test is performed, as a blower door and duct leakage testing device must run together to for the test, which increases the cost effectiveness of this test. Adding this test to the process of compliance should add between $50 and $100 to the cost of compliance for those currently using the prescriptive path.

RE107-16 : R403.3.3-SCHWARZ13057

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The language isn't getting to the point about the testing and doesn't cover everything that it needs to. The cost impact statement is not accurate.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Submitted.

Commenter's Reason: The committee stated that "the language isn't getting to the point about the testing and doesn't cover everything that it needs to." I would agree that the code language should be understandable to all. However, some of the code language speaks to specific target audiences. For example, table R402.1.1 makes it obvious to a builder that there are air barrier and insulation mandatory requirements. The language embedded in the table is not very understandable to the builder but speaks to framers, insulators and makes it relatively clear what is needed. In the same way this section of the code demonstrates to the builder that they have to do both a total duct and duct leakage to outside test. The exceptions are really speaking to the testing contractors. Absolutely everything is covered here in terms of what is required for testing. In fact, there is tremendous flexibility built into the language which will lower the probability that both tests will actually have to occur.

1. Small homes and units are currently penalized and required to achieve unrealistic duct leakage goal because of the target calculation equation. Exception 1 in Total leakage section and 2 in the leakage to outside section say that the duct leakage target can't be below 60 CFM.
2. If the total duct leakage target is 60 CFM or lower than a duct leakage to outside test does not have to be performed.
3. If duct work is located entirely inside the building thermal envelope, then no duct leakage to outside test is required. This is currently the case but is currently little guidance on how to determine if the ducts are completely inside. This proposal offers that guidance.

I believe that the cost impact statement is correct. EnergyLogic performs these tests on a daily basis and I know what we charge for a duct leakage to outside test when done in conjunction with a blower door test. Since this is the only time that such a test can be performed the cost estimates are accurate. I am not saying that there will be no impact since there is a potential for having to perform two tests. What I am saying is that the potential to need to perform both test is low, but incorporating both test in the code is important.

RE107-16

RE108-16

R403.3.3 (IRC N1103.3.3), R403.3.4 (IRC N1103.3.4)

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

R403.3.3 (N1103.3.3) 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.~~
1. ~~Postconstruction~~ Rough-in 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 if installed at the time of the test. ~~Registers~~ All 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.~~
2. Postconstruction test: Leakage to outdoors shall be less than or equal to 4 cfm (113.3L/min) per 100 square feet (9.29 m^2) of conditioned floor area or total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m^2) of conditionedfloor area when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Alternatively, a duct leakage to outside test with a pressure differential of 0.1 w.g. (25 Pa) with reference to outside that includes the manufacturer's ait 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*.

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

1. Rough-in test: The total leakage shall be less than or equal to 4 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 test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
2. Postconstruction test: Total leakage or leakage to outside shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

Reason:

Allowing the option for measurement of duct leakage to the outside will give both HVAC installers and homeowners an accurate measurement of duct leaks to the exterior of the building. Duct leakage to the outdoors is an accepted duct testing method in the industry and was allowed under Section 403.2.2 of the 2009 IECC and approved for the 2015 IECC by the committee, but withdrawn by the proponent. The proposed leakage rate is set at 4 cfm per 100 square feet of conditioned floor area which consistent with the 2015 requirements for total duct leakage. Proposed changes provide clarity as to what distribution system efficiency should be applied to the Standard Reference Design and how the ducts should be modeled in the performance path.

Cost Impact: Will not increase the cost of construction

The code change proposal will not increase the cost of construction. Code requirements are not proposed to be changed, rather added options for compliance will have the ability to reduce the cost of construction.

RE108-16 : R403.3.3-SURRENA12553

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Leakage to inside the thermal envelope isn't really a concern--only leakage to outdoors.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Craig Drumheller, representing National Association of Home Builders (CDrumheller@nahb.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

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. <u>Alternatively, leakage to outside shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) relative to outside across the entire system, including the manufacturer's air handler enclosure.</u> 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*.

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:

1. Rough-in test: The total leakage shall be less than or equal to 4 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 test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
2. Postconstruction test: Total leakage <u>or leakage to outside</u> shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

Commenter's Reason: There was a problem with the original submittal and this modification fixes the issues. The committee supported the concept as evidenced with the Committee Reason.

Need for change:

Allowing the option for measurement of duct leakage to the outside of the house (in addition to total system leakage) will provide an accurate measurement of duct leakage to the exterior of the building (lost energy). Duct leakage to the outdoors is an accepted duct testing method in the industry (e.g. ANSI/RESNET/ICC 380-2016) and was allowed under Section 403.2.2 of the 2009 IECC and a similar change allowing leakage to the outside was approved for the 2015 IECC by the committee, but withdrawn by the proponent.

When determining annual energy consumption using the performance path, the total duct leakage is not used, only the duct leakage to outside is relevant.

RE108-16

RE109-16
R403.3.5 (IRC N1103.3.5)

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

R403.3.5 (N1103.3.5) Building cavities (Mandatory). Building framing cavities shall not be used as ducts or plenums.

Exception: Individual wall framing cavities used for transfer air between two spaces on the same level complying with Section 602.3 of the *International Mechanical Code* [IRC Section M1601.1.1.1]

Reason: For the last few editions of the IECC and the IRC, there has been a conflict between the energy and duct system provisions regarding the use of stud wall cavities as air plenums. As the IECC requirement was more stringent, the 'conflict' was resolved in favor of the energy provisions. The SEHPCAC discussed the provisions of IRC M1601.1.1 and consider it to be an acceptable approach for return air. Therefore the proposed exceptions to IRC N1103.3.5 and IECC R403.3.5 directs the user to M1601.1.1 for wall framing cavities used to transfer return air between two spaces on the same level.
This proposal was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at:
http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Cost Impact: Will not increase the cost of construction
The code change proposal will decrease the cost of construction. Due to current conflict in code, the energy provisions require the use of metal ductwork for all transfer openings, while the mechanical provisions allow the use without metal ductwork. Allowing the longstanding mechanical provisions to be used for transfer air will reduce construction costs and not increase energy costs.

RE109-16 : R403.3.5-COLLINS11458

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: It is poor practice to allow airflow in wall cavities. If a jumper duct system is needed, the proposal needs to be worded for that purpose.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee requests Approve as Submitted.

Commenter's Reason: RE109 resolves a code conflict between the IECC and Section M1601.1.1 of the IRC.

The SEHPCAC disagrees with the reason statements given for disapproving this proposal. Contrary to the committee's reasoning, the RE109 proposal does not allow for transfer air connections between floors. Contrary to the committee, the proposed method is not poor practice. The method is allowed under the IRC mechanical provisions. Publications from the US Department of Energy's Build America program and Building Science Corporation show wall cavity transfer air for HVAC system pressure equalization and proper air distribution within a residence.

To further address the committees concerns, M1601.1.1, Exception 7 allows transfer openings when:

7.1. These cavities or spaces shall not be used as a plenum for supply air.

7.2. These cavities or spaces shall not be part of a required fire-resistance rated assembly

7.3. Stud wall cavities shall not convey air from more than one floor level.

7.5 Stud wall cavities in outside walls of building envelope assemblies shall not be utilized as air plenums.

The exception as written, **"**Individual wall framing cavities used for transfer air between two spaces on the same level complying with Section 602.3 of the *International Mechanical Code* [IRC Section M1601.1.1.1]" allows the following:

- A transfer air within a single wall framing cavity between two studs. The transfer may not be within a floor or ceiling cavity.
- The transfer cavity must be fully within the building envelope. Transfer cavities may not be in building envelope assembly walls.
- A connection between two spaces on the same level
  - Neither M1601.1.1 nor this proposal would allow connection between floors. See 2015 IRC Commentary Figure M1601.1.1(2).
- The cavity is for transfer air only; the cavity may not be connected to the return or supply duct or fan. This allowance for transfer air will not subject the cavity to a significant pressure differential.

RE109 resolves a conflict between the mechanical and energy provisions of the IRC. This proposal allows for accepted, standard construction practice. It allows for better air distribution within a home without having to resort to jump ducts. A jump duct system can require cutting and sealing two holes in the air barrier and routing of the transfer air outside of the thermal envelope. Transfer within a single stud bay on a single level between two adjacent rooms avoids the cutting and patching of the ceiling and the transfer air remains within the thermal envelope.

If transfer air within a stud bay was unsafe or was a detrimental construction practice, the provision should be addressed within Chapter 16 of the IRC. However such concerns are irrelevant to energy use covered by Chapter 11 of the IRC (IECC Chapter 4 [RE]). The practice is of using stud bay transfer is accepted by the US DOE Build America program to provide better air distribution in homes.

This public comment was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015-16, the SEHPCAC has held five two- or three-day open meetings and 40 workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

RE109-16

RE113-16

R202 (IRC N1101.6) (New), R403.5 (IRC N1103.5), R403.5.1 (IRC N1103.5.1) (New)

Proposed Change as Submitted

Proponent : Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) DESUPERHEATER/WATER HEATER. A factory-made assembly of elements by which the flows of refrigerant vapor and water are maintained in such heat transfer relationship that the refrigerant vapor is desuperheated and the water is heated. A water circulating pump may be included as part of the assembly.

R202 (N1101.6) GRID-ENABLED WATER HEATER An electric resistance water heater that:

1. Has a rated storage tank volume of more than 75 gallons;
2. Was manufactured on or after April 16, 2015;
3. Has an energy factor of not less than 1.061 minus the product of 0.00168 times the tank's rate storage volume (in gallons); or an equivalent alternative standard prescribed by the Secretary of Energy and developed pursuant to 42 U.S.C. 6295 (e)(5)(E);
4. Is equipped at the point of manufacture with an activation lock; and
5. Has a label meeting certain criteria for permanence and states, using text set by the statute, that the water heater is intended only for use as part of an electric thermal storage or demand response program.

Revise as follows:

R403.5 (N1103.5) Service hot water systems. Energy conservation measures for service hot water systems shall be in accordance with Sections R403.5.1 through ~~R403.5.4~~ R403.5.5.

Add new text as follows:

R403.5.1 (N1103.5.1) Water heating equipment (Prescriptive). In climate zones 1 through 5 each dwelling unit shall be provided with one or a combination of the following with the capability to provide hot water to meet the anticipated needs of the dwelling unit:

1. A water heater with desuperheater tested and listed in accordance with AHRI 470
2. A heat pump water heater with an energy factor (EF) of 2.0 or greater
3. A solar water heating system, which consists of a solar thermal collector combined with a storage tank or any NAECA-compliant water heater, with solar system heating fraction of 0.50 or greater
4. An instantaneous water heater
5. A storage gas water heater with energy factor (EF) of 0.67 or greater
6. A grid-enabled water heater.

Exception: Replacements of existing water heating equipment

Reference standards type: This reference standard is new to the ICC Code Books

Add new standard(s) as follows:

AHRI 470-06 Performance Rating of Desuperheater/Water Heaters

Reason: Residential envelopes have been getting tighter and better over the last few years. As a result, domestic water heating energy is emerging as a significant end-use from the efficiency stand-point. There are multiple ways of improving the efficiency of generating hot water in homes. Previous analysis performed by DOE analyzed some of the more common water heating options for both gas and electric water heating. For homes with gas water heating, DOE analyzed high-efficiency gas storage water heaters and instantaneous water heaters; for homes with electric water heaters, DOE analyzed heat-pump water heaters. Desuperheaters were analyzed for all cases.

DOE found that high-efficiency gas storage water heaters not only saved energy over their lifespan, but also cost less to install. Instantaneous water heaters were cost-effective in the warmer climate zones, but were not as cost-effective in the colder climate zones. Heat pump water heaters that replace electric storage water heaters are cost-effective in all climate zones. Desuperheaters are most cost-effective for cooling-dominated climate zones, as they operate only when the air conditioners are running. The energy savings from desuperheaters are much higher for warmer climate zones. Given the results of the cost-effectiveness analysis performed by DOE, NRDC recommends that this prescriptive requirement apply to climate zones 1-5.

As part of DOE's appliance and equipment standards initiative, stakeholders expressed to DOE the importance of large-volume electric resistance water heaters to electric thermal storage (ETS) programs. Utilities use ETS programs, sometimes also known as load shifting or demand response programs, to manage peak demand load by limiting the times when certain appliances are operated. In certain water-heater based ETS programs, a utility typically controls a water heater remotely to allow operation only when electricity demand is during off-peak hours. During that off-peak operation, the electricity consumed is stored by the water heater as thermal energy for use during peak hours when the utility prevents the water heater from using electricity. In the Energy Efficiency Improvement Act (EEIA) of 2015, Congress amended the Energy Policy and Conservation Act (EPCA) to establish a category of water heaters called "grid-enabled water heaters" and create an energy conservation standard for that product. The definition of "grid-enabled water heaters" in this proposal is consistent with the definition adopted into law in EPCA.

Cost Impact: Will not increase the cost of construction
Analysis by DOE found that high-efficiency equipment often costs less to install than standard equipment. A new standard for water heaters took effect in 2015, so by the time the 2018 code is adopted this technology will be the industry standard.

Analysis: A review of the standard(s) proposed for inclusion in the code, AHRI 470-06, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016.

RE113-16 :
R403.5-
URBANEK12699

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: These requirements might violate federal law at some point in time. The reference to Secretary of Energy is not appropriate. This would eliminate electric resistance type water heaters from being installed. As water heaters are often installed in garages, a heat pump water heater is a garage in a colder climate is just not going to happen (not enough heat in the colder air.)

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Lauren Urbanek, representing NRDC (lurbanek@nrdc.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R202 (N1101.6) DESUPERHEATER~~/WATER HEATER~~. A ~~factory-made assembly~~ heat exchanger that uses superheated gases from the compressor of ~~elements by which the flows of refrigerant vapor and water are maintained in such~~ a heat ~~transfer relationship that the refrigerant vapor is desuperheated and the~~ pump or air conditioner to heat water~~ is heated. A water circulating pump may be included as part of the assembly~~.

R202 (N1101.6) GRID-ENABLED WATER HEATER An electric resistance water heater that~~:~~

~~1. Has~~ has a rated storage tank volume of more than 75 gallons~~;~~
~~2. Was manufactured on or after April 16, 2015;~~ and
~~3. Has an energy factor of not less than 1.061 minus the product of 0.00168 times the tank's rate storage volume (in gallons); or an equivalent alternative standard prescribed by the Secretary of Energy and developed pursuant to 42 U.S.C. 6295 (e)(5)(E);~~
~~4. Is equipped at the point of manufacture with an activation lock; and~~
~~5. Has a label meeting certain criteria for permanence and states, using text set by the statute,~~ includes controls that ~~the water heater is intended~~ enable activation only for use as part of an electric thermal storage or demand response program.

R403.5.1 (N1103.5.1) Water heating equipment (Prescriptive). In climate zones 1 through 5, each dwelling unit shall be provided with one or a combination of the following with the capability to provide hot water to meet the anticipated needs of the dwelling unit:

1. An instantaneous water heater
2. A *grid-enabled water heater* having both of the following:

    1. Energy factor (EF) of not less than 1.061 minus the product of 0.00168 times the tank's rated storage volume (in gallons).
    2. A permanent label indicating that the water heater is intended only for use as part of an electric thermal storage or demand response program.

3. A water heater with ~~desuperheater~~ a *desuperheater* tested and listed in accordance with AHRI 470.
~~2~~ 4. A heat pump water heater with an energy factor (EF) of not less than 2.0 ~~or greater~~ .
~~3~~ 5. A solar water heating system~~, which consists of a solar thermal collector combined with a storage tank or any NAECA-compliant water heater,~~ with solar system heating fraction of not less than 0.50 ~~or greater~~ .
~~4. An instantaneous water heater~~
~~5~~ 6. A storage gas water heater with energy factor (EF) of not less than 0.67 ~~or greater~~ .
~~6. A grid-enabled water heater.~~

Exception: Replacements of existing water heating equipment

Commenter's Reason: RE-113 should be approved because it improves the energy efficiency of the prescriptive path of the code while continuing to offer builders the same level of flexibility they already enjoy. Builders may still install any type of water heater available on the market that works for the home and location, including electric resistance water heaters. While it is true that not every home may be able to utilize every option listed, there is an option that is appropriate for any home. This proposal also modifies only the prescriptive path of climate zones 1-5, which leaves builders the flexibility of the performance and ERI paths.

This proposal is structured so that it does not trigger provisions of the National Appliance Energy Conservation Act (NAECA). See below for a legal memorandum.

LEGAL MEMORANDUM CONCERNING NRDC's PROPOSED R403.5.1 AND THE NATIONAL APPLIANCE ENERGY CONSERVATION ACT

Introduction

The Natural Resources Defense Council (NRDC) proposes the addition of R403.5.1 to Chapter 4 of the 2018 International Efficiency Conservation Code (IECC).[1] The proposed addition prescribes six types of water heaters which may be installed by builders in order to comply with the prescriptive compliance pathway of IECC Chapter 4. Some commenters on this proposal have expressed concern that such a provision would be preempted by the National Appliance Energy Conservation Act, which amended the Energy Policy Conservation Act and set up the energy efficiency standards program for appliances, including water heaters. This is not the case. The proposed code addition comports with the federal statutory provision for building codes because it does not require installation of water heaters that exceed the current federal minimum level.

Legal Analysis

The National Appliance Energy Conservation Act provides that state building codes may include provisions concerning the efficiency of appliances covered by federal efficiency standards if they meet seven specified requirements.[2] Commenters have expressed concern that the provision would not meet two of these requirements: Sections 6297(f)(3)(B) and 6297(f)(3)(E). The basic requirement of these two provisions is that the building code not require use of an appliance more efficient than the level set by the Department of Energy under the Act. The first focuses on the building code as a whole and the second on a building code that offers optional combinations of items.[3] In interpreting these provisions, the Ninth Circuit Court of Appeals has recognized that "a builder is not 'required' to select a [more efficient] option . . . simply because there is an economic incentive to do so."[4]

The proposed amendment would be not preempted because it allows installation in new residential buildings of minimum-efficiency water heaters. The statutory preemption test focuses on the "covered product," which is defined in this case as water heaters.[5] Thus, a building code is not preempted so long as it does not require installation of a covered product – in this case a water heater –

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[1] This memorandum is submitted as an attachment to NRDC's July 21, 2016 proposed amendment.
[2] 42 U.S.C. § 6297(f)(3).
[3] It is not clear whether the optional "combinations of items" applies to the prescriptive pathway at all. 42 U.S.C § 6297(f)(3)(E). Assuming that it does, we believe the relevant "combination" would be the combination of each of the different water heater options and the rest of the prescriptive options. The proposed standard avoids preemption because it includes multiple optional combinations that include minimum efficiency water heaters and only two that require higher efficiency appliances.
[4] *Building Industry Ass'n of Wash. v. Wash. State Bldg. Code Council*, 683 F.3d 1144, 1151 (9th Cir. 2012).
[5] 42 U.S.C. § 6292(a)(4).

that is above the minimum efficiency level. The proposed amendment plainly does not do so for several reasons. First, the performance path (Section 405) and the Energy Rating Index path (Section 406) focus on overall energy use and include no water heater requirements at all.

Second, even just considering the prescriptive pathway, the proposed amendment still does not require use of a water heater that exceeds minimum federal standards. The proposed amendment allows builders to select any of the six prescribed types of water heaters, at least two of which clearly do not exceed the federal requirements: instantaneous water heaters (R403.5.1.1) and grid-enabled water heaters (R403.5.1.2). For instantaneous water heaters, the proposed code amendment contains no minimum efficiency standard and thus the federal standards would apply.[6] For grid-enabled water heaters, the proposed code uses the same language as the federal provision.[7] As such, builders can comply with the standard by using water heaters that meet, but do not exceed, federal efficiency standards. Indeed, even if these minimum efficiency options were not available, the prescriptive path would still not "require" use of higher efficiency water heaters since any type of water heater can be used under the prescriptive approach if combined with other options such as a desuperheater or solar heater.[8]

The proposed amendment is also similar to existing building code provisions. The prescriptive compliance path in California's 2016 building code, for instance, requires installation of either gas/propane instantaneous water heaters or gas/propane storage type water heaters in new residential dwellings.[9] California's prescriptive compliance path allows use of certain minimum efficiency water heaters but does not allow use of every type of minimum efficiency water heater. Like the proposed code, the California code allows builders to choose an alternate compliance path, which allows use of any water heater.[10]

Conclusion

The core requirement for a building code to avoid preemption is that it not require above-minimum efficiency appliances. This requirement is met by the NRDC proposal because the proposal offers multiple ways that minimum efficiency water heaters can be used under both the prescriptive and performance pathways.

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[6] Energy Conservation Program for Consumer Products: Definitions and Standards for Grid-Enabled Water Heaters, Final Rule, 80 Fed. Reg. 48004-01 (August 11, 2015).
[7] *Id.*
[8] *See Building Industry Ass'n of Wash.*, 683 F.3d at 1151.
[9] 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings, Section 150.1(c)(8)(A), available at http://www.energy.ca.gov/title24/2016standards/index.html.
[10] *See* International Energy Conservation Code, R401.2, available at http://codes.iccsafe.org/app/book/toc/2015/I-Codes/2015%20IECC%20HTML/index.html.

Residential envelopes have been getting tighter and better over the last few years. As a result, domestic water heating energy is emerging as a significant end-use from the efficiency stand-point. There are multiple ways of improving the efficiency of generating hot water in homes. Analysis performed by DOE analyzed some of the more common water heating options for both gas and electric water heating. For homes with gas water heating, DOE analyzed high-efficiency gas storage water heaters and instantaneous water heaters; for homes with electric water heaters, DOE analyzed heat-pump water heaters.

Desuperheaters, which capture excess heat from air conditioners or heat pumps and use that excess to heat water were analyzed for all cases. Desuperheaters can be used in conjunction with any type of water heater including electric resistance water heaters,

DOE found that high-efficiency gas storage water heaters not only saved energy over their lifespan, but also cost less to install. This means that customers will save money on their bills by installing a more efficient gas storage water heater and will pay less to purchase the efficient model than the less-efficient model. Instantaneous water heaters were cost-effective in the warmer climate zones, but were not as cost-effective in the colder climate zones. Heat pump water heaters that replace electric storage water heaters are cost-effective in all climate zones. Desuperheaters are most cost-effective for cooling-dominated climate zones, as they operate only when the air conditioner or heat pump is in use. Desuperheaters can provide hot water more efficiently than a conventional electric water heater during both heating and cooling seasons, but are more effective during cooling season. Therefore, the energy savings from desuperheaters are much higher for warmer climate zones. Given the results of the cost-effectiveness analysis performed by DOE, NRDC recommends that this prescriptive requirement apply to climate zones 1-5.

As part of DOE's appliance and equipment standards initiative, stakeholders expressed the importance of large-volume electric resistance water heaters to electric thermal storage (ETS) programs, so those are also incorporated into this proposal. Utilities use ETS programs, sometimes also known as load shifting or demand response programs, to manage peak demand load by limiting the times when certain appliances are operated. In certain water-heater based ETS programs, a utility typically controls a water heater remotely to allow operation only when electricity demand is during off-peak hours. During that off-peak operation, the electricity consumed is stored by the water heater as thermal energy for use during peak hours when the utility prevents the water heater from using electricity. In the Energy Efficiency Improvement Act (EEIA) of 2015, Congress amended the Energy Policy and Conservation Act (EPCA) to establish a category of water heaters called "grid-enabled water heaters" and create an energy conservation standard for that product. The definition of "grid-enabled water heaters" in this proposal is consistent with the definition adopted into law in EPCA.

RE113-16

RE114-16

R403.5.5 (New) [IRC N1103.5.5 (New)]

Proposed Change as Submitted

Proponent : Karen Hobbs, National Resources Defense Council (khobbs@nrdc.org), Ed Osann, National Resources Defense Council (eosann@nrdc.org)

2015 International Energy Conservation Code

Add new text as follows:

R403.5.5 (N1103.5.5) Lavatory faucets (Mandatory). The flow rate of a lavatory faucet installed in a dwelling unit shall not exceed 1.5 gpm (0.11 L/s) at 60 psi (414 kPa).

Reason: Residential lavatory faucets rated at 1.5 gpm or less are commonly available and perform as well as those with higher flow rates. WaterSense established criteria for residential lavatory faucets and faucet accessories such as aerators in 2007. Based on recent reports by WaterSense partners, over 5,200 models from 134 brands currently meet the WaterSense specification, showing the widespread availability and commercial viability of more efficient lavatory faucets (Source: MaP Testing: http://www.map-testing.com/).
The Natural Resources Defense Council (NRDC) estimates that significant water and energy savings could accrue nationwide if this revised flow rates for residential faucets became effective in 2018:

121.9 million gallons of water per day in 2030;

2,198 GWh (Gigawatt Hours) of electricity per year in 2030; and

158 therms of natural gas per year in 2030.

The California Energy Commission (CEC) adopted a 1.2 gpm standard in August, 2015. In its review, the CEC analyzed the availability and functionality of lavatory faucets operating at 1.5 gpm, the same flow rate contained in this proposal. CEC found that "41 percent of lavatory faucets in the Commission's database would comply with a 1.5 GPM standard. A July, 2016 search of the Commission's database showed 56 percent of lavatory faucets would comply with the 1.5 GPM standard (California Energy Commission, "Staff Analysis of Lavatory Faucet Appliance Standards," Docket Number 15-AAER-05, p. 5, July 24, 2015, http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205513_20150724T152718_Staff_Analysis_of_Lavatory_Faucet_Appliance_Standards.pdf). Further, "staff did not encounter any issues with consumer acceptance, health and safety, or heat transfer loss from a 1.5 GPM standard and concludes that a 1.5 GPM maximum flow rate is technically feasible" (California Energy Commission, p. 5).

The CEC also found significant savings in water and energy use as a result of the 1.5 GPM standard, estimating first-year annual savings of 3.4 billion gallons of water, 89 GWh of electricity, 12 Mthm of natural gas, and consumer savings of 51 million dollars (California Energy Commission, p. 6).

Bibliography: California Energy Commission, "Staff Analysis of Lavatory Faucet Appliance Standards," Docket Number 15-AAER-05, July 24, 2015, http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205513_20150724T152718_Staff_Analysis_of_Lavatory_Faucet_Appliance_Standards.pdf.

Cost Impact: Will not increase the cost of construction
As noted above, faucets operating at the flow rates proposed are commonly available and perform as well as less efficient models. EPA WaterSense also found that, "Most high-efficiency faucet accessories that restrict flow are no more expensive that their conventional counterparts. However, pressure compensating faucet accessories that are designed to provide and maintain a constant flow rate despite fluctuations in water pressure typically cost a few dollars more." http://www.epa.gov/WaterSense/faucets.html. Lowe's Home Improvement Store features more than 1,759 residential bathroom faucets that meet the proposed standard of 1.5 gpm from 19 brands, ranging in cost from $15 to $2000 (Source: Lowe's Home Improvement Store website: http://www.lowes.com/Bathroom/Bathroom-Faucets/Bathroom-Sink-Faucets/_/N-1z0wz0vZ1z0z4i4/pl#!).
The California Energy Commission (CEC) "concluded that there was no incremental cost between a 1.5 GPM faucet and a 2.2 GPM faucet, based on studies conducted by the investor-owned utilities and verification through a retail price search showing no premium for the more efficient products" (California Energy Commission, p. 6).

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and in the Plumbing Provisions of the International Residential Code

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is a "green code" issue or not a I-code issue at all. The Plumbing Codes establish maximum fixture flow rates to match federal mandates. Lower fixture flow rates are a customer preference or a requirement of state mandates.

Assembly Motion: **As Modified**
Online Vote Results: **Failed**
Support: 39.75% (97) Oppose: 60.25% (147)
Assembly Action: **None**

Online Floor Modification:

Revise as follows:

CHAPTER 6 [RE]
WATER EFFICIENCY

R601.1 Plumbing fixture efficiency. Plumbing fixtures shall meet the minimum water efficiency.

~~R403.5.5 (N1103.5.5)~~R602.1 Lavatory faucet efficiency. The flow rate of a lavatory faucet installed in a dwelling unit shall not exceed 1.5 gpm (0.11 L/s) at 60 psi (414 kPa).

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code.

This code change proposal addresses the scope and application of the International Energy Code and the International Plumbing Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Individual Consideration Agenda

Public Comment 1:

Proponent : Hope Medina, representing self (hmedina@coloradocode.net) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

CHAPTER 6 [RE] Water Conservation and Efficiency
R601.1 Scope The provisions of this cahpter shall establish the means of conserving water with efficiency and the conservation of energy.

SECTION R602 Plumbing Fixture Efficiency

R602.1 General The provisions of Section 602 shall govern the water consumption and efficiency of plumbing fixtures.

R602.2 Lavatory faucet. The flow rate of a lavatory faucet shall not exceed 1.5 gpm at 60psi.

2015 International Residential Code

N1112.1 (R602.1) General. The provisions of this section shall govern the water consumption and efficiency of plumbing fixtures.

N1112.2 (R602.2) Lavatory faucet. The flow rate of a lavatory faucet shall not exceed 1.5 gpm at 60psi.

Commenter's Reason: All though the origional change does contain energy efficiency aspects I do feel they are a by product of this measure. This is a concept that should be visited. The placement of this change in service hot water system isn't the correct section it belongs in, but there isn't really a section within the existing energy code that would best fit this requirement. The solution for this is to create a new chapter that deals with water conservation that contains energy efficiency measures.

This is an opportunity to acknowledge that there is a relationship between water conservation and the energy efficiency that is gained from this. A new chapter that is dedicated to water efficiencies that go hand and hand with energy efficiency is where this concept and other similar concepts should be placed.

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and in the Plumbing Provisions of the International Residential Code
This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Ed Osann, Natural Resources Defense Council, representing Natural Resources Defense Council (eosann@nrdc.org); Gary Klein, representing self (gsmklein@comcast.net) requests Approve as Submitted.

Commenter's Reason: The Technical Committee rejected the original proposal not on its merits, but on grounds of code correlation. As the note applied by ICC staff to this proposal indicates, decisions on correlation issues are reserved to the ICC Board. A vote by the membership on the merits of the proposal is still appropriate.

This proposal will save significant amounts of energy, and is well-suited to the IECC, whose purpose is to establish minimum regulations for energy-efficient buildings. Indeed, few new energy-saving measures present such a cost-effective opportunity, since as noted in the original reason statement, there is *no incremental cost* associated with installing products that meet the EPA WaterSense flow rate specified by this proposal. All of the points made regarding energy savings in the original Reason Statement remain applicable.

One opponent has questioned whether lower maximum flow rates for lavatory faucets achieve any hot water savings, since most lavatories are not opened to the full open position on a regular basis. EPA addressed this issue in 2007 in its *Supporting Statement* for the WaterSense High-Efficiency Lavatory Faucet Specification, upon which this code change proposal is based. Field studies in Seattle and the East Bay Municipal Utility District were reviewed by EPA, and pertinent findings demonstrated that residential faucets with lower maximum flow rates achieved savings, and that 70% of faucet water use was hot water.

A more recent study provides further documentation of the real world savings of faucets with maximum flow rates at the WaterSense level. In a 2011 report by DeOreo entitled *Analysis of Water Use in New Single-Family Homes*, three groups of homes were compared: homes built before 1995, homes built after 2001, and high-efficiency new homes built after 2006 to the equivalent of the WaterSense specifications. As might be expected, total indoor water use measured in gallons per household per day (gphd) declined in newer homes compared to the oldest group in the study. And more specifically, faucet water use declined very significantly, from 26.7 gphd in pre-1995 homes, to 25.23 gphd for typical post-2001 homes, to 18.1 gphd for WaterSense-level high efficiency homes. This clearly demonstrates the energy- and water-saving impact of reducing the maximum flow rate for faucets as proposed in this code change proposal.

Bibliography: [WaterSense High Efficiency Lavatory Faucet Specification Supporting Statement] [Version 1.0] [US EPA] [2007] [page 5]
[https:www3.epa.gov/watersense/docs/faucet_suppstat_final508.pdf]

[Analysis of Water Use in New Single-Family Homes] [Report/Document #] [DeOreo, William] [2011] [page 16]
[http://www.aquacraft.com/downloads/epa-new-home-water-use-study/]

Analysis: The proposed maximum flow rate differs from the maximum rate indicated in the International Plumbing Code and in the Plumbing Provisions of the International Residential Code
This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental

Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Hugo Aguilar, representing American Supply Association (haguilar@asa.net) requests Disapprove.

Commenter's Reason: The Technical Committee was correct to disapprove the proposal as water consumption is not within the purview of the IECC. Fixtures such as lavatory faucets are already addressed in ASHRAE 189.1, IPC and the IRC. The IECC does not address any fixtures and including lavatory faucets in new Section R403.5.5 will create confusion in the industry. There needs to be a distinction amongst the codes and having similar provisions in every code creates confusion in the industry and makes it difficult for AHJ's to enforce. Lastly, Section R101.3 (Intent) indicates that *this code shall regulate the design and construction of buildings for the effective use and conservation of <u>energy</u> over the useful life of each building.*

Analysis: This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

Proponent : Matt Sigler, representing Plumbing Manufacturers International requests Disapprove.

Commenter's Reason: PMI **<u>agrees</u>** with the committee's action of **disapproved** for this item for the following reasons:

- As stated in the 2015 IECC Commentary (pg. C1-1): "The code addresses the design of energy efficient building envelopes, and the selection and installation of energy-efficient mechanical, service water-heating, electrical distribution and illumination systems and equipment in residential and commercial buildings alike." Nowhere within the IECC does it state that this code addresses water consumption requirements for plumbing fixtures or fittings.
- The bottom line is that the IECC has never addressed water consumption requirements for plumbing fixtures and fittings. Such requirements have always been addressed in the IGCC (now ASHRAE 189.1), IPC and IRC (Chapter 29).
- Proposals that dealt with water consumption requirements for plumbing fixtures and fittings in the ICC Codes were discussed during the Group A hearings and will be included in the 2018 IPC and/or IRC. If RE 114 is approved, it will conflict with the actions taken by the IPC Committee.
- Chapter 11 of the IRC addresses energy efficiency for the design and construction of buildings only, and not water consumption requirements for plumbing fixtures and fittings. Chapter 29 (Water Supply and Distribution) provides water consumption requirements for plumbing fixtures and fittings.

Analysis: This code change proposal addresses the scope and application of the International Energy Code, the International Plumbing Code and the International Residential Code. The action taken by the Residential Energy Conservation Code Committee on this proposal coupled with the final action taken at the 2016 Public Comment Hearings and subsequent Online Governmental Consensus Vote will be limited to an advisory recommendation to the ICC Board of Directors who will determine the final disposition on this proposed change in accordance with Section 1.3 of CP28, which stipulates that the ICC Board of Directors determines the scope of the I-Codes.

RE114-16

Proposed Change as Submitted

Proponent : Mike Moore (mmoore@newportventures.net)

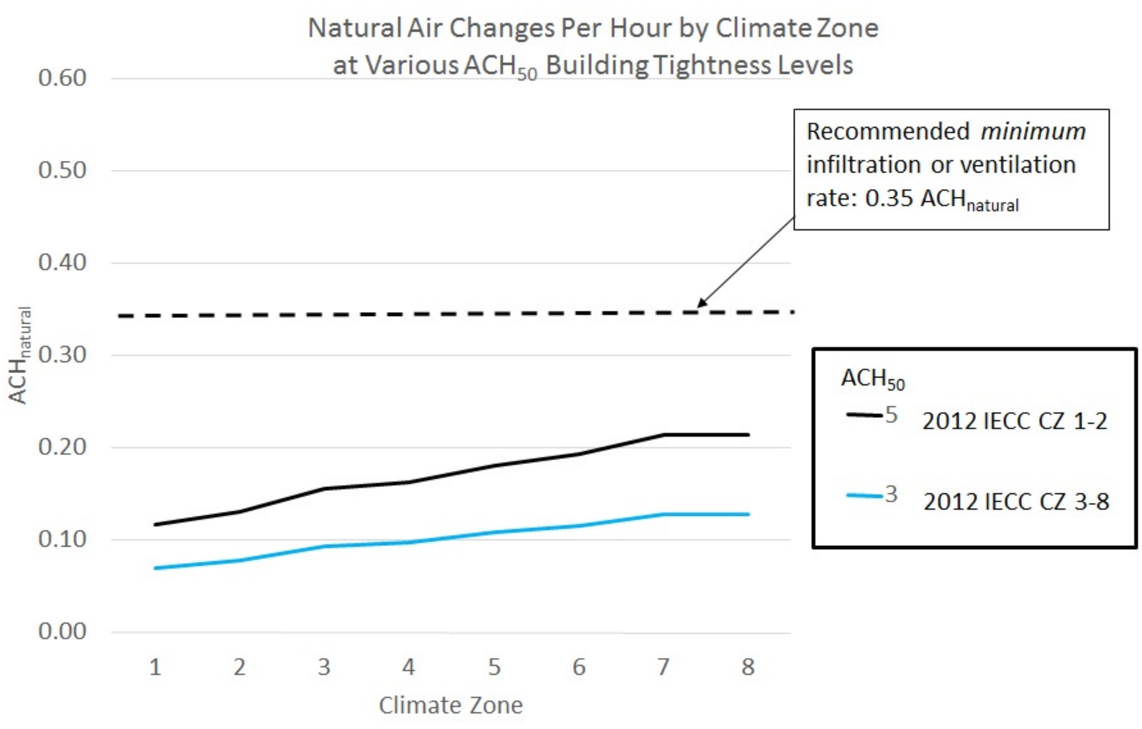
2015 International Energy Conservation Code

Revise as follows:

R403.6 (N1103.6) Mechanical ventilation (Mandatory). The building shall be provided with mechanical ventilation that meets the requirements of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Reason: Energy efficient, tight homes need mechanical ventilation to provide minimum acceptable indoor air quality. This is clearly recognized in the heading of this section, but is not called out explicitly in the text. Currently, the IECC requires all residential dwelling units to have an air tightness of 5 ACH_{50} or lower. Even if the 3-5 ACH_{50} requirement becomes prescriptive, simply following the IECC's mandatory air sealing checklist will easily result in homes that are 5 ACH_{50} or tighter (see below for corroborating testimony).[1,2,3,4,5,6,7,8,9,10,11] At this tightness, infiltration can only provide about half the ventilation air recommended for residential units (i.e., 0.35 air changes per hour; see chart). Studies have shown natural ventilation via window operation is not able to make up the balance of required outdoor air, because homeowners do not leave their windows open, often due to concerns for security and/or comfort.[12,13]

This section needs to be clarified to leave no doubt that *mechanical* ventilation is required for any residential dwelling unit following the IECC's mandatory air sealing checklist. The estimated cost of negative health effects associated with poor residential indoor air quality exceeds $300 billion annually;[14,15,16,17,18] this is too high of a cost to ignore by requiring tight construction without explicitly requiring mechanical ventilation.



Assumptions: 2000 square foot, 2-story single family detached home with 8 foot ceilings. Pressure exponent, n, equals 0.65. Representative cities for climate zones: 1 (Miami), 2 (Houston and Phoenix), 3 (Atlanta, Los Angeles, Las Vegas, San Francisco), 4 (Baltimore, Albuquerque, Seattle), 5 (Chicago, Boulder), 6 (Minneapolis, Helena), 7 (Duluth), and 8 (Fairbanks). $ACH_{natural}$ was calculated using equations from ASHRAE 62.2.

Feedback from building officials and HERS raters has confirmed that following the mandatory IECC air sealing checklist is all that is necessary to achieve building tightness below 5 ACH_{50} (and regularly below 3 ACH_{50}). Following are some examples of this testimony from internet threads, studies, and personal communications:

- California homes built from 2002-2004: Testing of a random sample of 102 tract homes built in California between 2002-

2004 (well before the detailed air sealing requirements of the 2009 IECC were developed) showed a median air tightness of 4.8 ACH_{50}.[1]

- Parker, CO: From 2013-2014, only three of the first 424 air tightness tests conducted on single family homes built by production builders in Parker, CO, failed to achieve 3 ACH_{50}, with an average score of 2.3 ACH_{50}. According to the building official, this level of tightness was achieved by simply following the same air tightness checklist that was in the 2009 IECC.[2]
- HERS rater in Illinois: "In my experience with testing homes in new construction, the 5ACH50 is too easy to achieve. I find that the builders don't have to try very hard to get under 5ACH50. What I find most disheartening is that they can pass code (5 ACH_{50} in Illinois) with a blower door test and not do any attic air sealing or properly seal rim joists - which would be my top priorities in most homes. I had a recent test where I walked away shaking my head. There were the usual suspects that I find with a leaky attic floor - no top plates sealed, leaky recessed lights, unsealed electrical penetrations, etc. Yet, they easily achieve the 5ACH_{50}."[3]
- Largest HERS Rater in Colorado: "Colorado has had good success in achieving 3 or less ACH_{50} consistently. We see a consistent average of 2.5 ACH_{50} for single family homes. Following the air tightness table in the code...well is the issue to achieve this. How well builders follow this guidance is directly relational to their ability to meet the 3 ACH50 threshold."[4]
- Builder in Illinois: "Our interest in the 1990's and early 2000's was more driven by reduced homeowner "cold room" complaints than energy compliance. But with that said, we did, inadvertently, start to build a more energy efficient home and thereby had a happier customer base and referral stream... It was not hard to get to 5 ACH_{50} at all. But never being required to measure the tightness level of our homes prior to 2010, ... I went back a tested a sampling of homes we had built in the past 10 years to pleasantly find most were testing right at or below 5 ACH_{50}."[5]
- Habitat for Humanity affiliate's experience: "If a habitat for humanity affiliate can make 5 ACH50 with different volunteers on each house, and that means retraining them for every build; I think a commercial builder that tells all subs his homes are going to be tested and will hit 5 or lower; is easy. This affiliate builds in a No Energy Code jurisdiction and looks for building tasks their volunteers can do. They turn down donations of site applied spray on WRB to allow their volunteers to install house wrap."[6]
- HERS rater in Colorado: "Based on the experience of the contractors we are working with 5 should be a no brainer and 3 should come with a few attention to details. Most of our contractors are consistently at 2 or better and many are at 1."[7]
- HERS rater in Kansas: "I did a brief study for our local HBA as they were working with the code officials and found most builders were at 6 ACH before implementation of the 2012 code air sealing requirements. Now most homes build to the code are under five with the larger homes under three as a general rule."[8]
- Program manager in Alaska: "The average ACH_{50} for homes built in Alaska since 2000 (all types) 3.93; Average ACH50 for homes built in Alaska since 2006 (all types) 3.37; Average ACH_{50} for homes built in Alaska since 2010 (all types) 2.96."[9]
- Builder from Washington: "Our worst blower-door test ever was our first, back in 2005. It came in at just under 2.5 ACH_{50}, and we didn't even know what a tight house was back then."[10]
- Connecticut Light and Power Study: Blower door tests on a statistical sample of 69 single family homes built to the 2006 IECC and spread across Connecticut found an average air tightness of 5.8 ACH_{50}. These homes were built from 2009-2011 and were constructed prior to the state's adoption of the 2009 IECC and its prescriptive air sealing checklist.[11] Minimum code compliant homes built since this time are expected to be tighter.

Bibliography:

1. Offerman, F.J. (2009). Ventilation and indoor air quality in new homes. PIER Collaborative Report. California Energy Commission & California Environmental Protection Agency Air Resources Board. At the time of construction, air sealing requirements in the CA Building Energy Efficiency Standards were limited to the following sentence, "Joints and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weatherstripped, or otherwise sealed to limit infiltration and exfiltration," (CEC 2001 Energy Efficiency Standards, Section 117). Air sealing of CA residences has been required since 1982. http://www.energy.ca.gov/2014publications/CEC-400-2014-024/CEC-400-2014-024-FS.pdf.
2. Email communication with Gil Rossmiller, Chief Building Official, Parker, CO. Dec 8, 2014.
3. Email communication with Todd Abercrombie, EverGreen Home Energy Consultants, Inc. Dec 8, 2014.
4. Comment from Robby Schwarz, Principal of Energy Logic. Posted on LinkedIn's RESNET.US Group discussion, "How Tough is it to Hit 5 ACH_{50}?" Dec 10, 2014.
5. Email communication with Brian Flaherty of Flaherty Buiders. Dec 4, 2014.
6. Comment from John Nicholas, HERS Rater with The Energy Guy. Posted on LinkedIn's RESNET.US Group discussion, "How Tough is it to Hit 5 ACH_{50}?" Dec 9, 2014.
7. Comment from Mark Attard, Sales Consultant at AE Building Systems. Posted on LinkedIn's RESNET.US Group discussion, "How Tough is it to Hit 5 ACH_{50}?" Dec 9, 2014.

8. Comment from Bruce Chyka, Owner at Performance Plus Homes. Posted on LinkedIn's RESNET.US Group discussion, "How Tough is it to Hit 5 ACH_{50}?" Dec 9, 2014.
9. Comment from Nathan Wiltse, Policy Program Manager / Building Economist at Cold Climate Housing Research Center. Posted on LinkedIn's RESNET.US Group discussion, "How Tough is it to Hit 5 ACH_{50}?" Dec 10, 2014.
10. Comment from Ted Clifton, President of Zero Energy Plans. Posted on LinkedIn's RESNET.US Group discussion, "How Tough is it to Hit 5 ACH_{50}?" Dec 10, 2014.
11. KEMA, Cadmus, et al. (2012). Connecticut 2011 Baseline Study of Single-Family Residential New Construction. Available at: http://energizect.com/sites/default/files/ConnecticutNewResidentialConstructionBaseline-10-1-12_0.pdf. Accessed December 19, 2014.
12. Offerman, F.J. (2009). Ventilation and indoor air quality in new homes. PIER Collaborative Report. California Energy Commission & California Environmental Protection Agency Air Resources Board.
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14. Logue JM, Price PN, Sherman MH, and Singer BC. 2012. A Method to Estimate the Chronic Health Impact of Air Pollutants in U.S. Residences. Environmental Health Perspectives 120(2): 216-222.
15. Turner WJN, Logue JM, and Wray CP. 2012. Commissioning Residential Ventilation Systems: A Combined Assessment of Energy and Air Quality Potential Values.
16. Brown DW. 2008. Economic value of disability-adjusted life years lost to violence: estimates for WHO Member States. Rev. Panam Salud Publica, 24, 203-209.
17. Lvovsky K, Huges G, Maddison D, Ostro B, and Pearce D. 2000. Environmental costs of fossil fuels: a rapid assessment method with application to six cities. Washington,D.C.: The World Bank Environment Department.
18. Highfill T and Bernstein E. 2014. Using Disability Adjusted Life Years to Value the Treatment of Thirty Chronic Conditions in the U.S. from 1987-2010. U.S. Department of Commerce Bureau of Economic Analysis WP 2014-9.

Cost Impact: Will not increase the cost of construction
This is simply a clarification of a current requirement, so no additional costs will result.

RE116-16 : R403.6-MOORE11058

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal mandates mechanical ventilation. This will be a major change that will have a cost impact, contrary to what the cost impact statement indicates.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net) requests Approve as Submitted.

Commenter's Reason: This change is needed to bring clarification and consistency across the IECC, IMC, and IRC mechanical ventilation requirements. The committee incorrectly stated that this proposal would be a major change, as any dwelling unit that complies with the air sealing requirements of R402.4 (N1102.4) already requires mechanical ventilation in accordance with the IRC (R303.4) or the IMC (401.2). The committee's failure to recognize this simple fact illustrates the need to clarify this section.

RE116-16

RE120-16

R403.6.1(IRC N1103.6.1), Table R403.6.1(IRC Table N1103.6.1)

Proposed Change as Submitted

Proponent : Mike Moore (mmoore@newportventures.net)

2015 International Energy Conservation Code

Revise as follows:

R403.6.1 (N1103.6.1) Whole-house mechanical ventilation system fan efficacy. ~~When installed to function as a~~ Fans used to provide whole house mechanical ventilation ~~system fans~~ shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler unit that is ~~whole-house mechanical ventilation fans are~~ integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler ~~they~~ shall be powered by an electronically commutated motor. HRV and ERV fans shall be exempt from the provisions of Section R403.6.1.

TABLE R403.6.1
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	~~AIR FLOW RATE MAXIMUM (CFM)~~
Range hoods	Any	2.8 cfm/watt	~~Any~~
In-line fan	Any	~~2.8~~ 3.5 cfm/watt	~~Any~~
~~Bathroom, utility room~~	10 to 89	~~1.4~~ 2.8 cfm/watt	-
~~Bathroom, utility room~~ Other exhaust fan	≥90	~~2.8~~ 3.5 cfm/watt	~~Any~~

For SI: 1 cfm = 28.3 L/min.

Reason: This proposal updates the fan efficacy requirements to the latest version of ENERGY STAR's ventilating products' criteria, simplifies the fan efficacy table and provides the following needed clarifications to the requirements:

1. Clarifies that the fan efficacy table only applies to fans used for whole-house mechanical ventilation.
2. Clarifies that H/ERVs are exempt from the fan efficacy requirements that are applicable to exhaust and in-line fans. Without this exception, over 95% of H/ERVs cannot comply with the efficacies listed in the table.
3. Clarifies that heating and cooling system air handlers (e.g., those used for furnace, AC, heat pump, etc.) must have an electronically commutated motor if also used to provide whole-house mechanical ventilation.

Cost Impact: Will not increase the cost of construction
Manufacturers have replaced their v3 ENERGY STAR model fans with v4 ENERGY STAR compliant fans that meet these higher efficacy requirements. These higher efficacies can still be met with PSC motors, so there is little to no significant cost increase anticipated. Any initial cost increase will be offset with annual energy savings of ~$37 (assumptions: 75 cfm, improvement in efficacy from 1.4 cfm/W to 2.8 cfm/W, 8760 hours/year of operation, $0.12/kWh).

RE120-16 : R403.6.1-MOORE11062

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The exception has a complete exemption for HRV and ERV fans leaving no energy requirements for those fans at all. The Committee prefers RE121-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Moore, representing Broan-NuTone (mmoore@newportventures.net) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R403.6.1 (N1103.6.1) Whole-house mechanical ventilation system fan efficacy. Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

- **Exceptions:** Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor. ~~HRV and ERV fans shall be exempt from the provisions of Section R403.6.1.~~

TABLE R403.6.1 (N1103.6.1)
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

SYSTEM TYPE	AIR FLOW RATE ~~MINIMUM~~ RANGE (CFM)	MINIMUM EFFICACY[a] (CFM/WATT)
Range hood	Any	2.8
In-line fan	Any	3.8
HRV or ERV	Any	1.2
Other exhaust fan	10 to 89	2.8
	> 90	3.5

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916.

Commenter's Reason: The committee disapproved this proposal because it exempted H/ERVs from the fan efficacy requirements of Table R403.6.1. In deference to this proposal, the committee approved RE121, which requires H/ERVs to have a fan efficacy of at least 1.2 cfm/Watt. This comment aligns RE120 with the committee's action on RE121 by requiring H/ERVs to have a fan efficacy of at least 1.2 cfm/Watt. Further, this comment will have the effect of updating the whole house mechanical ventilation system's fan efficacy to minimum ENERGY STAR levels for exhaust fans. Please note that these efficacy levels do not apply to local exhaust equipment, only equipment that is installed to provide whole house mechanical ventilation. The annual energy cost savings associated with this comment are substantial, at ~$37 per year. Further, there is little to no incremental cost difference for these higher efficacy fans, as manufacturers have already adjusted to the new ENERGY STAR specifications without needing to change motor technology or add significant cost.

Analysis: After RE120-16 was published for committee consideration, staff discovered that Section R403.6.1 and Table R403.6.1 were printed in error. The following shows corrections, in legislative format, to the first 3 printings of the 2015 IECC for this section and table. The proposal and the public comment have been adjusted to indicate how the correct text of the section and table would be amended by RE120-16.

R403.6.1 Whole-house mechanical ventilation system fan efficacy. When installed to function as a whole house mechanical ventilation system, fans shall meet the efficacy requirements of Table R403.6.1.

Exception: Where whole-house mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

TABLE R403.6.1

WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY[a] (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8	Any
In-line fans	Any	2.8	Any
Bathroom, utility room	10	1.4	<90
bathroom, utility room	90	2.8	Any

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916

RE121-16

R403.6.1 (IRC N1103.6.1), Table R403.6.1 (IRC Table N1103.6.1)

Proposed Change as Submitted

Proponent : Mike Moore (mmoore@newportventures.net)

2015 International Energy Conservation Code

Revise as follows:

R403.6.1 (N1103.6.1) Whole-house mechanical ventilation system fan efficacy. When installed to function as a whole house mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1.

~~**Exception:** Where whole-house mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.~~

Exceptions: Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

TABLE R403.6.1 (N1103.6.1)
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY[a] (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
HRV or ERV	Any	1.2 cfm/watt	Any
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.
a. When tested in accordance with HVI Standard 916

Reason: This proposal introduces a minimum fan efficacy for H/ERVs. The efficacy proposed is the minimum required by the ENERGY STAR H/ERV specification used in Canada. This will save homeowners ~$92/year in fan energy costs versus specifying the worst performing H/ERVs currently available on the market (i.e., assuming 0.5 cfm/W fan gets replaced by 1.2 cfm/W fan, 75 cfm, 8760 hours/year of operation, $0.12/kWh). Increasing the efficacy from 0.5 cfm/W to 1.1 cfm/W is feasible without a significant change in motor technology or product cost.

Cost Impact: Will not increase the cost of construction
At the levels proposed, fan efficacy is not a major driver of price. Low-cost H/ERVs are available at the efficacy level proposed.

RE121-16 : R403.6.1-MOORE11063

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: This proposal provides appropriate energy limitations for ERV and HRV fan motors.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : John Rose, representing Home Ventilating Institute (eng1@hvi.org) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

TABLE R403.6.1 (N1103.6.1)
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY [a] (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
HRV or ERV	Any	0.8 cfm/watt, SRE[b] ≥ 75%; 1.2 cfm/watt, SRE[b] <75%	Any
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

a. Whent tested in accordance with HVI Standard 916.

b. SRE = Sensible recovery efficiency.

Commenter's Reason: Code change proposal RE121-16 was voted for approval, which cites efficacy thresholds in the H/ERV ENERGY STAR specification used in Canada. The minimum efficacy ought to be corrected to match the thresholds permitted by that specification. A fan efficacy of 0.8 cfm/watt applies to units with a Sensible Recovery Efficiency of 75% or greater, while the higher fan efficacy of 1.2 cfm/watt is applicable to units with SRE between 65% and 75%. A lower fan efficacy is accepted where the energy consumed by the fan itself is offset by the higher energy recovered by the H/ERV unit.

Cost impact: Adoption of the additional efficacy range will not increase the cost of construction. This tiered efficacy approach allows for continued design flexibility for manufacturers, and does not unnecessarily narrow the field of choices of already available, ENERGY STAR qualified systems for the consumer.

Proponent : Craig Conner, representing self (craig.conner@mac.com) requests Disapprove.

Commenter's Reason: This proposal uses the wrong measure of HRV/ERV efficiency. The main purpose of the HRV/ERV is ventilate while recovering heat (cool). The fan is part, but not the main part, of the energy efficiency. There are better measures of HRV/ERV efficiency such as sensible heat recovery efficiency (SRE) and total heat recovery efficiency (TRV). This change is somewhat confusing and a step backwards as it makes the fan efficiency apply to only those fans that are part of a whole house ventilation. If a bath fan was part of the whole house ventilation it would need to be efficienct. However a similar bath fan that was just a bath fan would not have to be efficient. Doesn't make sense. Lets just have efficient bath fans.

RE121-16

RE123-16

R403.6.1, R403.6.1.2 (New) (IRC:N1103.6.1, N1103.6.1.2 (New))

Proposed Change as Submitted

Proponent : Jeremiah Williams (jeremiah.williams@ee.doe.gov)

2015 International Energy Conservation Code

Revise as follows:

R403.6.1 (N1103.6.1) ~~Whole-house mechanical~~ Heat recovery ventilation ~~system fan efficacy~~ (Prescriptive). ~~Mechanical~~
In climate zones 6, 7 and 8, buildings shall be provided with a heat recovery or energy recovery ventilation system ~~fans~~ . The system shall ~~meet~~ be balanced to provide a sensible heat recovery efficiency of not less than 70 percent at 0 °C (32 °F) at the ~~efficacy requirements of Table R403.6.1~~ rated airflow.

- ~~**Exception:** Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.~~

Add new text as follows:

R403.6.1.2 (N1102.6.1.2) Whole-house mechanical ventilation and heat recovery ventilation system fan efficacy. Mechanical and heat recovery ventilation system fans shall comply with the efficacy requirements of Table R403.6.1.

Exception: Mechanical ventilation and heat recovery fans that are integral to tested and listed HVAC equipment shall not be required to comply with this section provided that such fan motors are electronically commutated.

Reason: The energy used to condition ventilation air is completely lost through exhaust air in exhaust-based ventilation systems. This provision increases energy efficiency of ventilation systems by recovering a portion of energy lost to the exhaust air to condition incoming ventilation air. It also provides for a balanced ventilation system to avoid induced infiltration/exfiltration and minimize potential downdrafting problems. A large majority of projects constructed since 2010 in the cold/very cold regions under DOE's Building America program have included heat recovery ventilation.[1]

Energy Savings: DOE conducted an energy analysis using the established methodology: https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).[2] Most Heat Recovery Ventilation systems (HRVs) have a sensible heat recovery efficiency of 70%-80%.[3] The present analysis conservatively assumes a sensible heat recovery efficiency of 70%. The energy analysis indicates that HRVs yield annual energy cost savings ranging from 9.4% to 11.2% of IECC-regulated end uses (heating, cooling, lighting and water heating), in climate zones 6 through 8.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC (https://www.energycodes.gov/development/2018IECC).

Bibliography:

1. See Case Studies in the "cold/very cold" regions in the Building America Solution Center at https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold (https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold)
2. Taylor, ZT; Mendon, VV; and Fernandez, N. (2015). Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes. Pacific Northwest National Laboratory for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-21294 Rev1. https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).
3. See EnergySavers website http://energy.gov/energysaver/whole-house-ventilation (http://energy.gov/energysaver/whole-house-ventilation)
4. See cost of 70% effective HRV at http://www.nrel.gov/ap/retrofits/measures.cfm?gId=10&ctId=236&scId=2522 (http://www.nrel.gov/ap/retrofits/measures.cfm?gId=10&ctId=236&scId=2522)
5. Russell, Sherman and Rudd. 2007. LBNL 57730 - Review of Residential Ventilation Technologies. HVAC&R Research, Volume 13.
6. http://www.deckerhomeservices.com/nahb-study.pdf (http://www.deckerhomeservices.com/nahb-study.pdf)

Cost Impact: Will increase the cost of construction

The cost of HRV equipment ranges from $500-1100, depending on the manufacturer and capacity. The present analysis assumes a total measure cost of $1,300 for a single-point HRV system based on the NREL Retrofit Database, inclusive of equipment and installation.[4] Russell, Sherman and Rudd found a similar cost of $1,350 including installation.[5] A study conducted by the National Association of Home Builders (NAHB) indicates the life of HRVs to be 20+ years.[6] DOE's analysis assumes a 20-year life.

Cost-effectiveness: DOE conducted a cost-effectiveness analysis using the established methodology: https://www.energycodes.gov/development/residential/methodology (https://www.energycodes.gov/development/residential/methodology).[2] Analysis shows that HRVs are life-cycle cost-effective in climate zones 6 through 8. Life-cycle cost savings range from $868 in zone 6 to $4,464 in zone 8. The full analysis is available at https://www.energycodes.gov/sites/default/files/documents/iecc2018_R-3_analysis_final.pdf (https://www.energycodes.gov/sites/default/files/documents/iecc2018_R-3_analysis_final.pdf).

RE123-16 : R403.6.1-WILLIAMS12223

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The Committee previously disapproved RE117-16. These systems need to remain an option. Most of these systems will end up is a state of disrepair because few people will understand their purpose, let alone pay for properly maintaining them. They are passive system available. Appraisals do not recognize this added feature so home mortgages will be slightly harder to secure as the cost of the home is higher.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Jeremiah Williams, representing U. S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

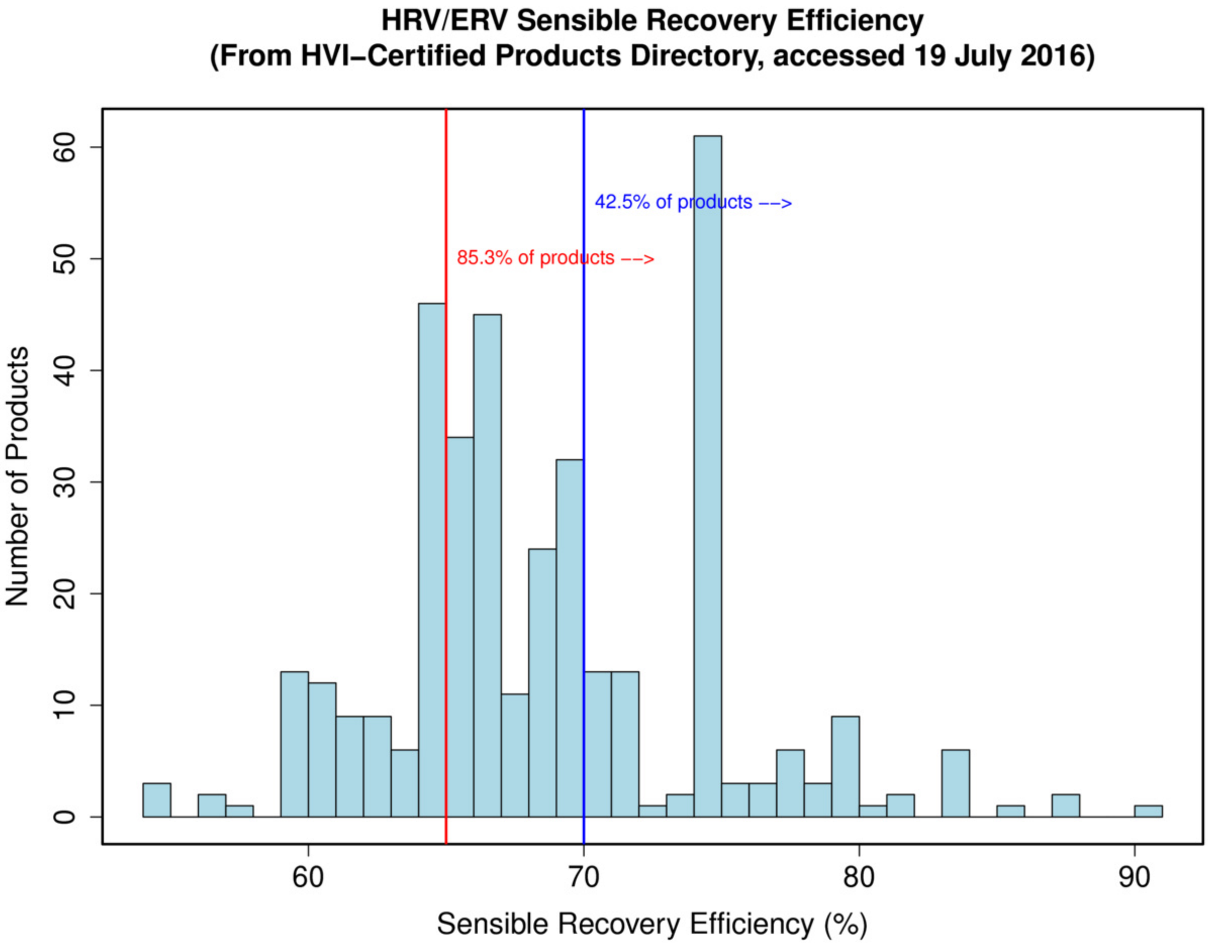
2015 International Energy Conservation Code

R403.7 (N1103.7) Heat recovery ventilation In climate zones 6, 7, and 8, buildings shall be provided with a heat recovery or energy recovery ventilation system. The system shall be balanced to provide a sensible heat recovery efficiency of not less than 65 percent determined in accordance with CSA C439 at 32 °F (0°C) and at a system net airflow equal to or greater than the design whole-house mechanical ventilation rate.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

Commenter's Reason: Based on discussion at the Committee Action Hearing, this Public Comment makes four changes to the original proposal:

1. Corrects the confusing mix of Prescriptiive and Mandatory provisions by moving this propoposed change to a new (prescriptive) subsection in its entirety.
2. Eliminates the fan efficacy requirements that were part of the proposal, in deference to efficacies established by RE121-16, which was approved by the Committee.
3. Reduces the proposal's required heat recovery efficiency based on CAH testimony showing that a 65% efficiency threshold would allow many more products to comply than would the original 70% threshold. As shown in the graphic, based on product data from the Home Ventilating Institute, the previous 70% cutoff allowed less than 43% of the available products to comply without using a performance tradeoff; the 65% cutoff increases that to more than 85% of available products. (See http://www.hvi.org/proddirectory/ (http://www.hvi.org/proddirectory/))
4. Adds a reference standard (CAN/CSA-C439-09 (R2014)) for determining the recovery efficiency. This standard was reviewed by ICC staff without issue in vetting RE117-16.



HRV/ERV Sensible Recovery Efficiency
(From HVI−Certified Products Directory, accessed 19 July 2016)
42.5% of products −−>
85.3% of products −−>
Number of Products
0
10
20
30
40
50
60
60
70
80
90
Sensible Recovery Efficiency (%)

RE123-16

RE127-16
R404.1 (IRC N1104.1)

Proposed Change as Submitted

Proponent : David Collins, representing Sustainability, Energy, High Performance Code Action Committee

2015 International Energy Conservation Code

Revise as follows:

R404.1 (N1104.1) Lighting equipment (Mandatory). Not less than ~~75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 75~~ 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

- **Exception:** Low-voltage lighting.

Reason: The lighting market is rapidly moving towards high-efficacy lighting. Raising the minimum lighting efficacy from 75% to 90% will align with market trends for high-efficacy performance and greater energy savings. Switching to an LED light bulb, for example, can reduce electricity consumption by more than 80 percent. This code change would allow 10% of fixtures to be non-compliant, thereby accommodating incandesent decorative lighting fixtures. The exisiting exception already exempts low-votage lighting.
This proposal was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2015, the SEHPCAC has held three two- or three-day open meetings and 25 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at:
http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx (http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx)

Cost Impact: Will not increase the cost of construction
The price of high-efficacy lighting is now competitive with other lighting as more and more products such as CFLs and LEDs saturate the market. The life-cycle costs of LEDs are significantly lower than any conventional lamp or light fixture.

RE127-16 : R404.1-COLLINS11478

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: There are available cost-effective products that are an easy way to lower energy use.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Glenn Heinmiller, representing International Association of Lighting Designers (glenn@lampartners.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R404.1(N1104.1) Lighting equipment (Mandatory). Not less than 90 percent of the permanently installed lighting fixtures shall be either light emitting diode luminaires or shall contain only high-efficacy lamps.

- ~~**Exception:** Low-voltage lighting.~~

Commenter's Reason: Many of the lighting fixtures now being installed in residential applications have integral lighting emitting diode (LED) light sources. In the common vernacular of the lighting industry, these light fixtures do not have lamps, and this makes it difficult to understand how the efficiency provisions of this section would be applied.
LED luminaires on the market today are almost all more efficacious than a conventional light fixture with a high efficacy lamp

meeting the requirements of this code, and by the time this code is adopted it is hard to believe any LED luminaires would not be more efficacious than the equivalent conventional light fixture with high efficacy lamp.

This public comment also includes the removal of the low-voltage lighting exception from RE-126 that was Approved by the Committee, so it is clear that this public comment is not trying to add it back in (cdpACCESS forces it to be shown in the comment).

RE127-16

RE130-16

R405.1 (IRC N1105.1), Table R405.5.2(1) [IRC Table N1105.5.2(1)

Proposed Change as Submitted

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

Revise as follows:

R405.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, lighting, and service water heating energy only.

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, lighting, and service water heating energy only.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Lighting	Type: in accordance with Section R404.1	As proposed
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed
Service water heatingd, [e, f, g]	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.
h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_S \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

Reason: This proposal updates the scope of the simulated performance alternative, and adds a new row to Table R405.5.2(1). The IECC in Section 404 contains minimum requirements for lighting installed in or at a residential building. With new technologies and controls, there are significant energy savings opportunities that can be easily modeled in a computer simulation.

Other simulation programs already include lighting as part of a simulated performance path for residential buildings.

Cost Impact: Will not increase the cost of construction
This proposal updates the scope of the building simulation and requires that lighting be part of the simulation. This proposal does not change any of the requirements in the code, and will not increase construction costs.

RE130-16 : R405.1-ROSENSTOCK11967

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: Lighting, like heating, cooling and ventilation should have flexibility so energy can be saved in different ways. The market is already causing this change voluntarily. Why not get credit in the performance path for use of high efficacy lighting?

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing

Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: This proposal should be disapproved because it rolls back energy efficiency by introducing a potentially broad loophole into the Section R405 Simulated Performance Alternative compliance method (the performance path) that will lead to less energy savings than the current code. There are two key problems with RE130 – one technical and one substantive:

- The **technical** problem with RE130 is that it does not provide a clear and specific enough lighting specification for the standard reference design (SRD), creating a huge potential for gaming, inconsistent results and less efficient homes. The SRD specification is critical, because the SRD sets the baseline features for the code compliant home in order to compare by simulation with the proposed new home (the proposed new home has to be at least as efficient as the SRD home). SRD assumptions are typically very specific as to the efficiency levels and areas covered by specific building components; however, in contrast, the lighting assumption proposed in RE130 is extremely vague:
  - The proposed SRD specification for lighting only states: "Type: in accordance with Section R404.1" -- unfortunately, this specification does not tell the code user or the building official how many of the lights must comply with Section 404.1 in the SRD (we presume 75% as specified in the current mandatory requirement, but it could be 100% or some other value).
  - Section R404.1 permits the user to use a wide range of high-efficacy lamps, including linear or compact fluorescents, or any lamp that achieves a threshold number of lumens per watt to meet the mandatory requirement. The lamps specified have different levels of energy use such that each would yield significantly different results in the performance calculation, yet the proposal does not say which type should be used as the SRD-specified lighting.
- The **substantive** problem with RE130 is that it will result in a significant reduction in energy efficiency by creating a potentially sizeable trade-off loophole. Specifically, including lighting in the performance path for compliance carries many of the same problems as including equipment in the performance path:
  - Very short-lived, potentially temporary lighting (which often can be easily removed) could be substituted for long-lived permanent thermal envelope components like insulation. This is obviously not a reasonable trade-off.
  - Like equipment, the minimum efficiency level for different types of lighting is addressed by federal law and modified over time, making it difficult to establish a reasonable baseline in the standard reference design. Indeed, federal standards that go into effect in 2020 will substantially improve lighting efficiency.
  - Whether by consumer demand now or federal standards in the near future, efficient lighting is already likely to be installed in the home without allowing an efficiency trade-off; this fact makes the lighting a free rider in both cases, allowing the builder to reduce energy efficiency in some other part of the home, without actually offsetting the reduction (since the lighting would be installed anyway).

If some trade-off related to lighting is truly desirable, the builder can and should use the ERI compliance path, which corrects for free ridership to some degree by setting a reasonably aggressive ERI target. For good reason, lighting has never been permitted in the IECC performance path as a potential trade-off substitute for other energy efficiency features. We estimate that adding lighting in this manner could create a potential trade-off loophole of as much as a 5.7 % increase in energy use on a national basis (assuming 100% usage instead of 75% and assuming moderately efficient lighting readily available):

CZ	Lighting Trade-off
1	6.2%
2	7.2%
3	6.7%
4	5.1%
5	4.8%
6	3.0%
7	2.6%
8	1.4%

Nat'l Avg	5.7%

Separate from free ridership issues, on a lifecycle cost basis, this trade-off *increases* the cost of ownership from $50 to $700 over a 30 year period (based on comparing the useful life and benefits of permitted lighting and insulation over 30 years).

Because RE130 would create code compliance and/or enforcement issues and could lead to a substantial reduction in long-term energy savings, we recommend disapproval of this proposal.

Proponent : Jeremy Field, representing Building Efficiency Resources requests Disapprove.

Commenter's Reason: With the acceptance of making 90% of lighting efficient by Mandate from RE127-16, there will be very little energy efficiency to be gained by adding lighting to the Performance code. If we're going down this route of adding electrical loads, why don't we include mechanical system efficiency and appliances? Wait...we already have a path to do this... its the ERI!
It is unnecssary to include lighting in R405. Please don't include.

If you agree you must include, then be careful of writing the code consistently with the approved RE132-16 regarding adding mechanical ventilation system efficiency which should be included.

RE130-16

RE131-16
R405.1 (IRC N1105.1)

Proposed Change as Submitted

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

Revise as follows:

R405.1 <u>(N1105.1)</u> Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling and service water heating energy only.

<u>**Exception:** Energy used to recharge or refuel vehicles that are used for on-road and off-site transportation purposes.</u>

Reason: This proposal modifies the scope to account for off-site transportation. It is very likely that more homes and residential buildings will have infrastructure to allow occupants to refuel or recharge their light-duty vehicles. With this infrastructure, the homeowner or tenant can obtain energy for their vehicle through the home energy infrastructure. However, the energy sent to the vehicles is not used by the building, in either a standard reference design case or a proposed design case.
Different vehicles w ill have different sizes of energy storage systems. While some plug-in hybrid vehicles have batteries w ith a capacity of 4-5 kWh, other all-electric vehicles currently on the market have batteries w ith a total capacity of anyw here from 24 to 85 kWh. On an annual basis, the energy sent to a vehicle can be significant. For example, if a vehicle gets 4 miles per kWh, and the owner drives 8,000 miles per year, then the car will receive 2,000 kWh through the building infrastructure.

This language is written specifically for vehicles that can travel on streets and highw ays, away from the building or building site. In other words, it is solely for for vehicles that are used for off-site purposes that may obtain their energy through the building energy infrastructure.

However, vehicles that are used on site at the building or at the building site for mobility or process purposes (e.g., motorized mobility devices or lawnmowers) do not qualify for this exception and could be accounted for like other miscellaneous end-use appliances, if a designer or modeler wanted to (miscellaneous end-uses are not required to be modeled under the current scope).

Cost Impact: Will not increase the cost of construction
This proposal does not change any of the requirements in Section 405, or the rest of the code, and only addresses how the simulation is to be performed <u>if</u> such infrastructure is installed at the building. As a result, it will not increase the cost of construction.

**RE131-16 :
R405.1-
ROSENSTOCK12191**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed exception is not relevant to the scope of the main section.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Submitted.

Commenter's Reason: As the scope of the performance path is expanded to include other end uses, it is very likely that this will turn into a whole building energy performance path. As such, this exception is needed to ensure that energy used for off-site transportation purposes is not included in the analysis.

RE131-16

RE134-16

R405.2 (IRC N1105.2), Table R405.5.2(1) [IRC Table N1105.5.2(1)]

Proposed Change as Submitted

Proponent : Craig Drumheller (CDrumheller@nahb.org)

2015 International Energy Conservation Code

R405.2 Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. The proposed total building thermal envelope UA, which is the sum of U-factor times the assembly area. shall be less than or equal to the UA of the building thermal envelope using the prescriptive U-factors from Table R402.1.4 multiplied by 1.15 in accordance with Equation 4-1. All supply and return ducts not completely inside the *building thermal envelope* shall be insulated to a minimum of R-6.

$UA_{proposed\ design} \le 1.15 * UA_{prescriptive\ reference\ design}$ Equation 4-1

Revise as follows:

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	~~As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7~~ Fuel Type/Capacity: Same as proposed design Efficiencies: Electric:air source heat pump complying with prevailing federal minimum standards. Nonelectric furnaces: natural gas furnace complying with prevailing federal minimum standards Nonelectric boilers: natural gas boiler complying with prevailing federal minimum efficiencies	~~As proposed~~ As proposed As proposed As proposed As proposed

Cooling systems[d, f]	~~As proposed Capacity: sized in accordance with Section R403.7.~~ Fuel Type/Capacity: Same as proposed design Efficiency: complying with prevailing federal minimum standards.	~~As proposed~~ As proposed As proposed
Service water heatingd, [e, f, g]	~~As proposed~~ ~~Use: same as proposed design~~ Fuel Type: Same as proposed design Efficiency: complying with prevailing federal minimum standards Use: gal/day = 30 + 10 x Nbr Tank temperature: 120ºF	~~As proposed~~ ~~gal/day = 30 + (10 × N_{br})~~ As proposed As Proposed Same as standard reference Same as standard reference
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed
Service water heatingd, [e, f, g]	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})

Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:

$AF = A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).

F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

L and *CFA* are in the same units.

Reason: This proposal includes energy neutral trade-offs for equipment efficiency, but also includes a reasonable thermal envelope through a the addition of a UA backstop.

The new ERI compliance path in the 2015 IECC reintroduced equipment efficiencies as part of energy neutral trade-offs and also included a new concept of requiring a reasonable minimum thermal envelope in a performance-type analysis. This proposal takes this "reasonable envelope" concept and applies it to the Simulated Performance Alternative (Section 405). However, rather than pointing to the prescriptive tables in a previous version of the IECC as is done in the ERI, the thermal backstop becomes a percent UA trade-off. The UA calculation will be performed internally with the compliance software. It is an easy calculation as all the necessary information is already entered (component area and U-factors/R-values). This should not be problematic as it is already done for windows.

Energy neutral equipment trade-offs had been in the IECC residential section for years. Equipment trade-offs are included in every other energy code/standard and above code program in the United States:

IECC Commercial
ASHRAE 90.1
IgCC
National Green Building Standard
LEED Commercial

LEED for Homes
Energy Star
RESNET

The fear that has been spread with bringing back equipment trade-offs is that the envelope will be substandard. The proposed UA trade-off of 15% considered a reasonable envelope backstop and is on par with the assumption that the 2012 IECC is roughly 15% more efficient than the 2009 IECC.

This proposal serves to retain energy-neutral equipment trade-off provisions from the 2006 IECC for heating and cooling systems and service water heating. By retaining these, builders have an opportunity to optimize a code-compliant house design by using energy-efficient equipment. Quite often, the use of this high-efficiency equipment provides a more cost-effective solution to achieve code compliance. Eliminating this ability discourages the concept of the "house as a system" approach, which is a cornerstone of building science.

This energy neutral trade-off is important for some industries such as log home manufacturers who may no longer be able to cost effectively construct to current and projected higher envelope requirements. The combination of increases in envelope thermal requirements, building tightness and duct tightness combined with the elimination of energy neutral trade-offs pose a serious threat to the viability of the log home industry. There are practical limitations to the thickness of log home walls. Increasing requirements for the log diameter has a exponential increase in the cost of the logs, making log walls with a U- factor of 0.082 or lower prohibitively expensive.

Cost Impact: Will not increase the cost of construction
Use of the energy neutral equipment tradeoff is an option that will likely reduce the cost of construction. In many cases the cost to increase equipment efficiency is less than many of the prescriptive requirements in the code.

RE134-16 :
R405.2-
DRUMHELLER12964

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

Revise as follows:

R405.2 Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. The proposed total building thermal envelope UA, which is the sum of U-factor times the assembly area. shall be less than or equal to the UA of the building thermal envelope using the prescriptive U-factors from Table R402.1.4 multiplied by 1.15 in accordance with Equation 4-1. <u>The area-weighted average maximum fenestration SHGC permitted in Climate Zones 1 through 3 shall be 0.40.</u> All supply and return ducts not completely inside the *building thermal envelope* shall be insulated to a minimum of R-6.

$UA_{\text{proposed design}} \le 1.15 * UA_{\text{prescriptive reference design}}$ Equation 4-1

Committee Reason: The modification was made to align this code section (for the performance method of energy compliance) with the prior action modification made for proposal RE156 (addressing the ERI method.) The solar heat gain coefficient also needs to be limited when using the performance method of compliance.

The proposed changes are needed because maximum flexibility is necessary to keep housing affordable.

Assembly Motion: **Disapprove**
Online Vote Results: **Successful**
Support: 57.09% (157) Oppose: 42.91% (118)
Assembly Action: **Disapproved**

Individual Consideration Agenda

Public Comment 1:

Proponent : Ben Edwards, representing self requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

R405.2 Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. The proposed total building thermal envelope UA, which is the sum of U-factor times the assembly area. shall be less than or equal to the UA of the building thermal envelope using the prescriptive U-factors from Table R402.1.4 multiplied by ~~1.15~~ 1.05 in accordance with Equation 4-1. The area-weighted avedrage maximum fenestration SHGC permitted in Climate Zones 1 through 3 shall be 0.40. All supply and return ducts not completely inside the *building thermal envelope* shall be insulated to a minimum of R-6.

$UA_{\text{proposed design}} <= \cancel{1.15}\ \underline{1.05} * UA_{\text{prescriptive reference design}}$ Equation 4-1

Commenter's Reason: A 15% loss of long-lived envelope efficiency measures is an excessive trade-off allowance for unverified equipment performance. If some flexibility is desired, a 5% trade is more appropriate.

Public Comment 2:

Proponent : Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

TABLE R405.5.2 [N1105.5.2(1)] (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed

Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commerical Provisions. Capacity: sized in accordance with Section R403.7 ~~Fuel Type/Capacity: Same as proposed design~~ ~~Efficiencies:~~ ~~Electric:air source heat pump complying with prevailing federal minimum standards.~~ ~~Nonelectric furnaces: natural gas furnace complying with prevailing federal minimum standards~~ ~~Nonelectric boilers: natural gas boiler complying with prevailing federal minimum efficiencies~~	As proposed ~~As proposed~~ ~~As proposed~~ ~~As proposed~~
Cooling systems[d, f]	~~Fuel Type/Capacity: Same as proposed design~~ ~~Efficiency: complying with prevailing federal minimum standards.~~ As proposed Capacity: sized in accordance with Section R403.7	As proposed ~~As proposed~~
Service water heatingd, [e, f, g]	As proposed Use: Same as proposed design ~~Fuel Type: Same as proposed design~~ ~~Efficiency: complying with prevailing federal minimum standards~~ ~~Use: gal/day = 30 + 10 x Nbr~~ ~~Tank temperature: 120ºF~~	As proposed gal/day = 30 + (10 × N_{br}) ~~As Proposed~~ ~~Same as standard reference~~ ~~Same as standard reference~~
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.
a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.
b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:

$AF = A_S \times FA \times F$

where:

AF = Total glazing area.

A_S = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).

F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

L and CFA are in the same units.

Commenter's Reason: RE134 should be approved as further modified by this public comment because the modification would remove the equipment trade-off from the performance path, consistent with the current IECC, while retaining the proposed new mandatory requirements that would limit trade-offs under the performance path. If this modification is not approved, then the entire proposal RE134 should be disapproved.

The original proposal, by itself, is a significant step backward in energy conservation, but the proposed modifications accomplish two key things that will help maintain and improve the efficiency of residential buildings:

- The modification proposed in this public comment maintains the efficiency of the simulated performance alternative (performance path) of the 2015 IECC by removing the trade-offs for heating, cooling, and water heating equipment efficiency that are included in the original RE134 proposal. These trade-offs were eliminated from the 2009 IECC, and proposals to go back and reinstate them were overwhelmingly rejected by ICC voters in the 2012 and 2015 IECC code development cycles. Allowing such trade-offs would be an enormous step backward for energy efficiency.
- As modified, the proposal would still adopt the thermal envelope backstop proposed by NAHB in the original RE134 (and as modified at the Committee Action Hearing), which would require a maximum UA and fenestration SHGC, helping to ensure at least a minimum level of efficiency for thermal envelope components for compliance under the simulated performance alternative. **To be clear, the backstop proposed by RE134 will not make up for the energy efficiency losses that would come about from the reintroduction of equipment trade-offs into the IECC.** But as a stand-alone change to the current code, the backstop itself would improve the code. It should be noted that we would prefer the thermal envelope backstop approach set forth in RE135, but the backstop proposed in RE134 is still an improvement over no backstop at all.

We recommend approval as modified with this modification. Without this modification, RE134 should be disapproved because it would result in a staggering setback in energy efficiency and create a whole new set of problems for states considering the IECC.

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Approve as Modified by Committee.

Commenter's Reason: The committee's action was correct and included its modification. In order to ahve a viable performance-related cost, the issues of energy-neutrality are key and are put forward in this proposal. Too often, performance options are added above and on top of prescriptive requirements, disincentivizing users to take the performance path. Equivalence of energy efficiency between precriptive requirements and performance options are essential, or performance will be come meaningless as an option. The proponent's orginal reason statement is applicable here: "This proposal includes energy neutral trade-offs for equipment efficiency, but also includes a reasonable thermal envelope through the addition of a UA backstop.

The new ERI compliance path in the 2015 IECC reintroduced equipment efficiencies as part of energy neutral trade-offs and also included a new concept of requiring a reasonable minimum thermal envelope in a performance-type analysis. This proposal takes this "reasonable envelope" concept and applies it to the Simulated Performance Alternative (Section 405). However, rather than pointing to the prescriptive tables in a previous version of the IECC as is done in the ERI, the thermal backstop becomes a percent UA trade-off. The UA calculation will be performed internally with the compliance software. It is an easy calculation as all the necessary information is already entered (component area and U-factors/R-values). This should not be problematic as it is already done for windows.

Energy neutral equipment trade-offs had been in the IECC residential section for years. Equipment trade-offs are included in every other energy code/standard and above code program in the United States:

- IECC Commercial
- ASHRAE 90.1
- IgCC
- National Green Building Standard
- LEED Commercial
- LEED for Homes
- Energy Star
- RESNET.

The fear that has been spread with bringing back equipment trade-offs is that the envelope will be substandard. The proposed UA trade-off of 15% considered a reasonable envelope backstop and is on par with the assumption that the 2012 IECC is roughly 15% more efficient than the 2009 IECC.

This proposal serves to retain energy-neutral equipment trade-off provisions from the 2006 IECC for heating and cooling systems and service water heating. By retaining these, builders have an opportunity to optimize a code-compliant house design by using energy-efficient equipment. Quite often, the use of this high-efficiency equipment provides a more cost-effective solution to achieve code compliance. Eliminating this ability discourages the concept of the "house as a system" approach, which is a cornerstone of building science.

This energy neutral trade-off is important for some industries such as log home manufacturers who may no longer be able to cost effectively construct to current and projected higher envelope requirements. The combination of increases in envelope thermal requirements, building tightness and duct tightness combined with the elimination of energy neutral trade-offs pose a serious threat to the viability of the log home industry. There are practical limitations to the thickness of log home walls. Increasing requirements for the log diameter has a exponential increase in the cost of the logs, making log walls with a U- factor of 0.082 or lower prohibitively expensive....The propoal will not increase the cost of construction. Use of the energy neutral equipment tradeoff is an option that will likely reduce the cost of construction. In many cases the cost to increase equipment efficiency is less than many of the prescriptive requirements in the code."

Proponent : David Collins, representing The American Institute of Architects (dcollins@preview-group.com) requests Disapprove.

Commenter's Reason: This code change reintroduces equipment tradeoffs in the performance path of the IECC. The committee voted to modify the original proposal, but a floor action for deny was passed on a 57/43 percent vote.
The AIA is strongly opposed to this proposal as it would be a major rollback of energy efficiency in the code. The reintroduction of the performance path tradeoff of envelope for equipment efficiency (EE) would be a giveaway or "free credit" for high-EE equipment. The current market has already responded and there are few additional benefits in energy efficiency to be gained from that trade-off.

This proposal removes any incentive to prioritize passive design solutions for energy efficiency. We strongly urge the membership to deny this change as the IECC would see a reduction in its objective to provide for high energy efficient buildings.

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Disapprove.

Commenter's Reason: RE134 should be disapproved for a number of reasons, including its disapproval by a successful floor motion. Similar proposals in past code development cycles have been disapproved because of the negative impact to energy efficiency. Contrary to the "neutral energy" impact claimed by the proponents, this proposal is not neutral in its real impact to energy consumption. For example, gas furnaces of 90% AFUE or greater are the commonly used and available equipment in new homes, particularly in northern climates. Yet, RE134 would allow a "bottom of the barrel" 80%AFUE furnace to be "assumed" for trade-off purposes, not the average or typical equipment. Thus, many homes that would have used a commonly available 90% AFUE furnance anyway will still use such a furnace, but also apply a "fictitious" 80% AFUE furnace on paper to trade off "real" energy efficiency in other parts of the building (as though such a minimum furnance would have been used) . Consequently, the consumer will believe they are getting a good deal (e.g., an "above minimum" efficiency furnace), but the real deal is that it was used to make "hidden" decreases in the efficiency of the home that result in a net loss of energy savings. This boondoggle is made possible through the continuance of an outdate Federal minimum equipment efficiency mandate. Therefore, the only way to resolve the problem, preserve the code's intent for energy conservation, and protect consumers is to not recognize equipment efficiency trades in the code. By disapproving RE134, the code's long-standing position on this matter will be maintained. Allowing equipment efficiency trades should not be entertained until such a time that the Federal minimum equipment efficiency standard is corrected and updated to catch up with current market conditions.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net) requests Disapprove.

Commenter's Reason: RE134 should be disapproved because it reintroduces equipment trade-offs into the IECC's performance compliance path at a tremendous cost to energy efficiency. This rollback has been proposed/supported by the same stakeholders and consistently rejected by the governmental voting officials since such trade-offs were first eliminated from the IECC in 2009. Similarly, the assembly action vote rejected this proposal, recommending disapproval as well. States have been enforcing building energy codes with no equipment trade-offs for a number of years now, and with great success. There is no evidence that eliminating trade-offs has affected installation of high-efficiency furnaces, air conditioners, or water heaters. In fact, the market penetration of efficient equipment continues to grow. Reinstating these trade-offs in 2018, *after nearly a decade without them,* would move energy efficiency for the rest of the home sharply backward for no good reason, and create a host of new problems.

(1) RE134 represents an enormous step backward in energy efficiency. ICF International, a nationally recognized energy consulting firm, conducted a detailed analysis of the negative impacts of a similar proposal to reinstate equipment trade-offs during the last code cycle (September 2013). This study can be found at: http://energyefficientcodes.com/wp-content/uploads/2013/08/2013-9-23-FIN-Review-Analysis-of-Equipment-Trade-offs-in-Residential-IECC.FIN_.pdf. Specifically, the study found that introducing equipment trade-offs into the performance path would reduce energy efficiency under the code by 6% to 9% depending on the climate zone simply based on trade-off credit from the use of a 90 AFUE furnace (note that furnaces considerably more efficient than this are commonly installed, which would create larger trade-off credit). Inclusion of other high efficiency equipment (air conditioning and hot water) would increase this trade-off credit loss in energy efficiency to a national 11% to 22% on average. In fact, installing an instantaneous (tankless) water heater alone would yield 9% trade-off "credit," which means the rest of the home could be built 9% less efficient, on average just for a better water heater. Massive trade-offs (efficiency reductions) of other important energy efficiency measures (insulation, windows, air and duct leakage) would be permitted if this approach were reinstated.

(2) In reviewing the 2009 IECC, US DOE concluded that eliminating the equipment trade-off is likely to save energy in many cases. In conducting its determination on the 2009 IECC, when the equipment trade-off was eliminated, US DOE stated:

"Because building envelopes have substantially longer lives than HVAC and/or water heating equipment, energy savings from envelope improvements may persist for many more years than comparable equipment improvements. Also, because high-efficiency equipment is already the predominant choice in many markets, disallowing envelope/equipment trade- offs is likely to result in improved overall efficiency in many situations." *See* 76 Fed. Reg. 42697, 42688 (July 19, 2011).

(3) Equipment trade-offs are not "energy neutral" as claimed by proponents. In fact, as noted in the ICF study, equipment trade-offs result in huge losses in energy efficiency – up to a reduction of 20% or more, essentially wiping out much of the progress made in advancing energy efficiency over the last several code update cycles. There are several reasons why trade-offs for heating, cooling, and water heating efficiency are not "neutral" and are in fact net reductions in energy efficiency – and thus would significantly weaken those homes that comply under the performance path:

- **Federal preemption** – Equipment trade-offs are fundamentally a problem because unlike other parts of a building (such as building envelope components) that can be directly regulated by state and local governments, federal law prohibits jurisdictions from setting reasonable energy efficiency requirements for this equipment. Only the federal government has authority to set the minimum efficiency requirements for heating, cooling, and water heating equipment, and these federal standards are often outdated and lag far behind the efficiency of commonly-installed equipment. Adding equipment trade-offs back into the IECC would tie the hands of state and local officials who have worked diligently to improve building efficiency, and would impose outdated, weak federal efficiencies on them, creating enormous room for energy-losing trade-offs.

- **Free ridership** – Because federal minimum efficiency requirements are so far behind commonly-installed equipment, an artificial trade-off "gap" is created, permitting builders to trade away the efficiency of the building thermal envelope for equipment that they would have installed anyway. This is "free ridership" for the builder, and it results in higher energy costs being imposed on the homeowner.

The free ridership gap between what is commonly installed by builders and the federal minimum efficiency is huge. For example, the state of New York recently completed a residential baseline study that indicated 94% of new homes included a furnace with an AFUE of 90% or greater and 71% of new homes with an AFUE of 94% or better. (See https://www.nyserda.ny.gov/-/media/Files/Publications/building-stock-potential-studies/residential-baseline-study/Vol-3-HVAC-Res-Baseline.pdf)

This means that in New York, homes are meeting the code without equipment trade-offs and then adding much more efficient equipment. If RE134 is adopted, the performance path baseline would reflect a furnace more than 10% less efficient, creating substantial free rider trade-off credit and reductions in efficiency in the rest of the home.

The recent U.S. Department of Energy Code Compliance Field Study also reviewed the efficiency of equipment being installed in new homes in several states. Per the information below, states in which heating loads are significant, the market penetration of efficient technologies is already quite high (above 80%). Even in locations where heating loads are minimal, the share of efficient equipment is above 25%. Again, allowing trade-off credit in these homes would simply create free ridership and reduce efficiency under the code as other efficiency measures are traded-off for equipment that would have been installed anyway.

Market Penetration of Condensing Furnaces in Select DOE Compliance Field Study States

	% of homes above 90 AFUE	**% of homes above 92 AFUE**
Alabama	24.1%	10.3%
Kentucky	80.0%	35.6%
Maryland	99.3%	98.5%
North Carolina	33.3%	29.8%
Pennsylvania	98.3%	96.6%
Texas	27.7%	3.6%

- **Trading near-term measures against long-term efficiency** – Aside from free riders, another problem with equipment trade-offs is the likelihood that builders will trade away the long-term benefits (to homeowners) of features such as an efficient thermal envelope, in favor of short-term cost cutting in the form of more efficient equipment, which will be replaced several times over the lifetime of the home. For example, if a trade-off is permitted for water heater efficiency, an instantaneous natural gas water heater could allow the builder to reduce the efficiency of the home by an average of 9%. The resulting home will be 9% less efficient for its entire useful lifetime. As the water heater is replaced every 10-15 years, that home will continue to underperform by 9%.

By contrast, under the current code, no trade-off credit is awarded for the instantaneous water heater, which means the home will be built to code. As the water heater is swapped out in future years, the current code home will out-perform the trade-off home by 9%. As an example of what this means in terms of backing off the thermal envelope, this trade-off would permit a home in New York (Climate Zone 6) to have walls that are built and insulated to the same level as home following the 2006 IECC in Miami (Climate Zone 1).

While the thermal envelope backstop included in RE134 provides some limited protection against trade-offs, it is simply insufficient to address this problem. Even with the backstop, the thermal envelope efficiency advances of the last few code cycles will be lost, since the 115% of UA backstop and the 0.40 SHGC proposed in RE134 are less efficient than even the requirements of the 2009 IECC. In fact, by definition, a 115% UA backstop allows the trade-off of 15% of the insulating value of the entire thermal envelope, a large amount by any measure.

- **Credit for efficient equipment is already available and the effects are accounted for in the ERI** – The 2015 IECC does award credit for equipment efficiency, but only within the Energy Rating Index. This is because the ERI Index target is set at a level low enough to recapture most of the free-ridership losses. While the ERI does not guarantee against all unnecessary trade-offs of long-term energy efficiency, as DOE analysis shows, it is far more effective on this issue than the unlimited equipment trade-offs proposed in RE134.

If jurisdictions seek additional options to receive credit for going beyond federal minimum efficiency levels, we urge voters to approve RE179, the EECC "Flex Points" proposal, which awards credit not only for heating, cooling, and water heating efficiency, but other new innovative technologies – all without reducing the efficiency of the existing code. Unlike RE134, RE179 builds upon the solid energy conservation foundation of the 2015 IECC, rather than simply trading it away for artificial trade-off credit.

(4) Equipment trade-offs in the performance path will create problems for states adopting the IECC. We note that only a small handful of states allow performance path equipment trade-offs at all. The vast majority of states have completely eliminated equipment trade-offs, and have turned the page on this efficiency loophole with no negative impact. Reintroducing these trade-offs raises several complicated issues:

- **ARRA compliance** – As a condition for receiving tens of millions of tax dollars from the federal government under ARRA, state governments confirmed to the U.S. DOE that their states would adopt the 2009 IECC (which does not permit equipment trade-offs) and achieve 90% compliance by 2017. More than 2/3 of states have adopted the 2009 IECC or a more recent edition. Adopting equipment trade-offs could cause these states to fall out of compliance and renege on these obligations.
- **Federally-insured mortgages** – The U.S. Department of Housing and Urban Development and the U.S. Department of Agriculture recently finalized energy conservation standards that apply to federally-insured mortgages. In order to qualify for one of these federally-insured loans (such as FHA), new homes must meet or exceed the requirements of the 2009 IECC. Adopting equipment trade-offs into the state code could put new homes out of compliance with this rule, and could disqualify many potential homeowners from being able to purchase these homes.
- **Efficiency rollback** – The vast majority of states have adopted a residential energy code that does not allow equipment trade-offs. For states that regularly update their residential codes, this proposal presents a problem – if the 2018 IECC results in a clear step backward in efficiency due to equipment trade-offs, these states may either be unable to adopt the code or may need to amend the code to delete these provisions.

RE134 would create a host of new problems, roll back energy efficiency, and should be disapproved.

Proponent : Jeremy Field, representing Building Efficiency Resources requests Disapprove.

Commenter's Reason:

This is a terrible proposal that will signficiantly roll back efficiency of the code. What this in essence will allow is:

1. Worse performing envelope than Prescriptive code
2. Poor performing duct systems

Both of these will be able to be offset by better mechanical systems. This is great, except for in reality the federal minimum heating system standards are in sigificnat need for overhaul and updating; there is simply no reason why a builder installing a 90% efficient furnace should have their home compared to a 78% reference furnace in 2018.

This proposal if accepted will strike a significant blow to efficiency in the Performance Code which has brokered at least better performing air leakage and duct leakage to offset worse envelopes. See attached PDFs . What this shows is a current REM/Rate 2015 IECC analysis of an average home in Iowa. It is built as follows:

- Basement walls: R-10 continuous
- Below grade slab: R-0
- Framed floor: R-21 cavity
- Rim joist: R-19
- AGWs: R-15
- Windows: U 0.28 SHGC 0.23

- Doors: R5.3
- Ceiling: R38 blown truss attic

This envelope is just under the 115% of the UA value of the code Reference as this proposal would permit. In order to meet the curent R405, the duct leakage to outside must be less than 2% and the infiltraiton 2.3 ACH50. Thus, substantial savings in envelpoe and duct sealing allow the home to have a 15% reduced envelope performance

When modeifying the home to have federal minimum equipment (78% furnace, 13 SEER AC, and 0.62 EF DHW), the new cost threshold for the refrence is $1365. Modifying the Design case to a reasonably standard new equipment (92% furance, 14 SEER AC, and 0.65 EF DHW), the home is allowed to just meet the 3 ACh50 mandatory required leakage, as well as nearly 6% duct leakage to outside to pass the Performance Code by $1.

Obviously, this is just an example. however, the principle is the same; by allowing equipment efficiency to be inclduded, any savings made in duct leakage or envelope leakage is eliminated. Since the 2015 IECC moved duct leakage rate to being Prescriptive, this means that duct leakage can be signfiicantly rolled back potenitally. Remember, the example i gave was using only modestly more efficeint equipment... imagine the allowable duct leakage if we were dealing with a 96% furnace, 16 SEER AC and a 95% tankless water heater... likely 15-20% duct leakage to outside would be possible.

This provision, coupled with the proposed acceptance of reduced Mandatory air leakage, will significantly roll back the Perofmrance Code whcih is already substantially weak in terms of buildling actual building performance. Please do not accept this proposal.

Proponent : Shaunna Mozingo, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net) requests Disapprove.

Commenter's Reason: The Colorado Chapter of ICC opposes this proposal as submitted or as modified. The traade-offs are already in the ERI path. The ERI path was made more restrictive because it was offset with the more felibible trade-offs. Why do we need 2 paths for performance if they are both going to say the same thing. You are actually taking away a level of flexibility by adding this proposal. The paths through the code are starting to cross over into each other, which is making the code more confusing to read and use. This proposal does not bring any added value to the IECC.

Proponent : Lauren Urbanek, representing NRDC (lurbanek@nrdc.org) requests Disapprove.

Commenter's Reason: This proposal should be disapproved. The proposal changes the performance path such that the standard reference design of heating, cooling, and service water systems is the minimum federal standard. It would result in a severe weakening of the code, which would make the performance path much less stringent than both the ERI path and the prescriptive path. Weakening the performance path in this manner would undercut the authority of the code as a credible source document for energy efficiency and consumer protection.

The proposal would weaken the code in two ways. First, it would result in the performance path being weaker than the prescriptive path. This is just common sense: if the reference house is designed using the least efficient heating, cooling, and water heating products that are available, and since many, if not most, new homes are built with equipment that is already more efficient than the minimum federal standard requirements, the savings from equipment that is *already being widely installed* would be replace the savings due to a more stringent building envelope. This leads to a net decrease in energy savings for the consumer. In some heating-dominated states, furnaces that exceed the federal standard are already installed in more than 98% of new homes. This proposal would create a huge free ridership issue, where builders can install equipment that the market already demands but then take credit for the savings while installing fewer efficiency measures elsewhere in the house. This is harmful to the homeowner.

The second threat is less apparent but could lead to even worse outcomes. The performance path provides no rules for how performance is calculated in order to be traded off, or for how to input inspected parameters into performance software (or even what characteristics that performance software should have). This rolls out a red carpet to gaming the design of the reference house and leaves homeowners in the dark about what their actual expected energy consumption will be. It also imposes an unrealistic burden on the code official: how is the official to determine whether the performance tradeoff calculation is being done correctly? This is a complicating element that is not at all addressed in the proposal.

This problem does not exist in the ERI standard, where there are clear requirements on how ERI calculations are to be done, and an existing infrastructure of certified software and experts that produces ERI ratings.

The US Department of Energy is required by federal law to analyze the code and determine if it saves energy. Like NRDC, DOE performs their analysis as compared to the most recent version of the adopted code. If this proposal were to be adopted, it is clear that DOE would not be able to give a positive determination to the 2018 performance path of the code. This outcome is sure to cause chaos for state implementation by diminishing the credibility of the IECC as a code that protects the interests of consumers.

Equipment tradeoffs were removed from the energy code in 2009 and have been voted down by the voting members in both 2012 and 2015 code development processes, for precisely the reasons outlined here. This proposal will blatantly reduce the efficiency of the performance path of the code and should be disapproved.

Proponent : Assembly Motion requests Disapprove.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Disapprove was Successful by a vote of 57.09% (157) to 42.91% (118) by eligible members online during the period of May 11 - May 26, 2016.

RE134-16

RE135-16
R405.2 (IRC N1105,2)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Mandatory requirements. Compliance with this section requires ~~that~~ compliance with all of the following:

1. The mandatory provisions identified in Section R401.2 shall be met.

2. All building thermal envelope components such as insulation and fenestration shall comply with the building thermal envelope requirements specified under Section R406.2.

3. All supply and return ducts not completely inside the *building thermal envelope* shall be insulated to a minimum of R-6.

Computer software used to determine compliance in accordance with Section R405 shall incorporate the requirements of this section such that compliance will only be achieved when these requirements are met. The compliance reports required in Section 405.4.2 shall have a list of the requirements of this section for each building component and an indication of each building component's compliance with those requirements.

Reason: The primary purpose of this proposed code change is to establish reasonable mandatory requirements for a minimum thermal envelope under the performance compliance path in section R405. In order to maintain consistency with the same requirements applicable under the ERI compliance path in section R406, the proposal simply references the requirements in section R406. This proposal also establishes requirements for computer software consistent with these mandatory requirements to improve code compliance.
The fact that the mandatory provisions in the ERI compliance path already establish minimum thermal envelope requirements underscores the need for such a backstop when allowing various energy efficiency measures to be traded through any type of performance-based analysis. The reasons for establishing minimum thermal envelope requirements for the ERI are well-established: A well-built thermal envelope provides long-term energy savings and improved comfort for occupants over the lifetime of the home, and upgrades to the thermal envelope are easiest to incorporate (and most cost-effective) at construction. This is consistent with the intent of the IECC set forth in Section R101.3. Specifically, the IECC is intended to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

This logic applies to the standard performance compliance path under section R405 as well. Regardless of the compliance option selected by the code user, the IECC should require a reasonable level of performance by the home's thermal envelope. As a result, this proposal would apply the same mandatory requirements, including envelope requirements, to section R405 compliance as currently apply to section R406 compliance. This proposal will serve to better align the requirements under the two performance compliance paths in sections R405 and R406.

Cost Impact: Will increase the cost of construction
The additional requirements proposed for Section R405.2 will serve only as a backstop to ensure that a minimum reasonable thermal envelope will be provided. Because this backstop is incorporated into an optional compliance path (the performance path), this proposal does not require the builder to incur additional cost. Instead, the builder has the potential to incur additional cost only if the builder selects this compliance path. Moreover, since this section does not require overall efficiency beyond that which is required in Section R405, when the code user selects this compliance path, the cost impact (if any) is entirely dependent on design choices made by the builder. For example, if a building complying via section R405 already meets or exceeds the prescriptive thermal envelope requirements of the IECC, as is likely in many cases, then the thermal envelope backstop proposed for Section R405.2 will have no cost impact. By contrast, if the building would have been constructed with a weaker thermal envelope than the proposed backstop, and the difference would have been offset by improvements to other components of the building in order to achieve the requisite simulated performance, the cost impact will depend on whether the upgrades to non-envelope components cost more or less than the envelope improvements would have cost.
We note that the prescriptive improvements made to the IECC prescriptive path during the past few years (which are the basis

for the backstop) have already been demonstrated to be cost-effective to the consumer – irrespective of other trade-offs that may take place. For example, the U.S. DOE found that over a 30-year useful lifetime, an owner of a home built to the prescriptive and mandatory measures of the 2015 IECC (as compared to the 2009 IECC) would save between $4,418 and $24,003 in energy costs, depending on climate zone. *See* V. Mendon, et. al., Pacific Northwest National Laboratory, *National Cost-Effectiveness of the Residential Provisions of the 2015 IECC*, at iv (June 2015), https://www.energycodes.gov/sites/default/files/documents/2015IECC_CE_Residential.pdf. These figures include the expected costs of the upgrades over the 2009 IECC. DOE also found that homeowners would achieve a positive cash flow within the first two years in every climate zone. *Id*. at v. The analysis shows an estimated simple payback period that ranges between 2.2 years and 8.1 years, again depending on climate zone. *Id*.

Thus, if the improved thermal envelope requirement drives builders to incorporate improvements to the thermal envelope consistent with the prescriptive requirements of the IECC, these improvements have already been shown to be cost-effective to the homeowner by U.S. DOE.

RE135-16 :
R405.2-FAY12800

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There are already backstops in place in the code. Also, the "such as" in the last sentence is questionable language.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R405.2 (N1105.2) Mandatory requirements. Compliance with this section requires compliance with all of the following:

1. The mandatory provisions identified in Section R401.2 shall be met.

2. All building thermal envelope components such as insulation and fenestration shall comply with the building thermal envelope requirements specified under Section R406.2.

3. All supply and return ducts not completely inside the *building thermal envelope* shall be insulated to a minimum of R-6.

~~Computer software used to determine compliance in accordance with Section R405 shall incorporate the requirements of this section such that compliance will only be achieved when these requirements are met. The compliance reports required in Section 405.4.2 shall have a list of the requirements of this section for each building component and an indication of each building component's compliance with those requirements.~~

Commenter's Reason: This proposal should be approved as modified or approved as submitted because it would save energy by applying the same reasonable trade-off backstop for thermal envelope measures in the performance path that applies to the Energy Rating Index in the 2015 IECC. The proposed modifications respond to issues raised at the Committee Action Hearing and help ensure that the backstop will remain identical to the backstop that applies to the ERI option.

The ERI backstop in Section R406.2 has been adopted as published by every state that has adopted the ERI as part of the 2015 IECC. It recognizes the crucial importance of a reasonably efficient thermal envelope, irrespective of the efficiency trade-offs among various other building components. Because the 2009 IECC is the baseline for federal legislation such as ARRA, and the referenced standard for a home to qualify for a federally-insured mortgage, it does not make sense to allow any home to be built with components that would not achieve compliance with the 2009 IECC.

This public comment removes language related to computer software requirements that some had suggested would be appropriate elsewhere. While we believe it is useful, we proposed this modification in order to maintain focus on the addition of a thermal envelope backstop in the performance path.

A vote to approve RE135 as modified or as submitted would bring the same thermal envelope safety net to the performance path that currently applies to the ERI, and would ensure meaningful energy savings over the useful life of each new building.

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Approve as Submitted.

Commenter's Reason: This proposal places a consistent set of mandatory requirements, including backstops, for all compliance paths in the code. These backstops are needed to ensure that minimum energy conservation measures that are "built in" to the home, serve to save energy 24-7-365 over the useful life of the home, and are essentially unchangeable (i.e., difficult and costly to address or improve after the initial construction is complete) are not traded away for measures that are less durable and which are or can be more easily upgraded or altered over the useful life of the building.

RE135-16

RE136-16
R405.3 (IRC N1105.4)

Proposed Change as Submitted

Proponent : Keith Dennis, representing NRECA (keith.dennis@nreca.coop)

2015 International Energy Conservation Code

Add new text as follows:

R405.3 (N1105.4) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on site or source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. ~~The~~ Where used in a simulation, the source energy multiplier for electricity shall be ~~3.16~~ 2.04. The source energy multiplier for fuels other than electricity shall be 1.1.

Reason: The "source" energy metrics used to gauge the relative performance of electric generation are based on EIA methodologies established before reducing carbon dioxide emissions was a policy objective and before renewable energy generation was a significant contribution to the electric grid. As NREL notes in their report of source energy metrics, the source-site ratios are "based on the assumption that most of the electricity was produced from thermal electric power plants. The result tells nothing of the fuel types consumed or the emissions from the electricity production." [i] This means that before even taking into account the efficiency of an electric appliance itself, the electricity from the grid used to power the device has already been determined by energy efficiency tools and policies to be less than a third as efficient as on-site fossil fuel, no matter how it was generated.

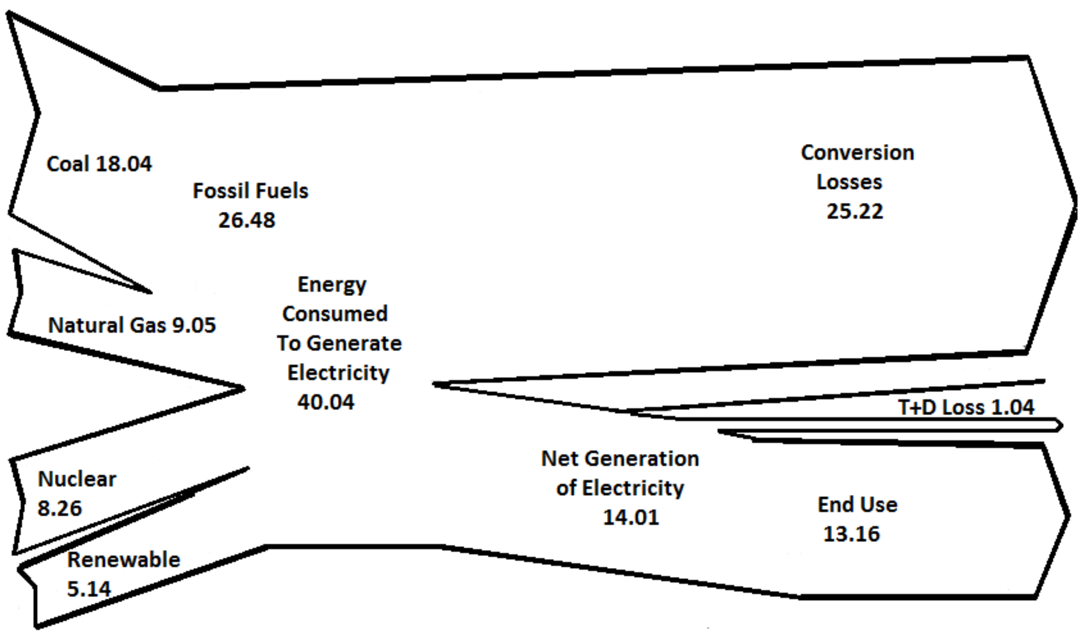


Figure 1: 2011 Electricity Flow (in Quadrillion Btu)[ii]

The EIA Electricity Flow chart (Figure 1), upon which the source energy metric is based, is designed to illustrate the relative contribution of energy by fuel type into the electrical system. In order to illustrate the relative portion of non-fossil fuel in the grid, an artificial conversion for electricity generated by non-fossil fuels is used. For renewable energy, for example, a fossil fuel heat rate above the average for natural gas plants is used, see Figure 2. However, those artificial conversions are not appropriate for the purposes of illustrating relative resource efficiency or environmental performance of the various non-fossil fuels. The conversions are not based on any practical science and are contradictory to the policy objectives that the source energy metric is designed to address.

		Approx Heat Rates
Fossil Fuels	Coal	10,498
	Petroleum	10,991
	Natural Gas	8,039
	Total Fossil Fuel	9,516
Non-Emitting Generation	Nuclear	10,479
	Noncombustable Renewable Energy	9,516

Figure 2: Approximate Heat Rates for Electricity New Generation Calculations Used by EIA in Energy Flow

Using these heat rates to calculate source-site energy ratios makes the ratio insensitive to changes in the grid mix. In fact, adding renewable energy generation to the electric grid would have the same effect on the ratio as adding the average fossil fuel generation using EIA's methodology. Adding nuclear generation would actually increase the source-site ratio for electricity, which would signal consumers to invest in more on-site fossil fuel combustion as the grid lowers emissions. This is the opposite of policy objectives, is not understood by even the most informed consumers,[iii] and is likely an unintended flaw in the methodology of the ratio that is just coming to light as use of the metric increases.

A Power Systems Engineering study replicating the EIA's methodology under various hypothetical scenarios demonstrates the flaws in the way the source energy metric is currently calculated. The analysis shows that a switch of all coal-fired power in the country to renewable energy would result in a source-site ratio of 2.99 (see Figure 3). Under this scenario, despite using non-emitting sources to provide 71% of the grid's power, consumers would still be incentivized three to one to have gas end uses rather than electric.

	Source-Site Ratio
All Coal Switched to Gas	2.81
All Coal Switched to Renewable	2.99

Figure 3: Source-Site Ratios Using EPA/DOE Methodology[iv]

Of critical concern, and driving the need to fix this metric, is that a myriad of energy policy tools are built on this flawed source energy metric. Output from these policy tools, for example, forms the basis for deciding whether homeowners and businesses should be provided or denied incentives based on the energy performance of their homes and buildings. These consumers are given inaccurate signals from the government and are improperly incentivized due to the flaws in this metric. This is in contrast to the intent of the tools which is to help consumers to be better informed market participants. [v]

As the nation moves forward in an effort to curb carbon dioxide emissions, use of this metric in policy runs counter to those goals – especially in the context of EPA's Clean Power Plan (CPP). Under the CPP or other policies that cap emissions in the electric sector, there could be a significant and unintended incentive to switch consumers from a more environmentally beneficial electric system to one that burns fossil fuel on-site. The emissions from this one-site combustion would not be subject to the electric sector cap, so the switch from electricity to on-site gas would simply shift the emissions to sectors not covered under the cap. Use of source metrics in combination with other climate policies could thus lead to compliance of the electric-sector GHG rules while simultaneously significantly increasing GHG emissions of the country overall.

With new grid-connected combined cycle natural gas plants that are over 60% efficient, increasing new renewable electric generation on the grid, and large contributions of non-fossil hydro and nuclear power, it is inaccurate and inappropriate to characterize electricity as one-third as efficient as site-delivered fossil fuel. Since these metrics are subject to debate in many forums, from code hearings and appliance standards proceedings to legislation, there is an opportunity for utilities, environmental advocates, and policy makers to work to fix this issue. One proposal would be to simply replace the current "source" energy metric with a "fossil source" energy metric using data from the same EIA chart. A sample calculation with this simple change to the calculation used to derive the current metric is presented in Figure 10.[vi] This solution would better align the source energy metric with its intent of reducing primary fossil fuel use and its associated emissions. In addition to correcting the flawed treatment of renewable resources, NRDC's comments to DOE also include a proposal to use a "marginal source" value to better reflect the types of generation that power new appliances.[vii]

Sample Calculation of Current "Source" Energy Conversion Factor Using 2011 Data

Energy Consumed to Generated Electricity / (Gross Generation of Electricity – T & D Losses) =

40.04 / (14.01 - 1.04) = ***3.09***

Sample Calculation of Proposed "Fossil Source" Energy Conversion Factor Using 2011 Data

Fossil Fuels / (Gross Generation of Electricity – T & D Losses)

26.48 / (14.01 - 1.04) = ***2.04***

Figure 4: Sample Calculation of a "Fossil Source" Energy Metric

For more context, please the peer-reviewed article published in the Electricity Journal entitled "Beneficial Electrification: Electricity as the End-Use Option." http://dx.doi.org/10.1016/j.tej.2015.09.019 (http://dx.doi.org/10.1016/j.tej.2015.09.019)

[i] M. Deru, P. Torcellini. 2007 Source Energy and Emission Factors for Energy Use in Buildings. NREL. p.4.

[ii] EIA. Electricity Flow 2011. Modified for better display.

[iii] For example, BSD-151: Understanding Primary/Source and Site Energy, by Kohta Ueno and John Straube, states: "Of course, over time, the fraction of renewable energy is expected to increase, making the grid 'greener.' With the retirement of old coal, the addition of wind, high efficiency gas, biomass, tidal, or even nuclear, the carbon intensity of producing electricity will drop, and the source-site ratio will drop." The idea put forth by these experts is not accurate as increasing use of these fuels will not significantly affect the source-site ratio. This highlights the level of confusion around the source metric and the technical details of how it is calculated.

[iv]David Williams. 2014. *Source-Site Ratios.* Power Systems Engineering.

http://www.nreca.coop/wp-content/uploads/2015/04/sourcesite_ratios_final_022015.pdf

[v] Keith Dennis. The Electricity Journal. 2006. The Compatibility of Economic Theory and Proactive Energy Efficiency Policy. Vol.19. Issue 7. P. 61.

[vi] This would replace the use of the 40.04 quads listed as "energy consumed to generate electricity" with the 26.48 quads of fossil fuel used to generate electricity in source calculations. The result would indicate the grid fossil source portion of the electric grid is currently approximately 50%, or the "fossil source-site" ratio is approximately 2.

[vii] NRDC Comments to DOE Docket: EERE-2014–BT–STD–0031. July 2015 at 7.

Bibliography: Dennis, K., Environmentally Beneficial Electrification: Electricity as the End-Use Option. Electr. J. (2015), http://dx.doi.org/10.1016/j.tej.2015.09.019

Cost Impact: Will not increase the cost of construction
This proposal only changes how an energy simulation is to be performed, and does not have any impact on the cost of construction.

RE136-16 :
R405.3-
DENNIS12746

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This proposal is confusing. There wasn't agreement between testifiers as to what the correct multiplier should be.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Keith Dennis, representing National Rural Electric Cooperative Association (keith.dennis@nreca.coop); Charles Foster (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R405.3 (N1105.4) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

> **Exception:** The energy use based on site or source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. Where used in a simulation, the source energy multiplier for electricity shall be ~~2.04~~ 1.9. The source energy multiplier for fuels other than electricity shall be 1.1.

Commenter's Reason:
DENNIS: This public comment modifies my original proposal by updating the fossil fuel component of generating electricity to reflect the most current data avilable from the Energy Information Agency. Thus, for every btu of electricity delivered to a consumer, 1.9 btu's of fossil fuel are consumed on average.

See original proposal for a detailed explanation supporting the proposal and public comment.

FOSTER: The proponent for this proposal orginally calculated a "fossil source" energy conversion factor of 2.04 based on 2011 data published by the Energy Information Agency. Since the proposal was submitted, EIA has updated its data on fossil fuel consumption used in the production of electricity in 2015. Based on the new data, this public comment updates the originally calculated 2.04 value to a more up-to-date value of 1.90.

Preliminary data for 2016 shows the downward trend continuing,

Bibliography: Electricity Journal, Keith Dennis, Environmentally Beneficial Electrification: Electricity as the End-Use Option, [2015] http://dx.doi.org/10.1016/j.tej.2015.09.019.

Public Comment 2:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R405.3 (N1105.4) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

> **Exception:** The energy use based on site or source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. Where used in a simulation, the source energy multiplier for electricity shall be ~~2.04~~ 1.43. The source energy multiplier for fuels other than electricity shall be 1.1.

Commenter's Reason: The revised value for electricity is based on the estimated 2030 value due to the following trends:
-Several states announcing increases in their Renewable Portfolio Standard (RPS) requirements.

-Significant federal tax incentives for the production of renewable electricity through 2020.

-Lower costs for solar and wind electricity production systems.

-The EPA Clean Power Plan requirements for new, modified, and existing power plants. For existing power plants, the requirements increase until the year 2030.

Buildings will use energy in the future, not the past. It is important to use an estimate that will account for changes in the energy industry. It is better to use an estimate that reflects the future potential impact from future building energy usage, rather than relying on backward looking numbers that are typically overstated.

RE136-16

RE137-16

R405.3 (IRC N1105.3)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

R405.3 (N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an ~~annual~~ energy cost over a 30 year useful life of the building, on a present value basis, that is less than or equal to the ~~annual~~ energy cost over a 30 year useful life of the building, on a present value basis, of the *standard reference design.* Improvements in energy efficiency in the proposed design over the Standard Reference Design shall revert to the Standard Reference Design at the end of the useful life of the improvement. Energy prices, energy price escalation rates, discount rates, the useful life of specific building features and components including installed energy efficiency measures in the building and all other necessary assumptions for the analysis shall be taken from a source or sources *approved* by the *code official*~~, such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report*~~ . *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

> **Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

Reason: The purpose of this code change is to improve the efficiency of buildings and the accuracy of the performance path compliance option under Section R405. The proposal modifies the current methodology by replacing annual energy cost analysis with a present value analysis of energy cost (by reflecting the useful life of various energy efficiency measures) over the useful life of the building. The U.S. Department of Energy applies a similar methodology in its cost-effectiveness calculations, and updates it regularly through a public process. *See* https://www.energycodes.gov/development/residential/methodology.

The current section R405.3 calculates the annual energy cost in the first year of a proposed new home and compares it against a baseline Standard Reference Design home to determine compliance. A major problem with this approach is the fact that it only compares energy cost in the first year and does not factor in how long each measure being considered will provide benefits (frequently measures that save energy longer also cost more). The home is designed to last for many years and over such period energy costs will change and various components of the home and energy efficiency measures will be required to be replaced due to shorter useful lives. This fact is recognized in the Intent of the IECC, Section R101.3 which is directed at regulating "the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

The flaw in the current approach is illustrated well by the comparison of two efficiency measures – lighting versus thermal envelope. The components of the thermal envelope are expected to last far longer than the lighting, providing benefits over a much longer period, but the current compliance methodology, if applied to these two options, would measure the benefits of each option as if they had the same useful life – specifically, over only the first year of operation. This could result in the replacement of a longer-life measure with a much shorter-life measure and a loss of energy efficiency.

A more sophisticated analysis would account for these changes over time. The proposed change is intended to require this more sophisticated analysis. Specifically, the proposed changes require:

- the use of a 30-year useful building life;
- energy costs to be escalated over time;
- incorporation of the useful life of each feature of the building constituting an energy efficiency improvement over the standard reference design, by requiring that the analysis assume that the feature revert to the standard reference design at the end of its useful life;
- the use of the present value of energy costs for comparison purposes; and the assumptions for the analysis be derived from a source approved by the code official.

If this proposal is approved, the US Department of Energy could adapt its cost-effectiveness methodology or another party could develop a similar process for determining reasonable inputs, and this improved methodology could be easily incorporated into REScheck and other compliance software.

Cost Impact: Will increase the cost of construction
Builders are not required to use this compliance option, so the requirement will not necessarily increase the cost of the construction in many cases. However, for builders who elect to use Section R405 to comply, designers are granted the ability to select the most cost-effective efficiency features for the home to be built. The initial construction cost for features that have a longer useful life may be higher than those with a shorter useful life – if so, this analysis could result in a higher construction cost. However, over the life cycle of the home the combined construction and operational costs will be reduced as investments in efficiency features will realize savings over a longer period of time.

RE137-16 :
R405.3-FAY12799

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed revisions would make the performance path option very unappealing to use. It is too convoluted and would increase the potential for "gaming" the requirements of the code.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 30.16% (76) Oppose: 69.84% (176)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change would require performance calculation to be done on a life-cycle basis The committee voted to deny the change and a floor action to approve as submitted failed, by 30/70%.
The AIA is asking for approval as submitted. During the Committee Action Hearings, the committee stated that this proposal would cast the use of the performance path option as convoluted and unappealing. Contrary to the committees opinion, we believe that the revisions would provide useful clarifications on the calculation's assumptions. Such analysis would allow for higher levels of examination of the long-term effectiveness of design assumptions and building efficiencies resulting from them. Without the clarity such an approach, that is not found in the code would not be as beneficial. We urge you to support this change.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net) requests Approve as Submitted.

Commenter's Reason: This proposal should be approved as submitted because it improves the accuracy of the energy cost simulation in the performance path and will result in long-term energy savings by homeowners. The current performance path considers only year 1 of the home's performance. The revised methodology assesses a home's performance with the proposed set of energy efficiency measures as compared to the standard reference design over a longer 30-year period. While homes are likely to last well beyond 30 years, a 30-year proxy will provide far more accurate information on the home's expected energy efficiency performance than a one-year snapshot.
Building science has advanced exponentially in recent years, and we know far more today than ever before about how buildings operate as they age. Decisions made at construction, made with an eye toward complying with the code, could impact homeowners for many years. The performance path should reflect the intent of the IECC to consider "the effective use and conservation of energy over the useful life of each building." *See* Section R101.3. For these reasons, and all of the reasons outlined in the original supporting statement, we recommend approval as submitted.

RE138-16
R405.3 (IRC N1105.3)

Proposed Change as Submitted

Proponent : Charles Foster, representing self (cfoster20187@yahoo.com)

2015 International Energy Conservation Code

Revise as follows:

R405.3 (N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

> ~~**Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.~~
>
> **Exception:** Energy use based on site energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for energy cost.

Reason: General:
While there are several jurisdictions in the United States that use source energy as the basis of their energy codes, the overwhelming majority use either site energy or cost. This exception (in R405.3) was originally offered to accommodate those few jurisdictions that have chosen to use source energy.

One of the challenges for use of source energy in codes is that the relationship between site and "source energy" consumption is not well defined. For instance, the 3.16 value currently in the code assumes that electricity produced from wind, solar, hydro and other forms of renewable energy is equivalent to the consumption of fossil fuels. The same assumption holds for electricity derived from nuclear energy. Thus, from a source energy perspective an unbiased observer would be relatively indifferent between choosing electricity from 100% renewable sources (wind or hydro for instance) and diesel, fuel oil, or gas. This outcome does not seem helpful.

In addition, the mix of sources for the production of electricity (wind, solar, hydro, nuclear, coal, oil, gas, geothermal, etc.) changes – and will continue to change dramatically going into the future with the proliferation of additional renewable energy resources (especially wind) into the national mix. Even if the 3.16 source energy multiplier was a good number when it was originally adopted (something this proposal disagrees with as argued above), it is surely not still valid.

Finally, it is important to recognize that the impact of the IECC will be realized in the future – codes considered today will have marketplace impacts starting in 2018 so looking at electric source energy multipliers today (2015) that are based on data from 2014 (or earlier) for use in 2018 (or later) is likely to convey to users inaccurate pictures of actual resource impacts.

Specific:

Part I: Net Zero Energy Buildings

The use of site energy is more appropriate for buildings that are producing or storing energy on-site. In the future,many buildings will be producing energy and storing energy, along w ith consuming energy. Building systems may be consuming energy that w as produced from an off-site energy grid and/or produced from an on-site energy production system and/or delivered from an off-site energy storage system (e.g., a grid battery or EV battery)and/or delivered from an on-site energy storage system, (e.g., and battery or fuel storage tank or thermal energy storage system). At the same time, the building may be producing energy that is used by building equipment, sent to an on-site energy storage system, or exported to another building (or buildings) or to the energy grid.

Below is what ASHRAE wrote to DOE on the subject of "zero energy" buildings:

"Recommendation II: Define "Net Zero Energy Building" Using Site Energy, With Sub-classifications Based on Source Estimates, Building Energy Cost, and Building Emissions.

In line w ith ASHRAE 's Vision 2020 document, the Society encourages the Department to adopt the following definition of net zero energy building:

> 'A net zero energy building (NZEB) is a building that produces as much energy as it uses when measured at the site. On an annual basis, it produces or consumes as much energy from renewable sources as it uses w hile maintaining an acceptable level of service and functionality. NZEBs can exchange energy w ith the pow er grid or other building energy supply grids or systems (e.g., natural gas, propane, etc.) as long as the net energy balance is zero on an annual basis'

In the same letter, ASHRAE also said:

"However, the Society believes that the multiple and varying weighting factors and algorithms required for estimating source energy conversions are often inconsistent and ultimately cloud and complicate understanding. Since source energy conversion factors vary w idely from place to place and across time, the use of fixed national average conversion factors could lead to inconsistent estimates of consumption."

"Thus, in this case the best method for determining if a building is a NZEB is to look at the energy crossing the boundary at the site of the building; hence "site" energy is the best choice to use."

Part II: Reasons for the Use of Site Energy

Site energy was part of the exception for many years until it was recently removed. There are many reasons to allow site energy to be used instead of energy costs:

- Site energy is an actual metric that can be measured and verified by code officials, while source energy is an estimate.
- Site energy information is credible, as it is show n on customers' energy bills on a monthly basis and used in other consensus-based code documents, such as ASHRAE 90.1, ASHRAE 90.2, and ICC-700 use site energy metrics for efficiency requirements.
- DOE uses site energy information in many of its energy efficiency and energy consumption publications, such as the Residential Energy Consumption Survey.
- DOE uses site energy for its appliance energy efficiency standards program and the FTC uses site energy on the yellow EnergyGuide labels found on consumer appliances. EPA uses site energy to determine if an appliance or home qualifies for the Energy Star program.
- Site energy is reliable, since it can be measured by utilities, consumers, and independent 3rd In terms of energy efficiency upgrades, consumers rely on site energy information (amount used by older appliance or equipment compared to new appliance or equipment) to help them make energy efficiency decisions.
- Site energy is replicable, as the units of measurement (kWh, therms, gallons, Btu's) can be used throughout the United States and are familiar to consumers on their monthly energy bills. Source energy is not replicable, as different estimates must be used for different energy sources, and different entities can make different assumptions about upstream production and delivery of different energy sources.
- Site energy is transparent and easy to understand. It can be based on meter readings or DOE test procedures or FTC EnergyGuide labels or Energy Star labels. It is the metric that allow s people to easily compare energy efficiency options in the marketplace. It is the metric that allow s people to make good economic choices w hen faced w ith competitive alternatives.

Part III: New source energy estimates penalize the use of renewables

In a November 2015 published by the American Gas Association paper entitled "Dispatching Direct Use", available at https://w w w .aga.org/sites/default/files/dispatching_direct_use__achieving_greenhouse_gas_reductions_the_use_of_natural_, there is a table of revised "full fuel cycle" (source) estimates that claim to show that using renew able energy is worse that using fossil fuels:

These "estimates" have significant policy impacts. It could lead building owners and policy makers to go away from using renew able forms of energy. In programs such as Energy Star Portfolio Manager and certain green building programs that use source energy estimates, buildings will get much w orse scores by using renew able forms of energy (either on-site or from the grid).

Summary: To improve the performance path, and to not penalize renew ables, the performance path should be based on site energy.

Cost Impact: Will not increase the cost of construction
This proposal does not directly or indirectly impact the specific requirements for constructing new homes and, as such, would not impact the cost of construction.

RE138-16 : R405.3- FOSTER12560

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Builders don't have control over what type of energy is available at the site. Options need to be kept open for flexibility.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Submitted.

Commenter's Reason:
To improve the performance path, and to not penalize renewables, the performance path should be based on site energy.
General: While there are several jurisdictions in the United States that use source energy as the basis of their energy codes, the overwhelming majority use either site energy or cost. This exception (in R405.3) was originally offered to accommodate those few jurisdictions that have chosen to use source energy. One of the challenges for use of source energy in codes is that the relationship between site and "source energy" consumption is not well defined. For instance, the 3.16 value currently in the code assumes that electricity produced from wind, solar, hydro and other forms of renewable energy is equivalent to the consumption of fossil fuels. The same assumption holds for electricity derived from nuclear energy. Thus, from a source energy perspective an unbiased observer would be relatively indifferent between choosing electricity from 100% renewable sources (wind or hydro for instance) and diesel, fuel oil, or gas. This outcome does not seem helpful. In addition, the mix of sources for the production of electricity (wind, solar, hydro, nuclear, coal, oil, gas, geothermal, etc.) changes – and will continue to change dramatically going into the future with the proliferation of additional renewable energy resources (especially wind) into the national mix. Even if the 3.16 source energy multiplier was a good number when it was originally adopted (something this proposal disagrees with as argued above), it is surely not still valid. Finally, it is important to recognize that the impact of the IECC will be realized in the future – codes considered today will have marketplace impacts starting in 2018 so looking at electric source energy multipliers today (2015) that are based on data from 2014 (or earlier) for use in 2018 (or later) is likely to convey to users inaccurate pictures of actual resource impacts.

Specific: Part I: Net Zero Energy Buildings The use of site energy is more appropriate for buildings that are producing or storing energy on-site. In the future,many buildings will be producing energy and storing energy, along w ith consuming energy. Building systems may be consuming energy that w as produced from an off-site energy grid and/or produced from an on-site energy production system and/or delivered from an off-site energy storage system (e.g., a grid battery or EV battery)and/or delivered from an on-site energy storage system, (e.g., and battery or fuel storage tank or thermal energy storage system). At the same time, the building may be producing energy that is used by building equipment, sent to an onsite energy storage system, or exported to another building (or buildings) or to the energy grid.

Below is what ASHRAE wrote to DOE on the subject of "zero energy" buildings: "Recommendation II: Define "Net Zero Energy Building" Using Site Energy, With Sub-classifications Based on Source Estimates, Building Energy Cost, and Building Emissions. In line w ith ASHRAE 's Vision 2020 document, the Society encourages the Department to adopt the following definition of net zero energy building: 'A net zero energy building (NZEB) is a building that produces as much energy as it uses when measured at the site. On an annual basis, it produces or consumes as much energy from renewable sources as it uses w hile maintaining an acceptable level of service and functionality. NZEBs can exchange energy w ith the pow er grid or other building energy supply grids or systems (e.g., natural gas, propane, etc.) as long as the net energy balance is zero on an annual basis' In the same letter, ASHRAE also said: "However, the Society believes that the multiple and varying weighting factors and algorithms required for estimating source energy conversions are often inconsistent and ultimately cloud and complicate understanding. Since source energy conversion factors vary w idely from place to place and across time, the use of fixed national average conversion factors could lead to inconsistent estimates of consumption." "Thus, in this case the best method for determining if a building is a NZEB is to look at the energy crossing the boundary at the site of the building; hence "site" energy is the best choice to use."

Part II: Reasons for the Use of Site Energy Site energy was part of the exception for many years until it was recently removed. There are many reasons to allow site energy to be used instead of energy costs:

Site energy is an actual metric that can be measured and verified by code officials, while source energy is an estimate. Site energy information is credible, as it is show n on customers' energy bills on a monthly basis and used in other consensus-based code documents, such as ASHRAE 90.1, ASHRAE 90.2, and ICC-700 use site energy metrics for efficiency requirements. DOE uses site energy information in many of its energy efficiency and energy consumption publications, such as the Residential Energy Consumption Survey. DOE uses site energy for its appliance energy efficiency standards program and the FTC uses site energy on the yellow EnergyGuide labels found on consumer appliances. EPA uses site energy to determine if an appliance or home qualifies for the Energy Star program. Site energy is reliable, since it can be measured by utilities, consumers, and independent 3rd In terms of energy efficiency upgrades, consumers rely on site energy information (amount used by older appliance or equipment compared to new appliance or equipment) to help them make energy efficiency decisions. Site energy is replicable, as the units of measurement (kWh, therms, gallons, Btu's) can be used throughout the United States and are familiar to consumers on their monthly energy bills. Source energy is not replicable, as different estimates must be used for different energy sources, and different entities can make different assumptions about upstream production and delivery of different energy sources. Site energy is transparent and easy to understand. It can be based on meter readings or DOE test procedures or FTC EnergyGuide labels or Energy Star labels. It is the metric that allow s people to easily compare energy efficiency options in the marketplace. It is the metric that allow s people to make good economic choices w hen faced w ith competitive alternatives.

Part III: New source energy estimates penalize the use of renewables In a November 2015 published by the American Gas Association paper entitled "Dispatching Direct Use", available at https://w w w .aga.org/sites/default/files/dispatching_direct_use__achieving_greenhouse_gas_reductions_the_use_of_natural_, there is a table of revised "full fuel cycle" (source) estimates that claim to show that using renew able energy is worse that using fossil fuels: These "estimates" have significant policy impacts. It could lead building owners and policy makers to go away from using renew able forms of energy. In programs such as Energy Star Portfolio Manager and certain green building programs that use source energy estimates, buildings will get much w orse scores by using renew able forms of energy (either on-site or from the grid).

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R405.3 (IRC N1105.3), Table R405.3(1) (New) [IRC Table N1105.3(1) (New)], Table R405.3(2) (New) [IRC Table N1105.3(2) (New)], Table R405.3(3) (New) [IRC Table N1105.3(3) (New)], Table R405.3(4) (New) [IRC Table N1105.3(4) (New)], Table R405.3(5) (New) [IRC Table N1105.3(5) (New)], Table R405.3(6) (New) [IRC Table N1105.3(6) (New)], Table R405.3(7) (New) [IRC Table N1105.3(7) (New)]

Proposed Change as Submitted

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

Revise as follows:

R405.3 (N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

> ~~**Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.~~
>
> **Exception:** The energy use based on site energy or source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy estimate multipliers for energy sources shall be taken from Tables R405.3(1) through R405.3(7).

TABLE R405.3 [N1105.3(1)]
ELECTRICITY SOURCE ENERGY ESTIMATES BY NERC REGION

NERC Region Acronym	NERC Region Name	Overall "source" ration of upstream heat input to end use (based on eGRID 2012)	"Source" Ratio in 2030 Under Clean Power Plan (or State RPS)
ASCC	Alaska Systems Coordinating Council	2.54	2.54
FRCC	Florida Reliability Coordinating Council	2.48	1.86
HICC	Hawaiian Islands Coordinating Council	2.76	1.66
MRO	Midwest Reliability Organization	2.23	1.51
NPCC	Northeast Power Coordinating Council	1.60	1.08
RFC	Reliability First Corporation	2.15	1.46
SERC	SERC Reliability Corporation	2.18	1.48
SPP	Southwest Power Pool	2.76	1.88
TRE	Texas Regional Entity	2.20	1.47
WECC	Western Electricity Coordinating Council	1.67	1.14

TABLE R405.3(2) [N1105.3(2)]
ELECTRICITY SOURCE ENERGY ESTIMATES BY eGRID SUBREGION

eGRID Subregion Acronym	eGRID Subregion Name	Overall "source" ratio of upstream heat input to end use (based on eGRID 2012)	"Source" ratio in 2030 under Clean Power Plan (or State RPS)
AKGD	ASCC Alaska Grid	2.99	2.99
AKMS	ASCC Miscellaneous	1.02	1.02
ERCT	ERCOT All	2.20	1.47
FRCC	FRCC All	2.48	1.86

HIMS	HICC Miscellaneous	2.38	1.43
HIOA	HICC Oahu	2.91	1.74
MROE	MRO East	2.51	1.71
MROW	MRO West	2.20	1.50
NYLI	NPCC Long Island	3.02	2.42
NYCW	NPCC NYC / Westchester	2.01	1.61
NEWE	NPCC New England	1.71	1.16
NYUP	NPCC Upstate NY	0.99	0.80
RFCE	RFC East	1.69	1.15
RFCM	RFC Michigan	2.75	1.68
RFCW	RFC West	2.27	1.54
SRMW	SERC Midwest	2.69	1.83
SRMV	SERC Mississippi Valley	2.29	1.56
SRSO	SERC South	2.26	1.54
SRTV	SERC Tennessee Valley	2.25	1.53
SRVC	SERC Virginia / Carolina	1.75	1.19
SPNO	SPP North	2.69	1.83
SPSO	SPP South	2.79	1.90
CAMX	WECC California	1.68	1.46
NWPP	WECC Northwest	1.14	0.77
RMPA	WECC Rockies	2.89	1.96
AZNM	WECC Southwest	2.09	1.42

TABLE R405.3(3) [N1105.3(4)]
ELECTRICITY SOURCE ENERGY ESTIMATES BY STATES

State Abbreviation	Overall "source" ratio of upstream heat input to end use (based on eGRID 2012)	"Source" Ratio in 2030 under Clean Power Plan (or State RPS)
AK	2.54	2.54
AL	1.96	1.32
AR	2.27	1.50
AZ	1.88	1.16
CA	1.59	1.38
CO	2.70	1.67
CT	1.31	1.22
DC	3.09	2.47
DE	2.99	2.27
FL	2.50	1.88
GA	2.07	1.36
HI	2.76	1.66
IA	2.14	1.24
ID	0.37	0.34
IL	1.60	0.93
IN	3.10	1.89
KS	2.47	1.41
KY	3.28	2.00
LA	2.53	1.79
MA	2.20	1.80
MD	2.05	1.29

ME	2.00	1.78
MI	2.32	1.41
MN	1.99	1.15
MO	2.72	1.72
MS	2.30	1.89
MT	1.92	1.02
NC	1.90	1.29
ND	2.64	1.45
NE	2.45	1.47
NH	1.44	1.11
NJ	1.27	0.98
NM	2.91	1.86
NV	2.09	1.63
NY	1.48	1.18
OH	2.72	1.74
OK	2.61	1.78
OR	0.64	0.51
PA	1.92	1.28
RI	2.49	2.09
SC	1.44	0.94
SD	0.85	0.53
TN	1.82	1.11
TX	2.32	1.55
UT	2.91	1.92
VA	1.74	1.18
VT	0.26	0.06
WA	0.27	0.17
WI	2.28	1.44
WV	3.04	1.79
WY	3.12	1.75

TABLE R405.3(4) [N1105.3(4)]
NATURAL GAS SOURCE ENERGY ESTIMATES BY EIA PIPELINE REGION

EIA Natural Gas Pipeline Region	Overall "source" ratio of upstream losses to end use (based on EIA and DOE reports)
Western	1.42
Central	1.53
Southwest	1.15
Midwest	1.42
Southeast	1.25
Northeast	1.38
Alaska	1.15

TABLE R405.3(5) [N1105.3(5)]
PROPANE GAS SOURCE ENERGY ESTIMATES BY EIA NATURAL GAS PIPELINES

EIA Natural Gas Pipeline Region	Overall "source" ratio of upstream losses to end use (based on EIA and DOE reports)
Western	1.50
Central	1.61
Southwest	1.21
Midwest	1.50
Southeast	1.32
Northeast	1.46
Alaska	1.21

TABLE R405.3(6) [N1105.3(6)]
PIPELINE GAS SOURCE ENERGY ESTIMATES BY TYPE OF CRUDE OIL

Crude Oil Source	Overall '"source" ratio of upstream losses to end use (based on EIA and DOE reports)
Domestic	1.54
Imported	1.77

TABLE R405.3(7) [N1105.3(7)]
SOURCE ENERGY ESTIMATES BY TYPE OF CRUDE OIL

Crude Oil Source	Overall "source" ratio of upstream losses to end use (based on EIA and DOE reports)
Domestic	1.19
Imported	1.37

Reason: This proposal will make the provision more flexible for building designers, building owners, and code officials. By allowing the use of site energy, which was allowed in previous versions of the IECC, the performance path can be based on real measured data. By updating source energy estimates, there will be more information provided to code officials and building owners.

Issue 1: Net Zero Energy Buildings

Allowing the use of site energy is more appropriate for buildings that are producing or storing energy on-site. In the future, many buildings will be producing energy and storing energy, along with consuming energy. Building systems may be consuming energy that was produced from an off-site energy grid and/or produced from an on-site energy production system and/or delivered from an off-site energy storage system (e.g., a grid battery or EV battery) and/or delivered from an on-site energy storage system, (e.g., and battery or fuel storage tank or thermal energy storage system). At the same time, the building may be producing energy that is used by building equipment, sent to an on-site energy storage system, or exported to another building (or buildings) or to the energy grid.

Below is what ASHRAE wrote to DOE on the subject of "zero energy" buildings:

"Recommendation II: Define "Net Zero Energy Building" Using Site Energy, With Sub-classifications Based on Source Estimates, Building Energy Cost, and Building Emissions

In line with ASHRAE's Vision 2020 document, the Society encourages the Department to adopt the following definition of net zero energy building:

'A net zero energy building (NZEB) is a building that produces as much energy as it uses when measured at the site. On an annual basis, it produces or consumes as much energy from renewable sources as it uses while maintaining an acceptable level of service and functionality. NZEBs can exchange energy with the power grid or other building energy supply grids or systems (e.g., natural gas, propane, etc.) as long as the net energy balance is zero on an annual basis'

In the same letter, ASHRAE also said:

"However, the Society believes that the multiple and varying weighting factors and algorithms required for estimating source energy conversions are often inconsistent and ultimately cloud and complicate understanding. Since source energy conversion factors vary widely from place to place and across time, the use of fixed national average conversion factors could lead to inconsistent estimates of consumption."

"Thus, in this case the best method for determining if a building is a NZEB is to look at the energy crossing the boundary at the site of the building; hence "site" energy is the best choice to use."

Issue 2: Reasons for Re-Allowing the Use of Site Energy

Site energy was part of the exception for many years until it was recently removed. There are many reasons to allow site energy to be used instead of energy costs:

- Site energy is an actual metric that can be measured and verified by code officials, while source energy is an estimate.
- Site energy information is credible, as it is shown on customers' energy bills on a monthly basis and used in other consensus-based code documents, such as ASHRAE 90.1, ASHRAE 90.2, and ICC-700 use site energy metrics for efficiency requirements.
- DOE uses site energy information in many of its energy efficiency and energy consumption publications, such as the Residential Energy Consumption Survey. DOE uses site energy for its appliance energy efficiency standards program and the FTC uses site energy on the yellow EnergyGuide labels found on consumer appliances. EPA uses site energy to determine if an appliance or home qualifies for the Energy Star program.
- Site energy is reliable, since it can be measured by utilities, consumers, and independent 3rd parties. In terms of energy efficiency upgrades, consumers rely on site energy information (amount used by older appliance or equipment compared to new appliance or equipment) to help them make energy efficiency decisions.
- Site energy is replicable, as the units of measurement (kWh, therms, gallons, Btu's) can be used throughout the United

States and are familiar to consumers on their monthly energy bills. Source energy is not replicable, as different estimates must be used for different energy sources, and different entities can make different assumptions about upstream production and delivery of different energy sources.

- Site energy is transparent and easy to understand. It can be based on meter readings or DOE test procedures or FTC EnergyGuide labels or Energy Star labels. It is the metric that allows people to easily compare energy efficiency options in the marketplace. It is the metric that allows people to make good economic choices when faced with competitive alternatives.

Issue 3: Revision of Source Energy Estimates

There are many ways to estimate upstream energy losses. The energy production industry is very dynamic and subject to significant changes. In the United States in 2015, there was a record amounts of natural gas produced from hydraulic fracturing production techniques. In 2015, there was a record amount of oil produced and imported from oil sands production. In 2015, there was a record amount of electricity produced from renewable forms of energy and a record amount of electricity produced by combined-cycle natural gas turbines.

The values that are currently shown should be deleted and not used for the following reasons:

- The values shown are not consistent with values shown in other published documents.

Many documents and articles have been published over the past several years with source energy estimates. Among them are:

National Renewable Energy Laboratory NREL/TP-550-38617 "Source Energy and Emission Factors for Energy Use in Buildings" (June 2007)

American Gas Association EA 2009-3 "A Comparison of Energy Use, Operating Costs, and Carbon Dioxide Emissions of Home Appliances" (October 2009)

Environmental Protection Agency "Energy Star Performance Ratings Methodology for Incorporating Source Energy Use" (August 2009)

National Renewable Energy Laboratory NREL/TP-550-47246 "Building America Research Benchmark Definition" (January 2010)

International Code Council "International Green Construction Code" (March 2012)

U.S. Department of Energy Residential Dishwasher Energy Efficiency Technical Support Document, May 2012:

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/67 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/67)

U.S. Department of Energy Residential Furnace Fan Technical Support Document, June 2012:

http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/41 (http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/41)

International Code Council "International Green Construction Code (May 2015)

The current values in the IECC do not match and cannot be substantiated with any of these published documents.

- Different fossil fuels have different upstream source estimates.

In the current IECC, all fossil fuels are assumed to have the same multiplier. In other documents, there is a large and statistically significant variation in the upstream estimates that will have a significant impact on energy performance results. As one example, for fuel oil and propane, EPA's Portfolio Manager uses a factor of 1.01 for both, while NREL used estimated values of 1.158 and 1.151, while IGCC 2015 uses 1.19 for fuel oil and 1.15 for propane.

- The use of 3.16 for electricity is overstated for many parts of the United States and does not account for significant regional differences or the increase in the use of renewable power generation and combined cycle gas turbines.

In other publications and web sites, the estimates for electricity are shown on a national basis, a regional basis, or a state by state basis. This is due to the variety of electric generation techniques which have upstream energy losses that can vary by orders of magnitude based on local conditions, regional conditions, physical location, season, month, week, or day, as well as hourly fluctuations in the amount of sunlight or wind speed.

In the IGCC Table 602.1.2.1, there are 26 values shown for electricity, based on the power pool sub-region in which a building is located. The values in the IGCC table (which are based on outdated 2010 electric generation data and incorrect "marginal" estimates) range from 1.90 to 3.82.

The revisions to the values are based on reports published by the US Energy Information Administration, the US Department of Energy, the US Environmental Protection Agency, national labs, and other public sources of information. It is a technical fact that there are significant regional differences in terms of upstream estimates for electricity as well as fossil fuels. The new estimates provide more granular estimates.

For electricity, the spreadsheets with updated estimates are below:

eGRID2012 Power Control Area (PCA) File

This power control area (PCA) file has 120 records and 111 data elements.

eGRID2012 file PCA sequence number	PCA ID	PCA name	PCA nameplate capacity (MW)	PCA annual heat input (MMBtu)
SEQPCL12	PCAID	PCANAME	NAMEPCAP	PCHTIAN
1	17698	AEP - PSO/SWEPCO	16,045.5	479,425,219.2
2	-1	Alaska Misc	746.5	5,109,037.9
3	56093	Alcoa Power - Yadkin Division	215.2	0.0
4	186	Alliant - East	4,168.2	143,352,493.8
5	193	Alliant - West	7,045.2	107,397,906.9
6	9208	Ameren Services Company	27,295.2	876,638,468.9
7	599	Anchorage Municipality of	369.2	11,909,384.0
8	803	Arizona Public Service Company	8,310.3	285,623,598.7
9	54805	Arlington Valley	713.0	12,664,882.6
10	924	Associated Electric Cooperative Inc	6,242.0	193,222,127.5
11	20169	Avista Corporation	1,637.9	7,822,865.1
12	-18	Balancing Authority of Northern California	1,957.8	40,191,116.5
13	1692	Big Rivers Electric Corporation	2,441.9	124,923,849.6
14	1738	Bonneville Power Administration	33,518.0	135,385,086.3
15	2775	California ISO	69,922.6	881,564,707.9
16	-17	CECD - Batesville	891.0	24,747,153.5
17	3522	Chugach Electric Assn Inc	993.4	26,072,430.5
18	3265	Cleco Corporation	5,592.2	180,981,608.6
19	4045	Columbia MO City of	354.5	2,197,284.6
20	4254	Consumers Energy Company	14,209.0	318,309,333.9
21	4716	Dairyland Power Cooperative	1,895.0	38,790,465.3
22	5109	DTE Electric Company	13,642.6	401,038,209.5
23	5416	Duke Energy Carolinas	28,191.7	351,119,814.4
24	3542	Duke Energy Corporation	10,695.8	321,485,929.1
25	6455	Duke Energy Florida	18,240.3	389,662,911.2
26	3046	Duke Energy Progress	21,505.0	357,711,738.3
27	5580	East Kentucky Power Cooperative	3,315.7	109,846,621.3
28	5701	El Paso Electric Company	1,624.5	39,085,297.2
29	5860	Empire District Electric Company	1,598.4	33,194,135.9
30	12506	Entergy	46,290.1	1,160,331,108.4
31	5723	ERCOT ISO	101,475.5	2,523,758,252.6
32	6567	Florida Municipal Power Pool	3,003.0	79,766,241.7
33	6452	Florida Power & Light Company	37,500.1	676,267,392.5
34	6909	Gainesville Regional Utilities	699.1	15,555,713.6
35	14412	Gila River Power	2,476.0	38,924,172.7
36	7353	Golden Valley Elec Assn Inc	492.2	12,121,617.8
37	7490	Grand River Dam Authority	1,794.3	63,637,783.2
38	7570	Great River Energy	3,329.1	123,692,365.4
39	56090	Griffith Energy	654.4	11,575,711.9
40	8287	Hawaii Electric Light Co Inc	374.1	7,452,045.3
41	-2	Hawaii Misc	590.9	14,704,132.8
42	19547	Hawaiian Electric Co Inc	2,091.4	69,408,159.9

EEI Calculations based on eGRID values

PCA ozone season heat input (MMBtu)	PCA annual net generation (MWh)	PCA ozone season net generation (MWh)	Calculated Annual Net Generation in MMBtu	"Source" ratio of upstream heat input to net generation	Est. Grid Loss Factor *	Overall "source" ratio of upstream heat input to end use
PCHTIOZ	PCNGENAN	PCNGENOZ				
231,830,203.6	50,778,039.3	24,298,390.3	173,305,448.1	2.77	1.0600	2.93
2,088,417.6	1,596,926.5	575,966.0	5,450,310.3	0.94	1.0600	0.99
0.0	613,680.0	239,987.0	2,094,489.8	0.00	1.0600	0.00
69,858,740.3	14,530,918.4	6,943,851.5	49,594,024.3	2.89	1.0600	3.06
49,486,125.0	19,496,799.3	8,650,248.6	66,542,576.1	1.61	1.0600	1.71
385,288,017.9	107,567,495.8	46,050,433.5	367,127,863.2	2.39	1.0600	2.53
4,742,686.0	1,061,722.0	393,108.9	3,623,657.2	3.29	1.0600	3.48
128,374,229.9	29,268,033.0	13,196,272.9	99,891,796.5	2.86	1.0600	3.03
10,191,188.4	1,734,610.0	1,395,941.0	5,920,223.9	2.14	1.0600	2.27
93,056,595.0	21,450,450.0	10,091,379.3	73,210,386.0	2.64	1.0600	2.80
3,122,832.2	5,369,417.0	2,586,181.5	18,325,820.2	0.43	1.0600	0.45
17,288,515.7	6,940,082.0	3,136,927.9	23,686,499.9	1.70	1.0600	1.80
54,610,513.0	11,243,920.2	4,959,601.8	38,375,499.5	3.26	1.0600	3.45
46,107,655.3	124,048,346.1	55,620,937.0	423,377,005.2	0.32	1.0600	0.34
396,028,504.4	175,419,409.5	80,382,913.7	598,706,444.5	1.47	1.0600	1.56
12,742,065.2	3,313,579.0	1,674,788.0	11,309,245.1	2.19	1.0600	2.32
10,081,444.6	2,973,352.6	1,074,760.3	10,148,052.5	2.57	1.0600	2.72
84,819,850.3	18,434,659.1	8,947,220.7	62,917,491.5	2.88	1.0600	3.05
1,002,892.4	215,909.0	102,880.2	736,897.4	2.98	1.0600	3.16
155,419,627.5	39,130,088.8	18,191,822.0	133,550,992.9	2.38	1.0600	2.53
16,276,297.6	5,240,388.0	1,998,304.9	17,885,444.1	2.17	1.0600	2.30
186,824,853.8	45,017,773.7	20,420,220.8	153,645,661.8	2.61	1.0600	2.77
171,159,126.6	95,828,920.7	43,721,183.3	327,064,106.4	1.07	1.0600	1.14
148,215,370.2	34,293,497.4	15,638,552.2	117,043,706.6	2.75	1.0600	2.91
186,621,547.4	43,867,237.1	20,897,969.3	149,718,880.2	2.60	1.0600	2.76
176,681,129.0	63,852,149.9	29,303,177.4	217,927,387.6	1.64	1.0600	1.74
47,560,695.5	10,858,252.3	4,644,353.7	37,059,215.0	2.96	1.0600	3.14
20,963,560.1	3,838,023.8	2,059,028.8	13,099,175.3	2.98	1.0600	3.16
17,766,180.5	3,547,620.0	1,929,605.4	12,108,027.0	2.74	1.0600	2.91
563,171,423.9	164,435,533.6	77,078,015.7	561,218,476.3	2.07	1.0600	2.19
1,265,106,191.9	360,221,517.3	174,463,757.7	1,229,436,038.5	2.05	1.0600	2.18
40,566,126.7	9,042,174.5	4,684,222.8	30,860,941.7	2.58	1.0600	2.74
323,316,617.3	104,105,062.2	47,838,181.9	355,310,577.3	1.90	1.0600	2.02
7,937,221.6	1,544,127.0	782,018.2	5,270,105.5	2.95	1.0600	3.13
17,847,071.1	3,929,342.0	1,381,873.0	13,410,844.2	2.90	1.0600	3.08
5,067,063.2	1,296,293.3	533,189.0	4,424,249.2	2.74	1.0600	2.90
30,677,849.8	5,272,225.0	2,481,658.5	17,994,103.8	3.54	1.0600	3.75
52,419,934.5	13,576,220.0	5,548,043.4	46,335,638.7	2.67	1.0600	2.83
10,834,007.2	1,584,075.0	1,485,493.0	5,406,448.0	2.14	1.0600	2.27
2,909,800.4	1,163,412.0	476,937.6	3,970,725.2	1.88	1.0600	1.99
5,974,484.2	1,769,731.4	744,679.2	6,040,093.1	2.43	1.0600	2.58
29,143,667.5	7,536,125.3	3,187,234.6	25,720,795.8	2.70	1.0600	2.86

43	9267	Hoosier Energy REC	1,957.2	65,671,503.1
44	9191	Idaho Power Company	3,562.0	6,876,042.7
45	9216	Imperial Irrigation District	1,879.0	16,735,996.8
46	9231	Independence MO City of	293.0	1,985,494.5
47	9273	Indianapolis Power & Light Company	4,097.3	148,485,889.8
48	9617	JEA	5,065.3	139,637,128.5
49	9996	Kansas City Board of Public Utilities	909.1	24,890,672.2
50	12699	Kansas City Power & Light Co-GMO	27.3	1,280.0
51	10000	Kansas City Power & Light Company	8,577.3	312,477,356.6
52	9096	Lafayette Utilities System	542.5	4,632,304.7
53	11249	LG&E and KU Services Company	10,702.1	389,016,674.6
54	11018	Lincoln Electric System	469.0	1,854,878.7
55	11208	Los Angeles Department of Water and Power	9,651.4	182,558,808.6
56	26253	Louisiana Energy & Power Authority	215.9	937,194.5
57	2777	Louisiana Generating	2.5	986,090.0
58	11479	Madison Gas and Electric Company	1,098.8	7,731,485.5
59	12427	Michigan Electric Coordinated Systems	2,350.7	27,000,169.3
60	12341	MidAmerican Energy Company	9,737.9	272,997,245.8
61	12647	Minnesota Power	2,290.7	109,394,584.9
62	13143	Muscatine Power and Water	293.5	7,420,300.5
63	-19	NaturEner Power Watch	399.0	0.0
64	13337	Nebraska Public Power District	4,590.7	130,490,665.7
65	13407	Nevada Power Company	9,073.0	157,123,750.4
66	1	New Brunswick Power Corporation	198.7	4,898,849.9
67	13434	New England ISO	37,796.0	636,816,184.1
68	32790	New Harquahala Generating Company	1,325.1	10,416,559.6
69	13485	New Smyrna Beach Utilities Commission of	48.0	647.0
70	13501	New York ISO	46,270.2	657,482,806.0
71	13718	North Little Rock AR City of	45.4	0.0
72	13756	Northern Indiana Public Service Company	5,698.0	158,808,667.5
73	13781	Northern States Power	13,385.5	206,360,230.3
74	12825	NorthWestern Corporation	3,848.7	167,874,835.5
75	14015	Ohio Valley Electric Corporation	2,390.3	113,741,792.4
76	14063	Oklahoma Gas and Electric Company	10,793.4	310,995,266.3
77	14127	Omaha Public Power District	3,681.2	138,575,442.5
78	14232	Otter Tail Power Company	2,860.4	121,810,836.9
79	14354	PacifiCorp	14,598.3	604,507,372.3
80	14725	PJM Interconnection	217,775.3	4,731,984,509.6
81	-20	Plum Point Energy Associates	720.0	47,155,540.9
82	15248	Portland General Electric Company	3,661.4	56,658,599.2
83	189	PowerSouth Energy Cooperative	1,989.0	49,206,554.0
84	15466	Public Service Company of Colorado	13,079.1	310,994,051.8
85	15473	Public Service Company of New Mexico	5,327.9	171,033,519.6
86	3413	PUD No. 1 of Chelan County	2,036.0	0.0
87	5326	PUD No. 1 of Douglas County	774.0	0.0
88	14624	PUD No. 2 of Grant County	2,200.0	0.0
89	15500	Puget Sound Energy	1,975.9	12,664,079.3
90	16572	Salt River Project	13,403.3	313,071,400.6
91	16868	Seattle City Light	1,948.2	96,776.0
92	21554	Seminole Electric Cooperative	5,087.8	95,893,952.4
93	17166	Sierra Pacific Power Company	2,977.4	62,312,751.9
94	17539	South Carolina Electric & Gas Company	8,138.9	188,798,688.5

27,678,165.5	6,156,297.1	2,581,300.0	21,011,441.8	3.13	1.0600	3.31
4,674,947.2	11,632,648.8	5,348,898.3	39,702,230.3	0.17	1.0600	0.18
7,429,549.7	5,524,877.5	2,379,101.9	18,856,406.9	0.89	1.0600	0.94
1,269,689.3	114,149.0	75,957.7	389,590.5	5.10	1.0600	5.40
63,945,128.5	13,953,470.6	5,913,487.6	47,623,195.0	3.12	1.0600	3.31
68,426,278.4	14,528,788.9	7,081,779.5	49,586,756.7	2.82	1.0600	2.98
11,028,233.6	1,889,320.0	797,093.0	6,448,249.2	3.86	1.0600	4.09
794.0	125.0	77.8	426.6	3.00	1.0600	3.18
150,368,555.2	30,954,898.4	14,998,253.3	105,649,068.1	2.96	1.0600	3.14
3,583,433.6	409,579.0	314,357.0	1,397,893.1	3.31	1.0600	3.51
175,863,025.9	37,725,803.1	16,815,894.7	128,758,166.0	3.02	1.0600	3.20
1,596,635.1	213,675.0	173,837.1	729,272.8	2.54	1.0600	2.70
87,046,969.0	22,330,945.5	10,615,747.2	76,215,517.0	2.40	1.0600	2.54
646,305.7	59,604.0	37,400.7	203,428.5	4.61	1.0600	4.88
489,352.0	10,941.7	5,429.9	37,344.0	26.41	1.0600	27.99
5,688,379.3	629,446.3	484,278.5	2,148,300.2	3.60	1.0600	3.81
13,332,508.7	2,671,523.6	1,238,249.7	9,117,910.2	2.96	1.0600	3.14
122,584,750.7	34,286,710.0	14,588,311.1	117,020,541.1	2.33	1.0600	2.47
43,819,229.0	10,834,638.7	4,331,134.0	36,978,621.9	2.96	1.0600	3.14
3,700,097.2	673,161.0	370,008.0	2,297,498.5	3.23	1.0600	3.42
0.0	634,107.9	179,898.8	2,164,210.2	0.00	1.0600	0.00
55,069,791.9	19,691,548.0	8,606,868.3	67,207,253.2	1.94	1.0600	2.06
80,420,087.1	21,118,291.9	10,711,209.6	72,076,730.2	2.18	1.0600	2.31
2,033,243.0	934,333.0	375,176.7	3,188,878.4	1.54	1.0600	1.63
299,576,794.5	119,390,191.2	53,803,146.4	407,478,722.4	1.56	1.0600	1.66
10,341,795.1	1,444,228.0	1,435,540.0	4,929,150.2	2.11	1.0600	2.24
431.0	-34.0	-23.0	-116.0	-5.58	1.0600	-5.91
329,695,255.2	140,176,340.4	63,638,813.6	478,421,849.9	1.37	1.0600	1.46
0.0	96,260.0	25,083.3	328,535.4	0.00	1.0600	0.00
80,009,201.3	17,528,658.6	8,210,726.7	59,825,311.7	2.65	1.0600	2.81
95,107,934.0	38,050,105.0	16,792,008.2	129,865,008.2	1.59	1.0600	1.68
56,457,911.1	19,020,708.8	6,741,532.0	64,917,679.2	2.59	1.0600	2.74
46,608,374.0	10,634,223.0	4,370,976.0	36,294,603.2	3.13	1.0600	3.32
157,283,224.6	35,374,279.7	16,979,536.5	120,732,416.6	2.58	1.0600	2.73
60,099,099.6	13,559,881.9	5,931,551.0	46,279,877.1	2.99	1.0600	3.17
52,414,518.3	13,877,909.0	5,723,105.6	47,365,303.3	2.57	1.0600	2.73
254,134,056.1	69,813,417.3	28,448,381.6	238,273,193.3	2.54	1.0600	2.69
2,227,341,201.5	783,297,601.2	348,143,523.6	2,673,394,712.8	1.77	1.0600	1.88
21,501,385.0	4,366,528.0	1,988,951.0	14,902,960.0	3.16	1.0600	3.35
16,833,725.1	9,385,562.0	3,013,730.8	32,032,923.0	1.77	1.0600	1.87
23,792,272.2	5,280,541.9	2,488,846.5	18,022,489.6	2.73	1.0600	2.89
140,698,431.1	37,001,980.6	16,241,372.0	126,287,759.8	2.46	1.0600	2.61
84,888,367.3	18,479,445.2	8,757,779.9	63,070,346.3	2.71	1.0600	2.87
0.0	10,276,346.0	4,915,798.0	35,073,168.9	0.00	1.0600	0.00
0.0	4,655,818.0	2,172,815.0	15,890,306.8	0.00	1.0600	0.00
0.0	9,957,489.0	4,216,277.6	33,984,910.0	0.00	1.0600	0.00
5,215,746.9	2,941,875.0	1,297,039.1	10,040,619.4	1.26	1.0600	1.34
144,011,782.3	65,439,076.6	30,096,481.0	223,343,568.4	1.40	1.0600	1.49
36,505.8	6,940,522.3	3,109,885.2	23,688,002.7	0.0041	1.0600	0.0043
45,569,144.1	10,388,620.0	5,001,907.0	35,456,360.0	2.70	1.0600	2.87
28,408,562.9	8,637,645.1	3,863,618.4	29,480,282.7	2.11	1.0600	2.24
86,655,219.2	27,888,055.9	12,830,219.1	95,181,934.9	1.98	1.0600	2.10

95	17543	South Carolina Public Service Authority	5,949.4	214,326,289.9
96	17568	South Mississippi Electric Power Assn	1,062.0	26,134,433.6
97	18195	Southern Company Services	78,100.5	1,725,486,408.9
98	17632	Southern Illinois Power Cooperative	438.7	23,919,792.7
99	17633	Southern Indiana Gas & Electric Company	2,058.5	111,264,112.9
100	40580	Southern Minnesota Municipal Power Agcy	659.8	2,532,616.1
101	17716	Southwestern Power Administration	3,368.4	46,742,517.6
102	17718	Southwestern Public Service Company	8,055.9	249,955,854.1
103	17828	Springfield IL - CWLP City of	855.8	23,711,833.8
104	18315	Sunflower Electric Power Corporation	2,160.2	31,698,220.2
105	18429	Tacoma Power	951.7	2,253,783.7
106	18445	Tallahassee City of	1,023.4	20,984,056.3
107	18454	Tampa Electric Company	9,363.0	222,987,233.0
108	18642	Tennessee Valley Authority	47,701.5	990,545,518.7
109	24211	Tucson Electric Power	2,569.2	109,672,304.1
110	19281	Turlock Irrigation District	761.9	13,436,815.0
111	54796	Union Power Partners	2,428.0	72,390,449.8
112	19578	Upper Peninsula Power Company	331.3	8,463,486.6
113	19610	WAPA - Desert Southwest Region	6,038.6	36,179,085.2
114	28503	WAPA - Rocky Mountain Region	6,172.8	281,858,697.1
115	25470	WAPA - Upper Great Plains East	8,351.1	185,772,740.2
116	25471	WAPA - Upper Great Plains West	71.4	0.0
117	22500	Westar Energy	9,780.0	199,525,796.8
118	20447	Western Farmers Electric Cooperative	2,414.9	40,079,651.6
119	20847	Wisconsin Energy Corporation	10,292.3	237,486,718.1
120	20860	Wisconsin Public Service Corporation	3,312.2	64,931,573.5
				26,820,073,797.1

*Actual grid loss factor should be obtained f

99,062,453.1	21,480,768.2	9,773,968.6	73,313,861.9	2.92	1.0600	3.10
13,060,331.2	2,604,833.0	1,312,382.9	8,890,295.2	2.94	1.0600	3.12
859,607,023.0	247,069,135.0	116,800,612.5	843,246,957.6	2.05	1.0600	2.17
11,170,543.1	1,739,617.0	814,926.4	5,937,312.7	4.03	1.0600	4.27
49,534,108.7	9,360,427.0	4,161,051.8	31,947,137.4	3.48	1.0600	3.69
1,351,416.8	867,924.5	323,440.5	2,962,226.2	0.85	1.0600	0.91
23,917,828.3	6,951,642.0	2,871,147.4	23,725,954.1	1.97	1.0600	2.09
122,001,991.0	28,809,180.2	13,573,076.4	98,325,731.9	2.54	1.0600	2.69
12,268,153.1	1,962,229.0	1,020,972.3	6,697,087.7	3.54	1.0600	3.75
16,272,034.4	4,136,287.8	1,948,611.2	14,117,150.4	2.25	1.0600	2.38
960,678.0	4,068,700.0	1,793,486.1	13,886,473.1	0.16	1.0600	0.17
9,352,576.0	2,501,639.0	1,109,028.0	8,538,093.9	2.46	1.0600	2.61
103,003,389.0	25,266,912.7	11,916,403.5	86,235,973.1	2.59	1.0600	2.74
475,225,903.6	169,266,819.7	76,015,414.9	577,707,655.6	1.71	1.0600	1.82
45,939,115.1	11,068,033.0	4,698,944.5	37,775,196.6	2.90	1.0600	3.08
5,511,683.1	1,942,607.0	905,397.2	6,630,117.7	2.03	1.0600	2.15
34,336,484.3	9,911,292.0	4,656,446.0	33,827,239.6	2.14	1.0600	2.27
3,485,349.0	1,004,101.0	384,447.4	3,426,996.7	2.47	1.0600	2.62
17,860,163.8	14,445,675.0	6,761,190.3	49,303,088.8	0.73	1.0600	0.78
120,609,715.9	26,634,859.0	11,500,404.6	90,904,773.9	3.10	1.0600	3.29
73,214,102.8	33,546,932.8	14,360,601.1	114,495,681.6	1.62	1.0600	1.72
0.0	213,895.0	63,176.0	730,023.6	0.00	1.0600	0.00
98,169,462.9	28,805,558.8	13,943,781.9	98,313,372.0	2.03	1.0600	2.15
19,820,006.3	6,644,794.0	2,865,322.8	22,678,682.0	1.77	1.0600	1.87
110,635,946.3	34,860,163.2	15,757,062.7	118,977,737.1	2.00	1.0600	2.12
31,768,306.9	12,464,590.4	5,634,515.3	42,541,647.0	1.53	1.0600	1.62
			13,807,352,643.0	1.94	1.0833	2.10

rom the Power Control Authority

eGRID2012 State File

This state file has 51 records and 111 data elements.

eGRID2012 file state sequence number	State abbreviation	FIPS State code	State nameplate capacity (MW)	State annual heat input (MMBtu)	State ozone season heat input (MMBtu)	State annual net generation (MWh)
SEQST12	PSTATABB	FIPSST	NAMEPCAP	STHTIAN	STHTIOZ	STNGENAN
1	AK	02	2,762.0	55,212,470.1	21,979,611.4	6,928,294.5
2	AL	01	36,284.1	940,198,951.5	457,545,013.7	153,105,217.0
3	AR	05	18,689.2	461,695,316.6	221,026,926.2	65,005,677.9
4	AZ	04	35,774.8	670,369,581.0	322,632,308.5	110,614,113.4
5	CA	06	97,737.5	1,022,257,541.8	460,274,489.3	199,189,655.8
6	CO	08	16,952.1	457,759,946.9	205,706,407.9	52,547,910.6
7	CT	09	10,902.7	146,138,524.1	66,500,837.4	35,557,337.4
8	DC	11	860.8	692,776.0	372,786.3	71,786.8
9	DE	10	3,999.4	80,579,254.7	40,475,020.9	8,633,823.3
10	FL	12	83,533.4	1,728,428,769.8	826,093,021.9	221,099,929.6
11	GA	13	48,472.3	788,221,699.5	405,866,328.7	122,014,744.3
12	HI	15	3,081.6	91,564,337.9	38,027,952.1	10,469,268.7
13	IA	19	18,509.8	390,008,957.0	177,441,191.3	56,602,145.7
14	ID	16	5,388.7	18,695,338.5	8,572,418.4	15,499,089.3
15	IL	17	59,211.6	989,140,070.9	451,375,789.8	197,522,001.0
16	IN	18	37,915.2	1,114,010,384.6	497,073,588.2	114,878,967.3
17	KS	20	15,927.4	352,888,848.6	173,624,869.5	44,286,624.6
18	KY	21	28,259.8	923,144,671.8	415,170,545.6	89,957,452.2
19	LA	22	30,604.9	816,050,783.8	390,180,135.1	103,347,602.4
20	MA	25	16,284.9	248,702,937.9	124,835,355.0	36,198,121.5
21	MD	24	14,595.8	242,687,988.8	128,344,753.1	37,808,347.2
22	ME	23	5,527.8	90,118,939.9	38,873,121.1	14,420,135.4
23	MI	26	34,036.7	783,043,434.4	370,652,086.4	108,166,077.4
24	MN	27	18,009.4	334,432,924.0	147,669,235.5	52,193,624.2
25	MO	29	24,141.3	781,693,746.5	369,083,252.4	91,804,321.4
26	MS	28	19,469.2	392,585,300.0	196,808,898.7	54,584,295.2
27	MT	30	6,693.6	172,291,037.3	58,219,695.0	27,795,017.1
28	NC	37	39,312.0	693,049,929.3	338,520,955.0	116,971,226.6
29	ND	38	7,390.6	308,021,928.9	128,793,698.1	36,125,158.9
30	NE	31	9,084.1	270,920,986.9	116,765,526.6	34,200,814.9
31	NH	33	4,720.9	86,908,731.2	37,243,002.8	19,264,434.9
32	NJ	34	23,680.2	259,579,009.0	140,242,511.9	65,232,564.1
33	NM	35	9,965.1	344,387,639.5	161,225,768.7	36,635,909.3
34	NV	32	17,929.0	237,416,383.8	117,896,225.0	35,142,774.0
35	NY	36	48,055.8	626,602,859.3	312,775,128.3	135,662,526.5
36	OH	39	39,660.3	1,102,935,989.6	508,904,734.1	129,741,418.3
37	OK	40	25,816.9	655,725,199.8	339,105,875.3	77,757,667.7
38	OR	41	18,972.1	124,560,183.5	38,163,661.4	60,612,559.4
39	PA	42	54,685.0	1,339,016,860.5	608,470,750.5	223,416,431.4
40	RI	44	2,052.2	64,577,922.1	32,002,765.1	8,309,035.9
41	SC	45	26,596.0	436,320,176.5	202,323,523.0	96,755,682.3

EEI Calculations based on eGRID values **EEI Calculations based on EPA Clean Powe**

Calculated Annual Net Generation in MMBtu	"Source" ratio of upstream heat input to net generation	eGRID 2012 Grid Gross Loss Factor	Overall "source" ratio of upstream heat input to end use	Percent Reduction Required by State by CPP or *RPS*	"Source" Ratio in 2030 Under Clean Power Plan (or State RPS)
23,646,269.1	2.33	1.0866	2.54	0	2.54
522,548,105.5	1.80	1.0917	1.96	33	1.32
221,864,378.6	2.08	1.0917	2.27	34	1.50
377,525,968.9	1.78	1.0576	1.88	38	1.16
679,834,295.1	1.50	1.0576	1.59	13	1.38
179,346,018.9	2.55	1.0576	2.70	38	1.67
121,357,192.5	1.20	1.0917	1.31	7	1.22
245,008.3	2.83	1.0917	3.09	*20*	2.47
29,467,238.8	2.73	1.0917	2.99	24	2.27
754,614,059.6	2.29	1.0917	2.50	25	1.88
416,436,322.1	1.89	1.0917	2.07	34	1.36
35,731,614.1	2.56	1.0769	2.76	*40*	1.66
193,183,123.1	2.02	1.0576	2.14	42	1.24
52,898,391.8	0.35	1.0576	0.37	8	0.34
674,142,589.3	1.47	1.0917	1.60	42	0.93
392,081,915.6	2.84	1.0917	3.10	39	1.89
151,150,249.8	2.33	1.0576	2.47	43	1.41
307,024,784.4	3.01	1.0917	3.28	39	2.00
352,725,367.0	2.31	1.0917	2.53	29	1.79
123,544,188.7	2.01	1.0917	2.20	18	1.80
129,039,889.0	1.88	1.0917	2.05	37	1.29
49,215,922.1	1.83	1.0917	2.00	11	1.78
369,170,822.3	2.12	1.0917	2.32	39	1.41
178,136,839.5	1.88	1.0576	1.99	42	1.15
313,328,149.0	2.49	1.0917	2.72	37	1.72
186,296,199.4	2.11	1.0917	2.30	18	1.89
94,864,393.3	1.82	1.0576	1.92	47	1.02
399,222,796.4	1.74	1.0917	1.90	32	1.29
123,295,167.3	2.50	1.0576	2.64	45	1.45
116,727,381.3	2.32	1.0576	2.45	40	1.47
65,749,516.5	1.32	1.0917	1.44	23	1.11
222,638,741.3	1.17	1.0917	1.27	23	0.98
125,038,358.5	2.75	1.0576	2.91	36	1.86
119,942,287.6	1.98	1.0576	2.09	22	1.63
463,016,202.8	1.35	1.0917	1.48	20	1.18
442,807,460.8	2.49	1.0917	2.72	36	1.74
265,386,919.8	2.47	1.0576	2.61	32	1.78
206,870,665.3	0.60	1.0576	0.64	20	0.51
762,520,280.2	1.76	1.0917	1.92	33	1.28
28,358,739.4	2.28	1.0917	2.49	16	2.09
330,227,143.8	1.32	1.0917	1.44	35	0.94

41,016,485.0	0.81	1.0576	0.85	38	0.53
264,118,201.4	1.67	1.0917	1.82	39	1.11
1,466,557,057.9	2.16	1.0703	2.32	33	1.55
134,473,636.0	2.76	1.0576	2.91	34	1.92
241,433,008.2	1.59	1.0917	1.74	32	1.18
22,416,997.0	0.24	1.0917	0.26	75	0.06
398,755,888.0	0.26	1.0576	0.27	37	0.17
217,554,551.5	2.16	1.0576	2.28	37	1.44
250,559,948.5	2.79	1.0917	3.04	41	1.79
169,245,912.6	2.95	1.0576	3.12	44	1.75
13,807,352,643.0	1.94	1.0833	2.10	32	1.43

42	SD	46	4,432.9	33,058,791.5	14,621,756.0	12,017,722.0
43	TN	47	25,710.6	440,443,036.0	220,882,390.5	77,385,936.5
44	TX	48	135,365.8	3,173,156,987.6	1,584,526,492.7	429,697,350.7
45	UT	49	8,826.7	370,598,739.8	164,276,334.7	39,400,420.8
46	VA	51	29,875.0	384,526,861.2	195,229,529.3	70,739,234.7
47	VT	50	1,276.0	5,301,223.5	2,185,657.7	6,568,121.0
48	WA	53	32,149.1	102,619,941.3	37,552,063.5	116,834,423.7
49	WI	55	21,870.5	469,822,851.8	225,613,046.3	63,742,909.9
50	WV	54	18,416.3	697,859,770.0	314,612,828.6	73,413,404.2
51	WY	56	9,925.5	500,047,260.6	202,355,313.3	49,588,606.1
				26,820,073,797.1		

eGRID 2012 Subregion File

This eGRID subregion file has 26 records and 113 data elements.

eGRID2012 file eGRID subregion sequence number	eGRID subregion acronym	eGRID subregion name	NERC region acronym associated with the eGRID subregion acronym	eGRID subregion nameplate capacity (MW)	eGRID subregion annual heat input (MMBtu)
SEQSRL12	SUBRGN	SRNAME	NERC	NAMEPCAP	SRHTIAN
1	AKGD	ASCC Alaska Grid	ASCC	2,007.8	50,103,432.3
2	AKMS	ASCC Miscellaneous	ASCC	754.2	5,109,037.9
3	ERCT	ERCOT All	TRE	115,223.9	2,523,758,252.6
4	FRCC	FRCC All	FRCC	80,756.1	1,640,755,276.2
5	HIMS	HICC Miscellaneous	HICC	974.2	22,156,178.1
6	HIOA	HICC Oahu	HICC	2,107.4	69,408,159.9
7	MROE	MRO East	MRO	10,323.2	224,479,039.4
8	MROW	MRO West	MRO	61,555.1	1,447,090,279.1
9	NYLI	NPCC Long Island	NPCC	6,031.2	114,525,698.3
10	NYCW	NPCC NYC/Westchester	NPCC	14,988.5	286,393,381.4
11	NEWE	NPCC New England	NPCC	40,761.9	641,715,034.1
12	NYUP	NPCC Upstate NY	NPCC	28,527.0	256,563,726.3
13	RFCE	RFC East	RFC	81,434.8	1,391,695,054.8
14	RFCM	RFC Michigan	RFC	30,753.9	746,347,712.6
15	RFCW	RFC West	RFC	165,405.0	4,024,988,554.1
16	SRMW	SERC Midwest	SERC	38,922.6	1,119,689,507.5
17	SRMV	SERC Mississippi Valley	SERC	52,377.2	1,305,610,342.6
18	SRSO	SERC South	SERC	81,805.3	1,800,827,396.6
19	SRTV	SERC Tennessee Valley	SERC	69,435.3	1,614,332,664.1
20	SRVC	SERC Virginia/Carolina	SERC	92,485.0	1,584,202,044.6
21	SPNO	SPP North	SPP	23,788.5	603,772,956.2
22	SPSO	SPP South	SPP	50,658.9	1,377,387,399.9
23	CAMX	WECC California	WECC	95,000.9	1,117,751,448.1
24	NWPP	WECC Northwest	WECC	80,235.0	1,056,452,192.3
25	RMPA	WECC Rockies	WECC	19,921.2	592,852,748.9
26	AZNM	WECC Southwest	WECC	63,160.5	1,202,106,279.3
					26,820,073,797.1

EEI Calculations based on eGRID values

eGRID subregion ozone season heat input (MMBtu)	eGRID subregion annual net generation (MWh)	Calculated Annual Net Generation in MMBtu	"Source" ratio of upstream heat input to net generation	eGRID 2012 Grid Gross Loss Factor	Overall "source" ratio of upstream heat input to end use
SRHTIOZ	SRNGENAN				
19,891,193.8	5,331,368.0	18,195,958.8	2.75	1.0866	2.99
2,088,417.6	1,596,926.5	5,450,310.3	0.94	1.0866	1.02
1,265,106,191.9	360,221,517.3	1,229,436,038.5	2.05	1.0703	2.20
784,793,331.4	211,244,527.5	720,977,572.3	2.28	1.0917	2.48
8,884,284.6	2,933,143.4	10,010,818.3	2.21	1.0769	2.38
29,143,667.5	7,536,125.3	25,720,795.8	2.70	1.0769	2.91
110,800,775.5	28,629,056.0	97,710,968.2	2.30	1.0917	2.51
627,139,932.5	203,915,893.0	695,964,942.8	2.08	1.0576	2.20
62,765,614.5	12,121,635.9	41,371,143.2	2.77	1.0917	3.02
137,666,230.1	45,503,844.6	155,304,621.7	1.84	1.0917	2.01
301,610,037.6	120,324,524.1	410,667,600.8	1.56	1.0917	1.71
129,263,410.6	82,550,860.0	281,746,085.1	0.91	1.0917	0.99
678,912,553.3	262,972,203.0	897,524,128.7	1.55	1.0917	1.69
355,576,989.9	86,819,386.1	296,314,564.9	2.52	1.0917	2.75
1,838,224,851.8	567,064,674.2	1,935,391,732.9	2.08	1.0917	2.27
502,786,201.5	132,935,700.9	453,709,547.1	2.47	1.0917	2.69
632,240,710.4	182,134,134.3	621,623,800.4	2.10	1.0917	2.29
896,459,626.5	254,954,509.9	870,159,742.3	2.07	1.0917	2.26
753,260,138.0	229,094,795.2	781,900,536.1	2.06	1.0917	2.25
770,388,018.7	289,711,035.7	988,783,764.7	1.60	1.0917	1.75
294,874,950.0	69,447,958.9	237,025,883.9	2.55	1.0576	2.69
674,580,693.2	152,734,002.2	521,281,149.6	2.64	1.0576	2.79
505,875,672.2	206,633,044.0	705,238,579.1	1.58	1.0576	1.68
415,952,620.6	287,596,498.3	981,566,848.6	1.08	1.0576	1.14
261,308,146.9	63,636,839.6	217,192,533.6	2.73	1.0576	2.89
579,100,917.2	177,873,710.9	607,082,975.4	1.98	1.0576	2.09
		13,807,352,643.0	1.94	1.0833	2.10

EEI Calculations based on EPA Clean Power Plan for 2030 or State RPS

Percent Reduction Required by CPP or *RPS*	"Source" Ratio in 2030 Under Clean Power Plan (or State RPS)
0	2.99
0	1.02
33	1.47
25	1.86
40	1.43
40	1.74
32	1.71
32	1.50
20	2.42
20	1.61
32	1.16
20	0.80
32	1.15
39	1.68
32	1.54
32	1.83
32	1.56
32	1.54
32	1.53
32	1.19
32	1.83
32	1.90
13	1.46
32	0.77
32	1.96
32	1.42
32	1.43

eGRID2012 NERC Region File

This NERC region file has 10 records and 111 data elements.

eGRID2012 file NERC region sequence number	NERC region acronym	NERC region name	NERC region nameplate capacity (MW)	NERC region annual heat input (MMBtu)	NERC region ozone season heat input (MMBtu)
SEQNRL12	NERC	NERCNAME	NAMEPCAP	NRHTIAN	NRHTIOZ
1	ASCC	Alaska Systems Coordinating Council	2,762.0	55,212,470.1	21,979,611.4
2	FRCC	Florida Reliability Coordinating Council	80,756.1	1,640,755,276.2	784,793,331.4
3	HICC	Hawaiian Islands Coordinating Council	3,081.6	91,564,337.9	38,027,952.1
4	MRO	Midwest Reliability Organization	72,028.2	1,671,569,318.5	737,940,708.0
5	NPCC	Northeast Power Coordinating Council	90,299.4	1,299,197,840.1	631,305,292.7
6	RFC	Reliability First Corporation	279,506.7	6,163,031,321.5	2,872,714,395.1
7	SERC	SERC Reliability Corporation	333,238.6	7,424,661,955.3	3,555,134,695.1
8	SPP	Southwest Power Pool	74,092.2	1,981,160,356.1	969,455,643.2
9	TRE	Texas Regional Entity	115,787.6	2,523,758,252.6	1,265,106,191.9
10	WECC	Western Electricity Coordinating Council	257,842.2	3,969,162,668.6	1,762,237,356.9
				26,820,073,797.1	

EEI Calculations based on eGRID values

NERC region annual net generation (MWh)	Calculated Annual Net Generation in MMBtu	"Source" ratio of upstream heat input to net generation	eGRID 2012 Grid Gross Loss Factor	Overall "source" ratio of upstream heat input to end use	"Source" Ratio in 2030 Under Clean Power Plan (or State RPS)
NRNGENAN					
6,928,294.5	23,646,269.1	2.33	1.0866	2.54	2.54
211,244,527.5	720,977,572.3	2.28	1.0917	2.48	1.86
10,469,268.7	35,731,614.1	2.56	1.0769	2.76	1.66
232,544,949.0	793,675,911.1	2.11	1.0576	2.23	1.51
260,500,864.6	889,089,450.7	1.46	1.0917	1.60	1.08
916,856,263.3	3,129,230,426.5	1.97	1.0917	2.15	1.46
1,088,830,176.0	3,716,177,390.6	2.00	1.0917	2.18	1.48
222,181,961.2	758,307,033.5	2.61	1.0576	2.76	1.88
360,221,517.3	1,229,436,038.5	2.05	1.0703	2.20	1.47
735,740,092.8	2,511,080,936.7	1.58	1.0576	1.67	1.14
	13,807,352,643.0	1.94	1.0833	2.10	1.43

For example, in terms of natural gas production, the US EIA wrote in 2011 (Today in Energy, 11/23/2011) "**Over one-third of natural gas produced in North Dakota is flared or otherwise not marketed".** In March 2013, the North Dakota Department of Mineral Resources wrote "Additions to gathering and processing capacity are keeping up with the percentage of gas flared holding at 29%. The historical high was 36% in September 2011." For end-users receiving gas from this production, it is impossible to have a "source" factor any less than 1/0.71 = 1.408

As the MIT report shows, the central and southwest portions of the US are the key producers of natural gas and export gas to other regions. As the DOE/NETL report shows, there are significant differences in energy losses depending on the type of gas production, and how far the gas has to travel via pipeline (and the use of natural gas compressors).

According to the EPA report on Greenhouse Gas Emissions published in August 2015 (page 8, Figure 2), there are significant regional differences in GHG emissions (and energy losses). Figure 2 on page 8 shows that for different regions in Canada, the CO2e emissions vary by as much as 30% depending on the region where the natural gas was produced.

Issue 4: Impact of Federal Policies

As a result of federal policies (such as the EPA Mercury and Air Toxics Rule of 2012 and the August 2015 Clean Power Plan), there will be a significant change in how electricity will be produced in the US. The EPA rules are already having a significant impact. States must file implementation plans with EPA starting by September 2016, for implementation and meeting the EPA requirements by 2030. The tables for electricity source estimates (except for power control areas) show values based on eGRID 2012 as well as projected values for 2030, based on the EPA Clean Power Plan or state Renewable Portfolio Standards.

Since buildings will be built in the future and consume electricity in the future, and not the past, the 2030 values provide realistic estimates that can be used by code officials that are interested in future estimated impacts.

Summary: This proposal provides more flexibility and makes key updates based on recent reports and policies, rather than use static and outdated values

Bibliography: ND Department of Mineral Resources 03/15/13 Report https://www.dmr.nd.gov/oilgas/directorscut/directorscut-2013-03-15.pdf (https://www.dmr.nd.gov/oilgas/directorscut/directorscut-2013-03-15.pdf)
MIT "The Future of Natural Gas" : http://mitei.mit.edu/system/files/NaturalGas_Report.pdf (http://mitei.mit.edu/system/files/NaturalGas_Report.pdf)

WRI Working Paper April 2013 "Clearing the Air: Reducing GHG Emissions from U.S. Natural Gas Systems" http://www.wri.org/publication/clearing-air

Congressional Research Service March 2014 "Canadian Oil Sands: Life Cycle Assessments of Greenhouse Gas Emissions" https://www.fas.org/sgp/crs/misc/R42537.pdf

DOE / NETL-2011/1522, "Life Cycle Greenhouse Gas Inventory of Natural Gas Extraction, Delivery, and Electricity Production" (October 24, 2011) http://www.netl.doe.gov/energy-analyses/pubs/NG-GHG-LCI.pdf

EPA eGRID 2012 October 2015 http://www.epa.gov/energy/egrid

EPA Portfolio Manger Technical Reference "Greenhouse Gas Emissions", August 2015, https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf

CERA "Oil Sands, Greenhouse Gases, and US Oil Supply Getting the Numbers Right—2012 Update" http://www.api.org/~/media/Files/%20Oil-and-Natural-Gas/Oil_Sands/CERA_Oil_Sands_GHGs_US_Oil_Supply.pdf

Carnegie Endowment for International Peace, "The Carbon Content of Global Oils", December 2012, http://carnegieendowment.org/files/global_oils.pdf

Cost Impact: Will not increase the cost of construction
This proposal only changes how the energy simulation in R405.3 is to be performed, and does not have any impact on the cost of construction.

RE139-16 : R405.3-ROSENSTOCK11888

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This over complicates what can be used by code officials.

Assembly Action: **None**

Public Comment 1:

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R405.3 (N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design)* be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design.* Energy prices shall be taken from a source *approved* by the *code official,* such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report. Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.

> **Exception:** The energy use based on site energy or source energy expressed in Btu or Btu per square foot of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy estimate multipliers for ~~energy sources~~ electricity shall be taken from Tables R405.3(1) through ~~R405.3(7~~ R405.3(3). The source energy estimate multiplier for fuels other than electricity shall be 1.1.

TABLE ~~R405.3(4) [N1105.3(4)]~~

~~NATURAL GAS SOURCE ENERGY ESTIMATES BY EIA PIPELINE REGION~~

~~EIA Natural Gas Pipeline Region~~	~~Overall "source" ratio of upstream losses to end use (based on EIA and DOE reports)~~
~~Western~~	~~1.42~~
~~Central~~	~~1.53~~
~~Southwest~~	~~1.15~~
~~Midwest~~	~~1.42~~
~~Southeast~~	~~1.25~~
~~Northeast~~	~~1.38~~
~~Alaska~~	~~1.15~~

TABLE ~~R405.3(5) [N1105.3(5)]~~

~~PROPANE GAS SOURCE ENERGY ESTIMATES BY EIA NATURAL GAS PIPELINES~~

~~EIA Natural Gas Pipeline Region~~	~~Overall "source" ratio of upstream losses to end use (based on EIA and DOE reports)~~
~~Western~~	~~1.50~~
~~Central~~	~~1.61~~
~~Southwest~~	~~1.21~~
~~Midwest~~	~~1.50~~
~~Southeast~~	~~1.32~~
~~Northeast~~	~~1.46~~
~~Alaska~~	~~1.21~~

TABLE ~~R405.3(6) [N1105.3(6)]~~

~~PIPELINE GAS SOURCE ENERGY ESTIMATES BY TYPE OF CRUDE OIL~~

~~Crude Oil Source~~	~~Overall '"source" ratio of upstream losses to end use (based on EIA and DOE reports)~~
~~Domestic~~	~~1.54~~
~~Imported~~	~~1.77~~

~~R405.3(7) [N1105.3(7)]~~

~~SOURCE ENERGY ESTIMATES BY TYPE OF CRUDE OIL~~

~~Crude Oil Source~~	~~Overall "source" ratio of upstream losses to end use (based on EIA and DOE reports)~~
~~Domestic~~	~~1.19~~
~~Imported~~	~~1.37~~

Commenter's Reason: The Committee thought the proposal as submitted was overly complicated. This public comment attempts to uncomplicate the proposal by removing tables 4, 5, 6 and 7, thus making the proposal much less complicated while still accomplishing the goal of extending the scope of the code section to include site energy as well as source energy.

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Submitted.

Commenter's Reason: While there are many tables, this proposal provides the best estimates based on many recent studies and papers. There are variances in "source" estimates by state and region, and a methodology that uses such estimates should have all of the information available.

RE139-16

RE142-16
IECC: R405.4.2.

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

R405.4.2 (N1105.4.2) Compliance report. Compliance software tools shall generate a report that documents that the *proposed design* complies with Section R405.3. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a compliance report based on the as-built condition of the building shall be submitted to the *code official* before a certificate of occupancy is issued. Batch sampling of buildings to determine energy code compliance ~~for all buildings in the batch~~ shall only be ~~prohibited~~ allowed for stacked multifamily units.
Compliance reports shall include information in accordance with Sections R405.4.2.1 and R405.4.2.2. Where the *proposed design* of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the *proposed design* for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case building air leakage and worst- case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

Reason: Sampling is a process of testing/evaluating one unit in a batch of 7 multiple like units to determine if all seven of the units would pass the intent of Code. The reality is that single family and attached housing, town houses and duplexes, are not like units even when they have the same model number and have been built off of the same plan. Our construction processes are not true assembly line processes so for the purpose of code compliance batch sampling should continue not to be allowed for these types of housing.

Multifamily stacked housing, on the other hand, is basically one large building that has been subdivided into multiple smaller units. Batch sampling is ideal for this type of construction as each unit is a continuation of the unit adjacent to it, thus create the total building. When inspecting at rough you can cost affectively evaluate multiple units so in reality the sampling truly only comes into play for the final diagnostics (blower door testing) and reporting.

Cost Impact: Will not increase the cost of construction
Sampling of stacked multifamily units is more cost effective than testing each unit while at the same time ensuring that the inspection process for code compliance is valid as intended.

RE142-16 : R405.4.2-SCHWARZ12448

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: This is a good method for testing stacked multi-family buildings. It has been used with good success in several areas of the country.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: This proposal should be disapproved because it could open a huge, undefined energy efficiency loophole related to compliance assurance. Although the proponent's reason statement suggests that the proposal is aimed at a specific sampling methodology (presumably a 1-in-7 unit air leakage test), the proposed change does not provide any specific requirements for how many units must be tested. In our view, all homes should meet the minimum requirements of the code, not just a sample of homes. Moreover, while we generally oppose sampling for compliance purposes, if there is to be a sampling exception, the methodology and minimum requirements should be clearly defined and limited as necessary.

We are particularly alarmed at the potential breadth of this exemption. While the proponent suggests that it might only apply to blower door testing, the specific code language is not clearly limited to that test. The language appears to apply to "batch sampling of buildings to determine energy code compliance," which could be read very broadly. Does this mean that a builder could also use sampling to demonstrate compliance with duct tightness? Insulation levels? Fenestration?

We recommend disapproving RE142 because it would create an undefined sampling exception that could possibly become a loophole for a wide range of energy code requirements.

RE142-16

RE145-16

Table R405.5.2(1) [IRC Table N1105.5.2(1)]

Proposed Change as Submitted

Proponent : Craig Conner, representing self (craig.conner@mac.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of Table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame.	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: from Table N1102.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-factor: same as fenestration from Table N1102.1.4	As proposed
Vertical fenestration other than opaque doors	~~Total area[h] =~~	As proposed
	~~(a)The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area~~ ~~(b)15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area~~	
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	SHGC: as specified in Table N1102.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than 0.01 × *CFA* + 7.5 ×(N_{br} + 1) where: *CFA* = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[a]. The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.

For SI: 1 square foot = 0.93 m ^{2} , 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m ^{2} , 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official* , testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals* , or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

~~h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:~~
~~*AF* = A $_S$ x *FA* x *F*~~
~~where:~~
~~*AF* = Total glazing area.~~
~~A_S = Standard reference design total glazing area.~~
~~*FA* = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).~~
~~*F* = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.~~
~~and where:~~
~~Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.~~
~~Below-grade boundary wall is any thermal boundary wall in soil contact.~~
~~Common wall area is the area of walls shared with an adjoining dwelling unit.~~
~~*L* and *CFA* are in the same units.~~

Reason: Keep it simple and usable. Simple is setting a specific window requirement and having it apply to the whole performance approach, as is done in the prescriptive approach. Simple is presuming that the glass area for the performance calculation is the same as the glass area in the proposed new home. Simple is removing unneeded calculations. This change also has the effect of allowing changes from plans to the home as constructed without recalculation.
As windows get more efficient, the window area matters less. In some situations more glass better. In northern climates high quality windows are nearly as good as a "normal" wall. Therefore the impact of window area is decreased and not worth the calculation.

Removal of the window area calculation was the major simplification in the 2003 IECC simplification needed to get to the 2006 IECC. The 2006 IECC simply says use as much window as you want, just make it energy efficient windows. Requiring a specific window for each climate zone created huge markets for those specific levels of efficiency. Window makers respond by making a energy efficient windows a commodity, with a significant fall in the cost for energy efficient windows. The effect has been so strong that the building code has repeatedly pushed Energy Star to move to new levels.

Cost Impact: Will not increase the cost of construction
Having the reference design house with the same window area as the proposed house makes tradeoff work better. It may slightly lower costs.

RE145-16 :
TABLE R405.5.2-
CONNER12798

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Although the market will probably self regulate, there are concerns by enough people that not having any limitations might invite problematic situations in some cases. Upcoming proposal RE146-16 offers corrections to eliminate the penalty for having more window area and offers credit for having less window area.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Thomas Culp, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R405.5.2 (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame.	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: from Table N1102.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed

Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-factor: same as fenestration from Table N1102.1.4	As proposed
Vertical fenestration other than opaque doors	<u>Gross area: same as proposed</u>	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	SHGC: as specified in Table N1102.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: *CFA* = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the mea- sured air exchange rate[a] . The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.
a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.
b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

Commenter's Reason: Windows play a key role in the home environment and are important for egress, ventilation, lighting, and view in addition to energy efficiency. What is important is having high performance windows, more so than limiting the amount of glazing. The committee was split on this proposal with a narrow 6-5 vote, and some of the concern was that this could lead to unlimited amounts of glazing on homes. However, evidence shows that there is a natural cost pressure that already keeps window areas at reasonable levels, as demonstrated in a study from Pacific Northwest National Laboratory. This study found that even in places without window area restrictions, there was no significant difference in average window area, and there was no evidence that window area would increase. (Z.T. Taylor, C.C. Conner, R.G. Lucas, "Eliminating Window-Area

Restrictions in the IECC", PNNL-SA-35432, Pacific Northwest National Laboratory, 2001.) Additionally, wall bracing requirements place a practical design limit on the amount of window area. This proposal provides a good simplification to the code, treating window area neutrally in the performance path. This lets the design, economics, and consumer dictate the appropriate window area, and focuses on having better windows to gain credit in the performance path. The modification just reinstates the wording "Gross area: same as proposed" which was inadvertently left out in the original proposal. We ask you to vote against the initial motion for disapproval, and vote to Approve as Modified by this Public Comment.

Bibliography: Z.T. Taylor, C.C. Conner, R.G. Lucas, "Eliminating Window-Area Restrictions in the IECC", PNNL-SA-35432, Pacific Northwest National Laboratory, 2001.

Public Comment 2:

Proponent : Jeff Inks, representing Window & Door Manufacturers Association (jinks@wdma.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R405.5.2 (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame.	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: from Table N1102.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-factor: same as fenestration from Table N1102.1.4	As proposed
Vertical fenestration other than opaque doors	<u>Total area: same as proposed</u>	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	SHGC: as specified in Table N1102.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)

	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: *CFA* = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[a]. The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.
a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.
b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

Commenter's Reason: We agree with proponent's reasoning and encourage approval this proposal as modified by this public comment for those and other reasons noted below.

The modification proposed by this public comment is editorial to clarify the intent of the original proposal which is to make the vertical fenestration area in the standard reference design the "same as proposed" in the proposed design. The original proposal deleted the current provisions but inadvertently did not replace it with "Total area: same as proposed," which is accomplished by this public comment.

The basis for this provision has changed significantly since it was first included and we believe the performance path requirements should now reflect that. The intent of penalizing vertical fenestration was established at a time when common vertical fenestration products were far less efficient than they are today. Given the exponential increase in the energy efficiency of vertical fenestration that is common today and the broad range of other beneficial attributes uniquely provided by vertical fenestration, penalizing vertical fenestration area is no longer justified. There is no such penalty in the prescriptive path and there should not be in the performance path. There is also no substantiation that subjective limitations are needed to control vertical fenestration area.

In addition, as the proponent indicates, this also helps to simplify performance path compliance and makes it more consistent with the prescriptive path requirements as well as other thermal envelope requirements in the performance path.

It should also be noted that the committee disapproved this proposal in favor RE146-16 stating "*RE146-16 offers corrections to eliminate the penalty for having more window area and offers credit for having less window area*." However, though the committee indicated support for eliminating the penalty, RE146-16 did not accomplish that. Approval of this proposal as modified by this public comment does.

RE145-16

RE146-16

Table R405.5.2(1) [IRC Table N1105.5.2(1)]

Proposed Change as Submitted

Proponent : Tom Kositzky, Coalition for Fair Energy Codes, representing Coalition for Fair Energy Codes; Mark Halverson, representing APA (mark.halverson@apawood.org); Loren Ross, representing TBD (LRoss@awc.org)

2015 International Energy Conservation Code

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of Table not shown remain unchanged

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame.	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-factor: from Table N1102.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-factor: same as fenestration from Table N1102.1.4	As proposed
Vertical fenestration other than opaque doors	Total area[h] = ~~(a)The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area~~ ~~(b)~~15 percent of the conditioned floor are~~a, where the proposed glazing area is 15 percent or more of the conditioned floor area~~	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: as specified in Table N1102.1.4	As proposed
	SHGC: as specified in Table N1102.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than 0.01 × *CFA* + 7.5 ×(N_{br} + 1) where: *CFA* = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[a]. The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official* , testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals* , or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_S \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

Reason: While typically only 15% of the floor area, fenestrations account for over 50% of the UA of envelope walls, so even small changes in fenestration area result in large changes in wall energy efficiency. It is only logical that the code recognize the savings from smaller glazing area via the performance path.

Currently, providing glazing area greater than 15% of the floor area is penalized for its reduced energy efficiency. This makes sense; more use of less efficient wall components creates a penalty.

However, reducing glazing area to less than 15% of the floor area is not rewarded for increasing energy efficiency. This does not make sense; increased use of more efficient wall components should be rewarded.

The thermal performance of code-conforming windows is not comparable to opaque walls. In the 2015 IECC-R, walls are typically 6 times more energy efficient than windows. The least insulated opaque walls (Climate Zone 1) are more than 4 times more efficient than the windows required in the coldest climate zone (Climate Zone 8).

Comparison Of U Factor Requirements[a] For Glazing Versus Opaque Walls In The 2015 IECC-R								
Climate Zone	1	2	3	4	5	6	7	8
Fenestration (Glazing)	.50	0.40	0.35	0.35	0.32	0.32	0.32	0.32
Frame wall (Opaque walls)	.084	.084	.060	.060	.060	.045	.045	.045
How much more efficient opaque frame wall area is compared to glazed area (rounded to whole number)	**6X**	**5X**	**6X**	**6X**	**5X**	**7X**	**7X**	**7X**

a. Table R402.1.4 Equivalent U-factors

Even with the current proposals to lower the window U-factors, there is no indication that window U-factors will approach the U-factors of opaque walls in the near term.

The IECC must recognize and encourage the option of less glazed area as a core principle of energy efficient buildings.

Cost Impact: Will not increase the cost of construction
This proposal makes modifications to Table R405.5.2(1) which establishes criteria for how proposed residential designs will be analyzed to determine energy efficiency. The proposal does not increase or change the standard reference glazing area of 15% of conditioned floor area. If it did, it could result in higher construction costs. Instead it merely recognizes that a proposed glazing area that is less than 15% of conditioned floor area, results in additional energy savings. This is in keeping with a true performance path approach and as such will not increase the cost of construction.

RE146-16 :
TABLE R405.5.2-
KOSITZKY12442

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The proposal re-establishes a level playing field for fenestration. If the building uses less windows, there is a credit. If more windows are used, there is a penalty. This lowers the costs for less expensive buildings as they will have fewer windows. This will make housing more affordable.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz) requests Disapprove.

Commenter's Reason: The RE146 proposal is flawed and should be disapproved. It does not create a level playing field for the consumer and will result in a net loss of energy savings and higher long-term costs for a large portion of the future housing stock. In many locations, housing data indicates typical fenestration areas in the range of 10 to 12 percent. By placing the trade-off benchmark at 15 percent, this proposal sets up a non-neutral energy efficiency trade-off that, in reality, will tend to decrease energy efficiency and increase energy bills for homes with typical amounts of fenestration. Therefore, this proposal is not in the best interest of consumers and contradicts the energy conservation purpose of the code. The current approach in the code is justified and working well.

Proponent : Thomas Culp, representing the Glazing Industry Code Committee and Aluminum Extruders Council (culp@birchpointconsulting.com) requests Disapprove.

Commenter's Reason: Windows play a key role in the home environment and are important for egress, ventilation, lighting, and view in addition to energy efficiency. What is important is having high performance windows, more so than limiting the amount of glazing. A previous study from Pacific Northwest National Laboratory shows that window area is naturally limited at reasonable levels, as a result of consumer demand, economics, and wall bracing requirements. (Z.T. Taylor, C.C. Conner, R.G. Lucas, "Eliminating Window-Area Restrictions in the IECC", PNNL-SA-35432, Pacific Northwest National Laboratory, 2001.) RE145 is a better approach, treating window area neutrally in the performance path. This lets the design, economics, and consumer dictate the appropriate window area, and focuses on having better windows to gain credit in the performance path. In contrast, RE146 would give free credit for homes that are already under 15% window area, and would encourage reduced window area which would adversely harm the environmental quality for the occupants. We ask for your Disapproval of RE146.

Bibliography: Z.T. Taylor, C.C. Conner, R.G. Lucas, "Eliminating Window-Area Restrictions in the IECC", PNNL-SA-35432, Pacific Northwest National Laboratory, 2001.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com) requests Disapprove.

Commenter's Reason: This proposal should be disapproved because it will rollback a well-established code requirement in the IECC and most state codes, which would result in reduced energy efficiency in homes with less than 15% fenestration area that comply with the code under the performance path. Specifically, by establishing a fixed 15% fenestration area (window to floor area) in the standard reference design, homes with less than 15% glazing in the actual design would be able to reduce (trade off) the efficiency measures in the rest of the home with the automatic free credit created by the difference in efficiency between the less efficient fenestration and more efficient opaque wall requirements.
The result of this proposal will be a net reduction in energy efficiency, as compared to the performance compliance path applied in nearly every state in the country. Specifically, we estimate a reduction in energy efficiency of 1.4% for a home with 12% glazing and 3.1% for a home with 10% glazing, on a national average basis. The following table summarizes the potential efficiency losses by climate zone:

Potential Efficiency Losses if Standard Reference Design Fenestration Assumption is Fixed at 15%

CZ	Proposed Design: 12% WFA	Proposed Design: 10% WFA
1	-1.0%	-3.7%
2	-0.8%	-2.8%
3	-1.4%	-3.1%
4	-1.6%	-3.2%
5	-1.6%	-3.0%
6	-2.3%	-3.9%

7	-2.4%	-4.1%
8	-3.9%	-6.2%
Nat'l Avg	-1.4%	-3.1%

To be clear, this proposal is not "energy neutral," but rather an "energy efficiency negative" loophole for homes built with less than 15% fenestration area. Under the 2015 IECC performance path methodology, a proposed design with 12% fenestration would be compared to a standard reference design with 12% fenestration – in other words the method would compare designs with the same area. However, under proposal RE146, the standard reference design would remain at 15%, even if the proposed design included only 12% window area, permitting code users to reduce the efficiency of the fenestration, opaque envelope, or other measures without undertaking any offsetting improvement in efficiency.

The amount of fenestration specified for most buildings is likely to be driven by a variety of factors unrelated to energy efficiency, including design or cost considerations. We have seen no evidence that fenestration area is driven, to any significant degree, by energy efficiency in general, much less in order to obtain trade-off credit under the code. For multifamily or attached housing in particular, fenestration area will likely be limited by the location of the unit in the building or row, the orientation, or other factors. To set the fenestration area assumption at a fixed 15% for these homes creates a significant free ridership "credit" for low glazing area, even where a low glazing area would have existed anyway and higher glazing area would have been impractical or impossible.

The Committee reasoning points to lowering costs for certain buildings. However, in any discussion of costs, it is important to consider not only first costs, but the ongoing costs of maintaining inefficient buildings. And while the proposal may reduce first costs, it will result in far more wasted energy (and higher costs) over the lifetime of the home. Maintaining a reasonable level of efficiency in buildings with lower fenestration area percentages is especially important. Examples of homes with lower fenestration area include townhouses, condos, multifamily buildings, or low-income housing. Weaker thermal envelopes in homes that may be targeted to low-income populations could have an even bigger negative impact on the ability of owners or renters to pay monthly energy bills.

Proposals to set fenestration area at a fixed percentage like this have failed multiple times at the ICC in many previous cycles. In fact, the current dynamic approach to setting fenestration area in the performance path has been successfully applied since the 2006 edition of the IECC, and has been adopted by nearly every state that has adopted the IECC.

A vote for disapproval will save energy by maintaining the current approach to fenestration area in the performance path and will help ensure reasonable energy performance in homes with below-average fenestration area.

Proponent : Julie Ruth, representing American Architectural Manufacturers Association (julruth@aol.com) requests Disapprove.

Commenter's Reason: Approval of RE146 creates a scenario that permits the reduction of insulation in the building envelope by reducing the amount of fenestration provided. It does not take into consideration potential benefits of fenestration in the energy efficiency equation by providing daylighting and ventilation of the home.
Calculating the anticipated energy usage of any building - whether commercial or residential - is complex. Consideration must be given to heat loss, heat gain, lighting and ventilation.

According to the U.S. Department of Energy, at the present time lighting load is only considered to be about 5% of the total energy cost for a home. The energy usage pattern for homes is considered to be different than that for commercial buildings because homes are typically occupied more during nighttime hours than commercial buildings. The lighting load, however, really only applies during those hours that the home is occupied, and the occupants are awake. Little to no lighting load occurs while the occupants of the home are sleeping. Lighting is also typically not needed during daytime hours because of the presence of windows and skylights throughout the home that bring in free lighting.

Depending upon the location of the home and the time of year, the lighting load therefore primarily applies to that energy needed to light a home for approximately 3 hours a day. If sufficient windows and skylights are not provided to light the home during daylight hours it may be neseccary to light the home using artificial lighting for up to 16 hours a day rather than just 3. This could result in the lighting load increasing by a factor of 5 or more (16/3 = 5.33 hours).

Proponent : Jeremiah Williams, representing U.S. Department of Energy (jeremiah.williams@ee.doe.gov) requests Disapprove.

Commenter's Reason: The proposal deletes any specification of vertical fenestration area in the Standard Reference Design, leaving the proper input value against which the Proposed Design must be compared unstated. This ambiguity will make the Simulated Performance Alternative confusing and/or unenforceable.

RE146-16

RE153-16

R202 (IRC N1101.6) (New), Table R405.5.2 (IRC Table N1105.5.2)

Proposed Change as Submitted

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) GRID-INTERACTIVE ELECTRIC STORAGE SYSTEMS (GETS) An energy storage system that provides electric system grid operators such as utilities, independent servce operators (ISOs), or regional transmission organizations (RTOs) with variable control of a building's space and water heating end uses to assist in the real-time balancing of energy supply and demand on the electric grid and integration of renewable energy from solar and wind while providing low cost space and water heat for consumers.

Revise as follows:

TABLE ~~R405.5.2~~ R405.5.2(1) [N1105.5.2(1)] (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed
Service water heatingd, [e, f, g]	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa). **Exception:** Where the proposed design is for an electric heating system that is grid-interactive electric thermal storage (GETS), the standard reference design shall be as proposed.	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2 , 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2 , 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official* , testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals* , or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_S \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

Reason: Grid-Interactive ELectric Thermal Storage is an innovative approach to space and water heating with a growing reputation among market participants as a solution to some of today's most pressing energy issues.

1. Building owners like GETS because it provides affordable and dependable space and service water heating for their structurs.

2. Electric grid operators like GETS because it helps them balance energy supply and demand in real time, thereby increasing grid stability while simultaneously reducing costs, energy and emissions. Maintaining grid stability becomes more challenging as the output of renewable energy generation (like wind and solar) is added to electric grids which explains why grid operators across the country (as well as the Federal Energy Regulatory Commission and the U.S. Department of Energy) have expressed their support for energy storage.

3. Renewable energy developers like GETS because it complements their products by providing cost-effective energy storage when renewable energy production exceeds demand. Without adequate energy storage, these projects are often curtailed.

Cost Impact: Will not increase the cost of construction
This proposal does not require the purchase of any additional materials and or the expenditure of any additional labor, accordingly, it will have no impact on the cost of construction.

RE153-16 :
TABLE R405.5.2-
WILLIAMS11640

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The added table information does not appear to be in the correct row of the table.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R405.5.2(1) [N1105.5.2(1)] (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.Capacity: sized in accordance with Section R403.7 <u>**Exception:** Where the proposed design is for an electric hearing system that is grid-interactive electric thermal storage (GETS), the standard reference design shall be as proposed.</u>	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed

Service water heatingd, e, f, g	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa). **Exception:** Where the proposed design is for an electric heating system that is grid-interactive electric thermal storage (GETS), the standard reference design shall be as proposed.	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2 , 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2 , 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official* , testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals* , or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_S \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

Commenter's Reason:

Reason: The committee was prepared to vote on a motion to approve this proposal at the CAH in April when the proponent discovered that the proposed language was in the wrong cell of the table at which point the proponent asked that the proposal be denied to allow the proponent time to correct the error during the public comment period.

RE153-16

RE154-16

Table R405.5.2(1) [IRC Table N1105.5.2(1)]

Proposed Change as Submitted

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2015 International Energy Conservation Code

Revise as follows:

TABLE R405.5.2 [N1105.5.5(1)] (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case:Annual vent fan energy use:kWh/yr = 0.03942 × *CFA* + 29.565 × (N_{br} +1)where:*CFA* = conditioned floor areaN_{br} = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 × *CFA* + 4104 × N_{br} (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[c] but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems[d, e]	As proposed for other than electric heating without a heat pump, where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting ~~the requirements of Section C403 of the IECC-Commercial Provisions.~~the minimum efficency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7), C403.2.3(8) and C403.2.3(9), as applicable, when tested and rated in accordance with the applicable test procedure. Where the proposed design is for an electric heating system that does not use a duct system, the standard reference design shall be as proposed. Capacity: sized in accordance with Section R403.7	As proposed
Cooling systems[d, f]	As proposed Capacity: sized in accordance with Section R403.7.	As proposed
Service water heatingd, [e, f, g]	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	Duct insulation: From Section R403.2.1A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditionedfloor* area at a pressure of differential of 0.1 inches w.g. (25 Pa).	As tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.
b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.
h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_S \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

Reason: As it is written, Table R405.5.2(1) requires a modeler to assume a heat pump system whenever a designer proposes to use "... other than electric heating without a heat pump," i.e., electric resistance or electric radiant heating (collectively "ERH") in a new residence. While perhaps serving a valuable function in some fashion (elimination of gaming where a modeler assumes an electric furnace for the reference house and then proposes a heat pump allowing a less stringent envelope), the limitation on use of ERH in the modeling is overly restrictive. ERH is available in many different applications and the performance characteristics of non-ducted ERH are very different from the performance characteristics of ducted heating systems, whether fueled by electricity, gas, or any other fuel. In addition to no duct energy losses, non-ducted ERH also enjoys significant energy savings from zoning. This proposal attempts to preserve the benefit of eliminating gaming while still recognizing the energy savings potential of non-ducted ERH. In addition, this proposal cites the heat pump specific provisions of the IECC commercial provisions rather than simply citing the commercial chapter.

DYNICE-Put Attachement HERE.

Cost Impact: Will not increase the cost of construction
This proposal does not require the purchase of any additional materials and or the expenditure of any additional labor, accordingly, it will have no impact on the cost of construction.

**RE154-16 :
TABLE R405.5.2-
WILLIAMS11641**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed language is confusing. It is hard to understand what is being accomplished and what effect it has.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Marilyn Williams, NEMA, representing National Electrical Manufacturers Association (mar_williams@nema.org) requests Approve as Submitted.

Commenter's Reason:
Reason: Table R405.5.2(1) requires a modeler to assume a heat pump system whenever a designer proposes to use "... other than electric heating without a heat pump," i.e., electric resistance or electric radiant heating (collectively "ERH") in a new residence. This limitation on use of ERH in the modeling is overly restrictive. ERH is available in many different types and configurations and the performance characteristics of non-ducted ERH are very different from the performance characteristics of ducted heating systems, whether fueled by electricity, gas, or any other fuel. In addition to no duct energy losses, non-ducted ERH also enjoys significant energy savings from zoning. This proposal attempts to recognize the energy savings potential of non-ducted ERH. In addition, this proposal cites the heat pump specific provisions of the IECC commercial provisions rather than simply citing the commercial chapter.

RE154-16

RE156-16
R406.2 (IRC N1106.2)

Proposed Change as Submitted

Proponent : Craig Drumheller (CDrumheller@nahb.org)

2015 International Energy Conservation Code

Revise as follows:

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as "mandatory" and Section R40.5.3 be met. The proposed total building thermal envelope UA which is sum of U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. Supply and return ducts not completely inside the building thermal envelope shall be ~~greater~~ insulated to a R-value of not less than ~~or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009~~ ~~*International Energy Conservation Code*~~R-6.

- ~~**Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.~~

$UA_{proposed\ design} <= 1.15 * UA_{prescriptive\ reference\ design}$ **Equation 4-1**

Reason: This proposal increases the flexibility of the thermal envelope minimums that are part of the new ERI compliance path mandatory requirements in the 2015 IECC. The minimum thermal envelope requirements are that of the 2009 IECC prescriptive table. While this could be considered a reasonable "backstop", the flexibility it offers is minimal; for example both the 2009 and 2012 IECC require R-20 walls in climate zone 5 and because the 2009 IECC is the minimum, there is no ability to trade off wall insulation in climate zone 5, but wall insulation can be traded of in zones 4 and 6 since the wall insulation requirements increased from the 2009 to the 2012.
This proposal preserves this "reasonable envelope" concept and applies it to the ERI, but, rather than pointing to the prescriptive tables in a previous version of the IECC, the thermal backstop becomes a percent UA trade-off. The UA calculation will be performed internally with the compliance software and will not require any additional information to be entered as all the necessary information is already entered (component area and U-factors/R-values). This should not be problematic as it is already done for windows.

The proposed UA trade-off of 15% should be considered a reasonable envelope backstop and is on par with the assumption that the 2012 IECC is roughly 15% more efficient than the 2009 IECC. This 15% will prevent installing single pane windows and significant reductions in the building envelope components (e.g. going from R20+5 walls to R-13).

Cost Impact: Will not increase the cost of construction
The increased flexibility offered by this proposal will provide an opportunity for builders and designers to cost optimize an efficient home and potentially reduce the cost of construction.

**RE156-16 :
R406.2-
DRUMHELLER13004**

Public Hearing Results

Committee Action: **Approved as Modified**

Modification:

Revise as follows:

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as â€˜mandatoryâ€™ and Section R40.5.3 be met. The proposed total building thermal envelope UA which is sum of U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 1 through 3 shall be 0.40. Supply and return ducts not completely inside the building thermal envelope shall be insulated to a R-value of not less than R-6.

$UA_{\text{proposed design}} <= 1.15 * UA_{\text{prescriptive reference design}}$ **Equation 4-1**

Committee Reason: The modification is necessary because the solar heat gain coefficient was not addressed in original proposal. The solar heat gain coefficient also needs to be limited when using the ERI method of compliance.

The proposal eliminates the reference to an older edition (2009) of the IECC for the determination of the "backstops" (the lowest allowable building thermal envelope efficiency and the greatest allowable solar heat gain coefficient) when designing buildings using the energy rating index (a "tradeoff" design method for achieving compliance with the IECC) so that Section R406 is much easier to understand and apply.

Assembly Motion: **Disapprove**
Online Vote Results: **Successful**
Support: 50.19% (133) Oppose: 49.81% (132)
Assembly Action: **Disapproved**

Individual Consideration Agenda

Public Comment 1:

Proponent : Charlie Haack, ICF International, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as â€˜mandatoryâ€™ and Section R40.5.3 be met. The proposed total building thermal envelope UA which is sum of U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by ~~1.15~~ 1.05 in accordance with Equation 4-1. Supply and return ducts not completely inside the building thermal envelope shall be insulated to a R-value of not less than R-6. The area-weighted maximum fenestration SHGC permitted in Climate Zones 1 through 3 shall be 0.30.

$UA_{\text{proposed design}} <= \cancel{1.15}\ \underline{1.05} * UA_{\text{prescriptive reference design}}$ **Equation 4-1**

Commenter's Reason: RE156 replaces the current ERI backstop, which is based on the 2009 IECC prescriptive path, with a UA-based backstop. However, in doing so, RE156 significantly rolls back and weakens the code. This modification will fix some of the major problems created by the RE156 proposal and it would improve efficiency.
Specifically, this public comment further modifies the proposal recommended for approval by the committee by making the proposal more closely match the level of efficiency required by the current code -- by using a 1.05 UA multiplier rather than a 1.15 UA multiplier and by retaining the current 0.30 SHGC requirement (from the 2009 IECC).

We prefer strengthening the current backstop, or at least leaving it as is. After all, every state that has adopted the ERI as part of the 2015 IECC has adopted the 2009 IECC-based backstop with no amendment. However, if a UA-based option is preferred, we recommend the modification proposed in this public comment. It would apply the same level of SHGC stringency as the current code, and it would still permit a 5% higher UA than the base code requires.

Without this modification, we recommend disapproval of RE156.

Public Comment 2:

Proponent : Bridget Herring, representing Mathis Consulting Company (bridget@mathisconsulting.com) requests Approve as Modified by this Public Comment.

Further Modify as Follows:

2015 International Energy Conservation Code

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections

R401 through R404 labeled as â€˜mandatoryâ€™ and Section R40.5.3 be met. The proposed total building thermal envelope UA which is sum of U-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by ~~1.15~~ 1.05 in accordance with Equation 4-1. Supply and return ducts not completely inside the building thermal envelope shall be insulated to a R-value of not less than R-6.

$UA_{\text{proposed design}} <= \cancel{1.15}\ \underline{1.05} * UA_{\text{prescriptive reference design}}$ **Equation 4-1**

Commenter's Reason: A 15% loss of long-lived envelope efficiency measures is an excessive trade-off allowance for unverified equipment performance. If some flexibility is desired, a 5% trade is more appropriate.

Proponent : Craig Drumheller, representing National Association of Home Builders (CDrumheller@nahb.org) requests Approve as Modified by Committee.

Commenter's Reason: NAHB encourages support of the committee action of As Modified on RE156-16. This proposal is critical in making the Energy Rating Index (Section 406) usable. This proposal is truly energy neutral as the performance levels and ERI targets do not change. The proposal creates a flexible backstop to insure a reasonable thermal envelope and provides the ability to trade-off envelope components that have not changed since the 2009 edition of the IECC.

Proponent : Richelle McMurtry, HBA of Metro Denver, representing Home Builders Association of Metro Denver (rmcmurtry@hbadenver.com) requests Approve as Modified by Committee.

Commenter's Reason: Colorado builders and energy raters support the flexibility to use 15% ERI savings as a credible method of achieving total UA, rather than as a minimum requirement. Both tools are necessary, but proper application of one over the other varies across regions and climates. In rural areas, this would support the ability of builders to meet energy code compliance as intended. During the Louisville hearings, there was a concern that this proposal would compromise the minimum quality of a home; however, it is more cost effective to build a better home. For example, R19 is cheaper than R15 insulation and substandard windows aren't available in major stores or from suppliers. This is a sensible code and the HBA of Metro Denver supports proposal RE156 as modified by the Committee.

Proponent : Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project; William Fay, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: This proposal should be disapproved because it will result in a less efficient building envelope in homes built to the Energy Rating Index, leading to less occupant comfort and higher energy bills over the expected lifetime of these homes. This rollback is also unnecessary; we have seen no evidence in the states that this backstop presents a problem. Indeed, every state that has adopted the ERI as part of the 2015 IECC has adopted Section R406.2 with no amendments. In many climate zones, RE156 weakens the ERI backstop to levels below the requirements of the 2009 IECC, which could create real problems for states working to demonstrate 90% compliance with the 2009 IECC under ARRA, or for builders who must show compliance with the 2009 IECC in order to qualify the home for a federally-insured mortgage.
RE156 is a step backward in energy efficiency:

- **Envelope Efficiency** - RE156 introduces the potential for significant trade-offs among individual envelope components below 2009 IECC prescriptive levels. Section R406.2 currently applies uniform requirements for each building component based on the 2009 IECC requirements. However, RE156 would allow trade-offs among these components, which could lead to drastic losses in comfort or efficiency on an individual component basis. For example, it could allow significantly reduced wall insulation or much less efficient fenestration in the northern climate zones.
- **Fenestration SHGC** - RE156 also rolls back fenestration SHGC by permitting a 33% weaker fenestration SHGC for climate zones 1-3 (by moving the SHGC value from 0.30 to 0.40), as compared to the current requirements, with no justification. At a time when utilities are struggling to meet summer electrical peak demands caused, in large part, by growing residential air conditioner use, allowing a *higher* average SHGC in the ERI is inexplicable.
- **Significant Impact in Some Climate Zones** – The impact of moving from a 2009 IECC-based backstop to the proposed 115% of UA-based backstop will vary widely by climate zone, resulting in thermal envelopes far weaker than the 2009 IECC in some climate zones. This trade-off is also less stringent than the current backstop of the 2009 IECC overall. Specifically:
    - For CZs 5 & 4C, the proposal permits insulation levels even below the 2006 IECC

- For CZs 2, 6, & 7, the proposal permits insulation levels close to the 2006 IECC.

The proponent has provided no justification for why building thermal envelopes in new homes should be permitted to be less efficient in the 2018 IECC than in the 2015 IECC – or the 2009 IECC, for that matter. RE156 should be <u>disapproved</u>.

Proponent : Assembly Motion requests Disapprove.

Commenter's Reason: This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly motion. The assembly action for Disapprove was Successful by a vote of 50.19% (133) to 49.81% (132) by eligible members online during the period of May 11 - May 26, 2016.

RE156-16

RE159-16
R406.2 (IRC N1106.2)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as "mandatory" and Section ~~R403.5.3~~ R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009 *International Energy Conservation Code*. Computer software used to calculate the ERI shall incorporate the requirements of this section such that the ERI will only be calculated by the software when these requirements are also met. The compliance report required under section R406.6.2 shall list the requirements of this section for each building component and show that they have been met.

- **Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

Reason: The purpose of this code change proposal is to provide additional clarity and direction to software makers about how to incorporate the mandatory backstop provisions of the Energy Rating Index into compliance software programs. Although mandatory provisions and backstops have been a part of the International Codes for many years, software designed for voluntary or "above-code" programs (such as HERS rating software) may not address mandatory items or treat them with the appropriate level of importance. Code officials understand very well that when a provision is listed as "mandatory," the building simply cannot achieve compliance without meeting that provision. Now that more and more code users are turning to software and rating professionals (who often use software) for code compliance, it is important to provide additional details for software developers as to how to incorporate these important provisions.
This proposal will improve code enforcement by providing a list of applicable mandatory measures and show whether the requirements have been met. Because the requirements of R406.2 are mandatory, software used to calculate the ERI should only produce an ERI for compliance when the mandatory criteria are met. This will avoid confusion and increase compliance with the mandatory measures.

Cost Impact: Will not increase the cost of construction
This code change proposal will not increase the cost of construction. It clarifies how compliance software developers must incorporate the mandatory provisions of the Energy Rating Index into the IECC.

RE159-16 :
R406.2-FAY12419

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed language is clumsy and in the wrong place. The code has Sections R406.6.1, R406.6.2 and R406.7 concerning software so if there needs to be something that the software needs to be doing, it needs to be in those sections.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing

Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: This proposal should be approved as submitted because it provides specific information to software providers about how to deal with the IECC's mandatory requirements, increasing the likelihood of compliance with these mandatory requirements. Some green or "above code" standards do not include mandatory requirements, so it is important to signal to software providers who may not have a history of providing code compliance software that certain elements of the code must be met, irrespective of trade-offs.

The Committee reasoning on RE159 does not suggest that the additional clarification provided by this language is unnecessary, but simply suggests that the proposed clarification about compliance software would be better located within a section outlining software requirements. As the Committee correctly noted, the software requirements are spread out throughout at least three ERI sections. We believe it makes more sense to locate the language next to the actual requirement that it implements.

RE159 does not alter the requirements of the code, but provides key instructions to compliance software developers about how to implement mandatory code requirements. Approval as submitted of RE159 will lead to better compliance, and ultimately to more efficiency.

RE159-16

RE161-16

R406.2 (IRC N1106.2), R406.3 (IRC N1106.3), R406.5 (IRC N1106.5), R406.6.2 (IRC N1105.6.2), R406.7.1 (IRC N1106.6.2)

Proposed Change as Submitted

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2015 International Energy Conservation Code

Revise as follows:

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Sections ~~R401 through R404 labeled as "mandatory"~~ R401.2 and ~~Section R40.5.3~~ the prescriptive provisions of R403.5.3 be met. The building thermal envelope efficiency shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009 *International Energy Conservation Code*.

> **Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that ~~uses~~ consumes no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the ~~rated design~~ *rated design* relative to the total energy use of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*.

R406.5 (N1106.5) Verification by approved ~~agency~~ entity. *No change to text.*

R406.6.2 (N1106.6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other form of identification of the residential building or buildings.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool used.

> **Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.7.1 (N1106.7.1) Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:

1. ~~Computer generation~~ Generation of the *ERI reference design* using only the input for the *rated design*.The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.
2. Calculation of whole building, as a single *zone* or dual *zone*, sizing for the heating and cooling equipment in the *ERI reference design* residence in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ~~ratios~~ efficiency and equipment operation on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed *code official* inspection checklist listing each of the *rated design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

Reason: This proposal suggests editorial improvements to this section.

For Section 406.2, the proposal makes an editorial correction for Section R.403.5.3, which only has prescriptive provisions).

For Section 406.3, the changes are editorial, changing the word "uses" to "consumes" and italicizing the phrase "rated design".

For Section 406.5, the editorial change is to account for the fact that an approved third party may not be a government agency.

For Section 406.6.2, there are editorial changes to clarify the section and to account for multiple building projects.

For Section 406.7.1, there are editorial changes for clarification and to account for the situations where homes (larger homes in particular) will install dual zone systems in the ERI reference design.

Cost Impact: Will not increase the cost of construction

This changes are editorial in nature or modify the minimum capabilities of software used for simulations, and will not have an impact on the cost of construction. They do not make any changes to the energy efficiency requirements of the section.

RE161-16 : R406.2-ROSENSTOCK11913

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposed revisions are unnecessary wordsmithing.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.2 (N1106.2) Mandatory requirements. Compliance with this section requires that the ~~mandatory~~ provisions identified in Sections ~~R401.2~~ R401 through R404 labeled as 'mandatory' and the prescriptive provisions of Section R403.5.3 be met. The building thermal envelope efficiency shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009 *International Energy Conservation Code*.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that consumes no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the *rated design* relative to the total energy use of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*.

R406.5 (N1106.5) Verification by approved entity. Verification of compliance with Section R406 shall be completed by an *approved* third party.

R406.6.2 (N1106.6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other form of identification of the residential building or buildings.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool used.

- **Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.7.1 (N1106.7.1) Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:

1. Generation of the *ERI reference design* using only the input for the *rated design*. The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.
2. Calculation of whole building, as a single *zone* or dual *zone*, sizing for the heating and cooling equipment in the *ERI reference design* residence in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load efficiency and equipment operation on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed *code official* inspection checklist listing each of the *rated design* component characteristics determined by the

analysis to provide compliance, along with their respective performance ratings.

Commenter's Reason: The proposed changes provide needed clarification to this section, and allows the modeling of dual zone systems, which are common in larger homes.

RE161-16

RE162-16

R406.2 (IRC N1106.2), R406.4 (IRC N1106.4)

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

R406.2 **(N1106.2)** **Mandatory requirements.** Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as "mandatory" and Section R40.5.3 be met. ~~The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009 *International Energy Conservation Code*.~~

- **Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.4 (N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4, before solar is added to the calculation, when compared to the *ERI reference design*.

Reason: This proposal sets out to accomplish two things:

1. Remove the 2009 insulation level back stop to allow greater flexibility and trade off to seek cost effective means to achieve required code compliance ERI scores as desired by Builders.
2. Ensure that with flexibility and trade off possibilities that sound building envelopes continue to be maintained by not allowing solar to drive a home's ability to meet the required code compliance ERI score. In this way the required ERI score itself will act as the back stop for those concerned about poor energy performance while promoting flexibility in tradeoffs and cost effective design and implementation.

Cost Impact: Will not increase the cost of construction
This proposal should allow more flexibility while either not impacting cost or potentially reducing cost by allowing for more cost effective design and tradeoffs.

RE162-16 : R406.2-SCHWARZ12450

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This proposal is inconsistent with the Committee's prior actions to create an updated backstop. The proposal also references just solar and not other renewables.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.4 (N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4, before solar ~~is~~ or other renewables are added to the calculation, when compared to the *ERI reference design*.

Commenter's Reason: Per the committee's suggestion I have added the language "before solar or other renewables are added to the calculation."

The committee action to approve an updated backstop in RE156 does not negate the merit of other proposals. The entire point of the ERI path is that the ERI score quantifies the energy performance of the building. It therefore can be eloquently used itself as the back stop if the requirement solar and other renewables that swing the ERI score so greatly is taken out of the equation for demonstrating code compliance. In this way jurisdiction who are already amending the ERI score requirements in their specific jurisdiction, have the ability to determine what level of energy performance they deem best for their constituency. What this also does is ensure that consumers are getting solid thermal envelopes that make their homes comfortable and efficient.

I have demonstrated that a home can score 100 on the ERI scale which is equivalent to the 2006 IECC. If just over 6 KW of photovoltaics are added to the home the score would go to 55, compliant in climate zone 5. This home would not be comfortable or cost effective for the consumer to own as it is approximately 31% less efficient than the 2015 IECC. The homebuyer would be able to offset their electrical use with the PV panel but most homes are still heating with gas so they would have to pay additional money to heat and water heating the home over what it would cost for a 2015 IECC home. Only when you take the home to an ERI score of zero would the PV system full offset heating and water heating.

RE156 and others that may deal with the back stop issue are simply too complicated. This proposal simply provides a back stop utilizing the ERI score to ensure that the energy code provides a solid efficient Building Thermal Envelope that will be able to manage the effective use and conservation of energy over the useful life of each building. The only way it works calculate the code compliant ERI score without solar or other renewables added to the equation. Renewables simply swing the score too dramatically which can sacrifice thermal envelope efficiencies, durability, comfort and more. ERI software engineers are already producing reports for other programs that report the score with and without renewables so it is not an issue to report this way for ERI compliance if a home were to have a renewable system installed.

RE162-16

RE163-16

R406.3 (IRC N1106.3), R406.3.1 (New) [IRC N1106.3.1 (New)], Table R406.3 (New) [IRC Table N1106.3 (New)], R406.3.1 (IRC N1106.3.1), R406.4 (IRC N1106.4), R406.6.2 (IRC N1106.2), R406.6.3 (IRC N1106.3), R406.7 (IRC N1106.7), R406.7.1 (IRC N1106.7.1)

Proposed Change as Submitted

Proponent : Ben Edwards, representing self

2015 International Energy Conservation Code

Revise as follows:

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total annual energy ~~use~~ cost of the rated design relative to the total annual energy ~~use~~ cost of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*.

Add new text as follows:

R406.3.1 (N1106.3) ERI calculation. Equations 4-1, 4-2 and 4-3 shall be used to calculate the ERI for the proposed design:

$ERI = PEC / REC * 100$ **(Equation 4-1)**

where:

PEC = Total Energy Cost of the proposed design =

$\Sigma(TEU * ECF)$ **(Equation 4-2)**

REC = Total Energy Cost of the ERI reference design =

$\Sigma(RTEU * ECF)$ **(Equation 4-3)**

where:

TEU = Total site energy use for each energy form of the proposed design

RTEU = Total site energy use for each energy form of the reference design

ECF = Energy cost factor for each energy form based on energy prices in the jurisdiction and established by the code official. Such established ECF values shall be inserted into Table R406.3 at the time of adoption by the authority having jurisdiction and shall be updated on a schedule determined by that same authority.

TABLE R406.3 (N1106.3)
ENERGY COST FACTORS BY ENERGY FORM

Form of Energy	Energy Cost Factor (ECF)	
	US Dollars	Units for ECF
Electricity	[INSERT VALUE]	per kWh
Natural Gas	[INSERT VALUE]	per Therm
Steam	[INSERT VALUE]	per Million Btu
Hot Water	[INSERT VALUE]	per Million Btu
Chilled Water	[INSERT VALUE]	per Million Btu
Fuel Oil	[INSERT VALUE]	per Gallon
Propane	[INSERT VALUE]	per Therm
Coal and Other	[INSERT VALUE]	per Ton

Revise as follows:

~~R406.3.1~~ R406.3.2 (N1106.3.2) ERI reference design. The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements for a *residential building* with electric heating, cooling, water heating, range, oven, and dryer.

~~The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.~~

R406.4 (N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the ~~*rated*~~ *proposed design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4 when compared to the *ERIreference design*.

R406.6.2 <u>(N1106.6.2)</u> Compliance report. Compliance software tools shall generate a report that documents that the ERI of the ~~rated~~ <u>proposed</u> *design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the ~~rated~~ <u>proposed</u> *design*. The inspection checklist shall show results for both the *ERI reference design* and the ~~rated~~ <u>proposed</u> *design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.6.3 <u>(N1106.6.3)</u> Additional documentation. The *code official* shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *ERI reference design*.
2. A certification signed by the builder providing the building component characteristics of the ~~rated~~ <u>proposed</u> *design.*
3. Documentation of the actual values used in the software calculations for the ~~rated~~ <u>proposed</u> *design*.

R406.7 <u>(N1106.7)</u> Calculation software tools. *No change to text.*

R406.7.1 <u>(N1106.7.1)</u> Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:

1. Computer generation of the *ERI reference design* using only the input for the ~~rated~~ <u>proposed</u> *design*.The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.
2. Calculation of whole building, as a single *zone*, sizing for the heating and cooling equipment in the *ERI reference design* ~~residence~~ in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed *code official* inspection checklist listing each of the ~~rated~~ <u>proposed</u> *design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

Reason: This proposed revision focuses on three important changes in the code landscape: energy costs, a single reference building, and existing code terminology.
If approved, the ERI compliance path would evaluate energy costs rather than the normalized modified end use loads (nMEUL) method currently used in this section. People understand cost not nMEUL. Consider the difference in explaining $0.13/kWh versus the "b" normalization coefficient in nMEUL. Cost works.

Builders, home buyers, mortgage companies, and policymakers responsible for residential building performance decisions understand costs. Other rating metrics, no matter how well intentioned, fail because home-buying and -financing decisions are based on costs: mortgage, energy, operation, insurance, etc. This proposal leverages readily available local, state, or national energy costs, as determined by the adopting authority, and recognizes that building energy conservation decisions are local.

A single reference building is necessary because a floating baseline perverts decisions, creating waste as designs adapt to artificial inequalities.. The marketplace demands cost optimization, and that can be done only when there is a stable benchmark.

Finally, and simply, the terminology has been changed to reflect that which already exists in the code.

Note: No changes are proposed to the efficiency levels defined by the code, just the means of determining the Energy Rating Index.

Cost Impact: Will not increase the cost of construction
This proposal does not change the the minimum efficiency levels defined by the code, and therefore does not affect construction cost. It, however, does allow greater design flexibility by optimizing to cost rather than an abstract end use loads method. Because of the increased flexibility and the focus on a cost baseline, this proposal has the potential to *reduce* construction costs. Builders using this section already will have retained a home energy rater or other professional engaged in building performance modeling to determine ERI for code compliance. That professional simply will multiply the modeled energy use for the proposed design by the local energy costs to determine code compliance. Approved software already has the ability to automate this step.

RE163-16 :

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Energy cost is variable, a moving target. It ignores the cost of what it takes get the energy to me (the consumer). Where the energy come from or how the energy is produced is not an appropriate basis for an energy rating index. Let the RESNET 301 standard committee work out those details.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.3.2 (N1106.3.2) ERI reference design. The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements~~ for a *residential building* with electric heating, cooling, water heating, range, oven, and dryer~~.

Commenter's Reason: This public comment supports the use of cost as a compliance metric for the IECC. Cost is a well known metric and is used by other codes and standards including ASHRAE Std. 90.1.
This public comment also removes the language establishing an electric baseline.

The proponent's approach will lead to gaming and a weakening of the standard. Cross fuel comparisons should not be permitted.

Public Comment 2:

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R406.3 (N1106.3)
ENERGY COST FACTORS BY ENERGY FORM

Form of Energy	Energy Cost Factor (ECF)	
	US Dollars	Units for ECF
Electricity	[INSERT VALUE]	per kWh
Natural Gas	[INSERT VALUE]	per Therm
Steam	[INSERT VALUE]	per Million Btu
Hot Water	[INSERT VALUE]	per Million Btu
Chilled Water	[INSERT VALUE]	per Million Btu
Fuel Oil	[INSERT VALUE]	per Gallon
Propane	[INSERT VALUE]	per <u>Gallon</u>~~Therm~~
Coal and Other	[INSERT VALUE]	per Ton

R406.3.2 (N1106.3.2) ERI reference design. The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements for a *residential building* with electric heating, cooling, water heating, <u>lighting,</u> range, oven, and dryer. <u>In the *proposed design*, fuel switching shall not be allowed for space heating, water heating, cooling, cooking, or laundry equipment.</u>

Commenter's Reason: These modifications provide a technical correction to proposed new Table R406.3 and provide necessary language to prevent any "gaming" when using the energy cost for the ERI. Fuel switching does not create an "apples to apples" comparison, and can result in a significant increase in energy usage, which is contrary to the purpose of the IECC.

RE164-16

R406.3 (IRC N1106.3) , R406.4 (IRC N1106.4)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

R406.3 Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the rated design relative to the total energy use of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*<u>, and shall not consider or include the effect of any on-site power production</u>.

R406.4 ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4 when compared to the *ERI reference design* <u>without any credit for on-site power production</u>. <u>The report generated by computer software used to calculate the ERI shall demonstrate that no on-site power production has been incorporated into the ERI calculation.</u>

Reason: The purpose of this code change proposal is to clarify that the Energy Rating Index calculation does not include the impact of on-site power production, whether renewable or not. It also provides more specific guidance to software providers in order to help maintain consistency between software and code compliance on this particular issue.

The current plain language of Section R406 does not permit the inclusion of electricity/power production in ERI calculations. Consistent with the intent of the IECC outlined in Section R101.3, to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building," the language establishing the ERI in Section R406 properly focuses on energy use and loads, not the production of energy. The methodology prescribed by the ERI provisions does not mention the use of renewable energy or other on-site energy production, and these issues were not reasonably analyzed or addressed during the 2015 IECC code development process.

However, some have suggested that because popular home energy rating software does include the impact of on-site power production in the calculation of energy ratings, that the ERI should also include on-site power production. While in our view, the current code is clear, this code change proposal will address this issue head on and clarify with unequivocal language that regardless of the energy rating software used, the ERI calculation shall not include renewable or other on-site energy production. It should be noted that current software can still be used to calculate the ERI under this proposal, so long as no on-site power production is input into the calculation.

To allow unrestricted trade-offs for on-site power production could bring about several negative unintended consequences. The most significant problem would be a huge reduction in the efficiency of the home in favor of on-site power production. As an example of the potential impact, a recent report analyzed the enormous potential impact of solar photovoltaics on the HERS Index. See Residential Energy Services Network, Inc., The Impact of Photovoltaic Arrays on the HERS Index (2015), http://www.academia.edu/15036659/The_Impact_of_Photovoltaic_Arrays_on_the_HERS_Index. This report found that in most parts of the country, a 4 kW photovoltaic array could reduce a HERS Index Score by 20-40 points. Other analyses have found even larger potential reductions in the HERS Index Score. If the IECC were amended to allow direct, unlimited trade-offs between a photovoltaic system and the efficiency of the thermal envelope, it would virtually eliminate the need to incorporate efficiency measures into the home to meet the code, wiping out many years of progress in improving the energy efficiency of homes. This is fundamentally inconsistent with the scope and intent of the IECC, and it should not be permitted.

To be clear, this proposal does not take any position on the value of solar photovoltaics or other types of generation in themselves. In fact, many of the proponents and supporters of this proposal are also strong supporters of renewable energy generation, like solar. We note that sustainability-oriented and green codes such as the IgCC and ICC-700 have addressed on-site power production, along with other sustainability-oriented measures that are beyond the scope of an energy conservation code.

However, to begin allowing credit for electric generation to be considered for compliance calculations solely to replace critical energy efficiency measures in the IECC, will result in higher peak demands, less occupant comfort and substantial additional energy use given the much longer typical life of certain efficiency measures. Moreover, allowing credit for generation to be included in residential code compliance will substantially complicate the code and this compliance path. Some of the questions raised by such an approach include: (i) how to address energy sold back to the utility, (ii) treatment of the timing of the electricity production as compared to its use; (iii) whether there should be a minimum level of generation required; and (iv) how to ensure that the generation is permanent (including issues related to leasing, maintenance, equipment output over time, etc.). Finally, unlike conservation measures, generation is not integral to the building or its habitability and need not be in the purview of the building code – while generation can be attached to the building or located on the site, there is certainly no requirement that it be, unlike other building components or systems. If electric generation is to be included in the IECC – Residential Provisions, it should be included explicitly and in a controlled manner, after a full discussion and debate. Residential energy code compliance should not be extended to cover electric generation through the backdoor of the ERI.

For all these reasons, we recommend that the IECC be clarified to specifically exclude on-site power production from the ERI calculation.

Cost Impact: Will not increase the cost of construction
This code change proposal will not increase the cost of construction. It is simply a clarification of language in Section R406 that already does not permit on-site power production to be included in the Energy Rating Index calculation.

RE164-16 :
R406.3-FAY12489

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The proposal prevents the power generated by any type of onsite power generation including renewable generation (not just solar), from being included in the calculations for the ERI compliance method. The ERI method should not completely eliminate the driving force for improvements that could be made in existing technologies or the creation of new power generation technologies. Perhaps the proposal could be tweeked in some way to not ban any type of onsite generated power from being considered in the calculations. The term "onsite power production" means different things to different people and it is not clear in this proposal what is encompassed by that phrase. A definition is needed so everyone understands what "power" this proposal intends to eliminate from the calculations.

Assembly Motion: **As Submitted**
Online Vote Results: **Failed**
Support: 45.42% (114) Oppose: 54.58% (137)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change would not allow on-site power production to be used as part of the ERI calculation without limitation. The committee denied the change and a floor motion for as submitted failed 45/55%.
This proposal addresses a serious loophole currently in the ERI compliance path by removing the use of on-site power production in the ERI calculation and offers specific guidance to software providers in order to help maintain consistency between software and code compliance using this path.

The AIA believes that the code should focus on criteria for energy conservation in lieu of energy production. Increased reliance upon higher levels of passive design solutions will more than reduce energy consumption negating the need for on site-production and providing a better balance to energy needs for buildings.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve

as Submitted.

Commenter's Reason: RE164 should be approved as submitted because it will clarify that a massive energy code rollback for those who would use on-site generation to offset energy efficiency is not permitted under the IECC. Allowing solar trade-offs could easily cost 20-40 ERI points worth of energy efficiency (for a 4 kW system as calculated for RESNET and noted in the original Reason Statement), **which amounts to 36% to 73% increased energy use** (using a 55 ERI target score). This would be a huge setback to energy efficiency in residential buildings.

When the ERI was first introduced into the IECC, there was no specific proposal to include any on-site power production (such as solar PV) in the ERI calculation. Although HERS had included an option for on-site power production to be included in a final HERS rating, the scope of HERS (which had mostly been used for voluntary, above-code, tax credit or "green" program certification) is not the same as the IECC's mandatory code-compliance format. The residential IECC has never established requirements for solar or other on-site generation or recognized on-site power production as a trade-off of any type. Similarly, the new ERI compliance path in Section R406 does not reference any sort of on-site power.

Some have exploited a lack of direct reference to or specific limit on on-site power production in the ERI provisions as a sort of "green light" to count 100% of all on-site generation of all types as a reduction in energy use – a practice that clearly conflicts with the history of, and the intent of the IECC set forth in Section R101.3, to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building." To allow direct trade-offs between electric generation – whether renewable or not – and energy conservation raises a number of serious unintended consequences, many of which are detailed in the original Reason Statement by proponents.

The Committee Reason Statement misses a key point when it claims that adding such language would "completely eliminate the driving force for improvements that could be made in existing technologies or the creation of new power generation technologies:"

- First, building codes have never been the "driving force" for the development of power generation technologies. The IECC is adopted in nearly every state for residential construction, and it has never awarded credit for on-site generation in any of its compliance options.
- Second, on-site power, and particularly solar PV, has already benefitted from a range of very generous federal and state tax credits, utility incentives and favorable net metering rates, and other incentives that have driven new technologies and reduced installation costs. Proponents of on-site power trade-offs are now arguing that all of these incentives could now be used as a means of weakening building efficiency. We simply do not believe that utility ratepayer funds, tax dollars, and other incentives aimed at reducing fossil fuel use should now be used to allow builders to increase energy use in buildings served by on-site generation. And, conversely, if these trade-offs are allowed, it is highly likely that some or all of these renewable energy incentives for new homes could be eliminated by federal or state jurisdictions, and by utilities and their regulators, since these systems would no longer be producing a net reduction in conventional electricity or fuel use or a net savings to the homeowner.
- Third, power generation has been the regulatory responsibility of public service and utility regulatory commissions for over a hundred years. The International Energy Conservation Code is not the place to attempt to regulate or promote the generation of energy. There should remain a clear line between energy conservation measures that are part of creating resilient, efficient buildings, and energy generation technologies that serve other purposes.

RE164 maintains a clear distinction between the regulation of residential energy conservation (the historic mission of the IECC and Model Energy Code), and energy generation of any type. To blend these two missions together would bring unnecessary complications and would not improve energy efficiency in any way. We strongly recommend approval as submitted.

RE164-16

RE165-16

R406.3 (IRC N1106.3), R406.3.1 (IRC N1106.3.1), R406.4 (IRC N1106.4), R406.4.1 (New) [IRC N1106.1 (New)], Table R406.4.1 (New) [IRC Table N1106.1 (New)], R406.6, R406.6.1 (IRC N1106.6.1), R406.6.2 (IRC N1106.6.2), R406.7 (IRC N1106.7), R406.7.1 (IRC N1106.7.1), R406.7.2 (IRC N1106.7.2), R406.7.3 (IRC N1106.7.3)

Proposed Change as Submitted

Proponent : Vickie Lovell, InterCode Incorporated, representing Leading Builders of America (vickie@intercodeinc.com)

2015 International Energy Conservation Code

Revise as follows:

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be ~~a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100~~ determined in accordance with ANSI/RESNET/ICC 301-2014, Republished January 2016, Addendum A-2015 and ~~a *residential building* that uses no net purchased energy has an Index value of 0~~ Addendum B-2015. ~~Each integer value on the scale shall represent a 1-percent change in the total energy use of the rated design relative to the total energy use of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*.~~

Delete without substitution:

~~**R406.3.1(N1106.3.1) ERI reference design.** The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements.~~

~~The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.~~

Revise as follows:

R406.4 (N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4 ~~when compared to the *ERIreference design*~~.

TABLE R406.4 (N1106.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

Add new text as follows:

R406.4.1 (N1106.4.1) On-site power production. Where on-site power is provided, the contribution of power produced on-site to the ERI shall not exceed the percentages specified in Table R406.4.1

TABLE R406.4.1 (N1106.4.1)
Credit for On-site Power Production

ENERGY RATING INDEX (ERI) OF RATED DESIGN	% CREDIT FOR ON-SITE POWER PRODUCTION[a]
65 and above	0
64	5
63	10
62	15
61	20
60	25
59	30
58	35
57	40
56	45
55	50
54	55
53	60

52	65
51	70
50	75
49	80
48	85
47	90
46	95
45 and below	100

a. Percentage of power produced on-site applied per ERI value.

Revise as follows:

R406.5 (N1106.5) Verification by approved agency. *No change to text.*

R406.6 (N1106.6) Documentation. Documentation of the software used to determine the ERI and the parameters for the residential building shall be in accordance with Sections R406.6.1 through ~~R406.6.3~~ R406.6.5.

R406.6.1 (N1106.6.1) Compliance software tools. ~~Documentation verifying that~~ Software tools used for determining the ~~methods and accuracy of the compliance software tools conform to the provisions of this section~~ ERI shall be ~~provided to the *code official*~~Approved Software Rating Tools in accordance with ANSI/RESNET/ICC 301-2014 Republished January 2016, Addendum A-2015 and Addendum B-2015.

R406.6.2 (N1106..6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs including the percentage of power produced on-site credited to the ERI entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.6.3 (N1106.6.3) Additional documentation. The *code official* shall be permitted to require the following documents:

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

~~**R406.7.2**~~ **R406.6.4 (N1106.6.4) Specific approval.** Performance analysis tools meeting the applicable sections of Section R406 shall be *approved*. ~~Tools are permitted~~ Documentation demonstrating the approval of performance analysis tools in accordance with Section R406.6.1 shall be provided to ~~be~~ the~~*approved*~~ *code official* ~~based on meeting a specified threshold for a jurisdiction. The *code official* shall approve tools for a specified application or limited scope.~~

~~**R406.7.3**~~ **R406.6.5 (N1106.6.5) Input values.** When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from ~~an approved source~~ ANSI/RESNET/ICC 301-2014.

Delete without substitution:

~~**R406.7 (N1106.7) Calculation software tools.** Calculation software, where used, shall be in accordance with Sections R406.7.1 through R406.7.3.~~

~~**R406.7.1 (N1106.7.1) Minimum capabilities.** Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:~~

1. ~~Computer generation of the *ERI reference design* using only the input for the *rated design*.The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.~~
2. ~~Calculation of whole building, as a single *zone*, sizing for the heating and cooling equipment in the *ERI reference design* residence in accordance with Section R403.7.~~
3. ~~Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.~~
4. ~~Printed *code official* inspection checklist listing each of the *rated design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.~~

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:
ANSI/RESNET/ICC 301-2014 Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using an Energy Rating Index
First Published March 7, 2014 Republished January 2016, Addendum A-2015 and Addendum B-2015.

Reason: This proposal creates an easy to enforce method that recognizes on-site power production, but LIMITS THE CREDIT FOR POWER PRODUCED ON-SITE THAT MAY BE APPLIED TO THE CALCULATION OF THE ERI.
The CONCEPT –

The International Code Conservation Code should not be inconsistent with the federal policy (and many state statutes) that encourage national energy independence through conservation, and incentivizes the use of on-site power generation in residential buildings. This proposal creates a compliance method that is easy to enforce and a design tool that is easy to use and understand.

A method for calculating for on-site power in the ERI is not currently required anywhere in Section 406. This proposal does NOT require on-site power production to be calculated in the ERI. It only limits how much on-site power is allowed to be considered in calculating the ERI if and when the designer chooses to incorporate on-site power in the total energy use of the rated design.

The new Table 406.6.1 promotes both energy conservation and energy production. It accomplishes this by driving improvements in the building enclosure and installed mechanical systems in order to earn greater contributions from the production of on-site power while maintaining the protections of meeting the code envelope requirements and mandatory measures in the 2009 IECC.

Homes currently have to meet the mandatory building requirements of the 2009 IECC. That does not change with the implementation of the new Table 406.4.1. Compliance with the 2009 "backstop" provisions ensure that the building itself is efficient.

The METHOD –

The proposed new Table 406.4.1 starts crediting on-site power at an ERI of 64 and moves in 5% increments per integer until 100% of on-site power produced may be applied to the ERI. The percentages in Table 406.4.1 represent those 5% increments.

The value of 65 for was selected for the Table 406.4.1 because it is the AVERAGE HERS RATING of over 610,000 new homes built since 2012 as reported by RESNET.

The designer can adjust the rated design by calculating exactly what percentage of the on site power may be utilized in the rated design to achieve a code compliant ERI scores found in Table 406.4

The new Table 406.4.1 is also designed to account for ERI scores that states and local jurisdiction may adopt that are both above and below the ERI values currently listed on Table R406.4. Table 406.4 is adaptable to states and local jurisdictions that are adopting different ERI scores different from what is contained in the 2015 IECC, such as Texas that adopted an ERI score of 65. The values in Table R406.4.1 can be applied to these higher ERI scores which would limit on-site power production consistently from state to state regardless of the ERI adopted by the states. The lower values (more stringent) than the current Table R406.4 values also "future proof" the table to account for more stringent ERI scores in later versions of the IECC.

The ENFORCEMENT –

Compliance with Table 406.4.1 is easy. The code official or plan reviewer only has to review the compliance report for the ERI score that is required for the climate zone in Table 406.4. The code official or plan reviewer then needs to verify that that the percentage of on-site power cited in the compliance report is consistent with percentage listed in Table 406.4.1.There is a companion proposal to this change to require that the percentage of onsite power used in the ERI in found in the compliance report.

The CONCLUSION

Enabling new paths to achieve energy efficiency creates new opportunities for even greater innovation is part of the stated purpose of the IECC. This is yet another option, the most stringent yet flexible of all the compliance options within the IECC, for consumers and builders. Power produced on-site is gaining steadily in popularity with homeowners and can help reduce the compliance costs for builders, making homes more affordable to build and to live in.

Cost Impact: Will not increase the cost of construction
Because on-site power production is not required to achieve code compliant Energy Rating Index values and this proposal only limits the amount of on-site power produced that can be applied to reduce the ERI to achieve code compliance, there is no direct cost impact.

Cost-effectiveness: This change is cost-effective because it is expected to provide neutral or positive energy impact and builders are not required to use on-site power production to reach code compliant Energy Rating Index values

Analysis: A review of the standard(s) proposed for inclusion in the code, ANSI/RESNET/ICC 301-2014 (Republished January 2016) , with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016.

RE165-16 : R406.3-LOVELL13344

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: Consistency with Committee's prior action on RE175-16.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Lauren Urbanek, representing NRDC (lurbanek@nrdc.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.2 Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as "mandatory" and Section R40.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the ~~2009~~ 2015 *International Energy Conservation Code*.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.4.1 (N1106.4.1) On-site power production. ~~Where~~ On-site power production shall be limited to renewable on-site power production. Where power produced on-site is provided,~~,~~ the contribution of on-site power ~~produced on-site~~ that is permitted to be credited to the ERI shall not exceed the ~~percentages~~ factors specified in Table ~~R406.4.1~~ 406.4.1.

TABLE R406.4.1 (N1106.4.1)
~~Credit for On-site~~ Maximum On-Site Power Production Credit

% CREDIT FOR ON-SITE POWER PRODUCTION[a]	ERI of the Rated Design[b]
0.00	62 or higher
0.05	61
0.10	60
0.15	59
0.20	58
0.25	57
0.30	56
0.35	55
0.40	54
0.45	53
0.50	52
0.55	51
0.60	50

0.65	49
0.70	48
0.75	47
0.80	46
0.85	45
0.90	44
0.95	43
1.00	42 or lower

a. ~~Percentage~~Where on-site power is provided, ANSI/RESNET/ICC 301 Eq. 4.1-2 shall be permitted to be modified using the factors in Table R406.4.1, as follows:

Purchased Energy Fraction = [(Gross Energy Use of ~~power produced on-site applied per~~ the Home)-(On-Site Power Production*Factor from Table R406.4.1)] ÷ [Gross Energy Use of the Home]

b. ERI ~~value~~ of the rated designs in specific climate zones shall comply with Table R406.4.

R406.6.2 (N1106..6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs, including the ~~percentage~~ contribution of power produced on-site ~~credited~~ applied to the ERI, entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

- ~~**Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.~~

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

Commenter's Reason: It is reasonable to recognize the benefits of on-site renewable power production in the code and to provide a limited amount of credit to builders who choose to utilize this option for their customers. However, if RE166-16 (RESNET's proposal to reference the ANSI/RESNET/ICC 301 standard) was to be adopted without adopting any other proposal to limit on-site power production, there is the real risk that a substantial portion of the ERI score could be met with renewable generation systems, thereby undercutting the energy efficiency goals of the code. A medium-sized solar PV installation is worth approximately 35 ERI points, meaning homes could be built with fewer efficiency measures, which would result in homes that are less efficient than the 2009 code. This would create chaos for both state and local adoption levels, as this would result in a rollback of the state's code. An unlimited solar provision would also create confusion for code officials enforcing the code, as they would have little idea if the system was optimally installed.

This proposal solves those problems by limiting the credit in the ERI calculation for power produced on-site in two ways:

1. Changes the thermal envelope backstop from referencing the 2009 code to referencing the 2015 code, and

2. Puts in place maximum on-site power production credit, which is a sliding scale for the amount of ERI credit a builder can receive for including on-site power production (limited to renewable energy generation). This credit is dependent on the amount of on-site power being produced and the target ERI of the rated design.

This proposal does not require on-site power production to be calculated in the ERI. But, if the designer chooses to incorporate on-site power into the rated design, this proposal simply limits how much on-site power is allowed to be considered in calculating the ERI.

1. **Thermal Envelope Backstop**

Homes complying with the 2015 ERI path must meet building thermal envelope requirements of the 2009 IECC. That does not change for homes that do not use on-site power production to comply with the 2018 ERI pathway. However, homes that *do* use on-site power production to comply with the ERI pathway must meet the building thermal envelope requirements of the 2015 IECC. This is done to ensure that the building itself is efficient prior to allowing credit for any on-site power production.

A "worst-case scenario" home that meets only the minimums of the 2009 envelope requirements can have an ERI score of between 77 and 88 depending on climate zone, whereas a "worst case scenario" home that meets the 2015 envelope requirements would have an ERI score of between 64 and 77. Requiring a stronger envelope backstops for homes that take credit for on-site power production means that the generation system can be smaller and less expensive. This saves money and maximizes the value to consumers.

2. **Maximum On-Site Power Production Credit**

The Concept

The Energy Rating Index is calculated as specified in Section R406. The ERI is the ratio of energy loads for heating, cooling, water heating, lighting, and appliances between the rated design (a description of the proposed building used to determine the energy rating index) and the corresponding ERI reference design (a version of the rated design configured such that it meets the minimum requirements of the 2006 International Energy Conservation Code).

The ratio calculated prior to including any on-site power production (referred to in the example below as the Preliminary ERI) would be modified by the Purchased Energy Fraction, to account for on-site power production in Equation # Eq. 4.1-2 of the ANSI/RESNET/ICC 301 standard. Purchased Energy Fraction is calculated in accordance with Table R406.4.1. The result of the Preliminary ERI multiplied by the Purchased Energy Fraction is then be multiplied by 100 to turn it into a whole number. The result of this calculation is the ERI of the rated design that must comply with Table R406.4.

The Method

The proposed Table R406.4.1 starts crediting on-site power at a target ERI of the rated design of 61 and moves in 5% increments per integer. At a target ERI score of 42 or lower, 100% of on-site power produced may be applied to the ERI. There are currently no states that specify ERI scores this low in Table R406.4. The factors in Table R406.4.1 represent those 5% increments.

The average HERS rating since 2012 for a home without on-site power production is a 63. The HERS Rating Index was recently updated to account for energy savings from certain hot water efficiency measures. This change means that builders already get 1-3 additional ERI points for measures that are common practice, like lower-flow plumbing fittings and efficient hot water layouts. Homes that are being designed to meet an ERI score of greater than 61 are already doing so without on-site power production and should not receive credit for production. Those homes could certainly still have on-site power production, a builder would just not receive any credit in the ERI path of the code.

Table R406.4.1 can be applied consistently to any jurisdiction, regardless of whether they cleanly adopt the ERI values listed in Table R406.4 or whether they modify the values. Table R406.4.1 will still be applicable to states with more stringent versions of the ERI, as well.

How does it work?

The calculation will be incorporated into the software defined in ANSI/RESNET/ICC 301, so builders, code official, designers, and consumers will not need to separately perform the calculation to determine the credit for on-site power production. The calculation would work as follows (again, this would be inherent to the software and no calculation will be required on the part of the builder, designer, code official, etc):

Step 1: Determine the gross energy use of a home meeting the ERI reference design (2006 IECC) and the gross energy use of the home as designed (regardless of energy generation source).

Step 2: Calculate the Preliminary ERI score (prior to accounting for on-site power production): the gross energy use of the home as designed (regardless of energy generation source) divided by the gross energy use of a home meeting the ERI reference design, and multiplied by 100

Step 3: Use Table R406.4.1 to calculate the Purchased Energy Fraction. This is the factor that the Preliminary ERI score will be adjusted by.

Step 4: Multiply the Preliminary ERI score by the Purchased Energy Fraction. This is the Final ERI score, which must comply with the Energy Rating Index values in Table R406.4.

Example

An example of how this would work in Climate Zone 4:

Step 1:

-Gross energy use of a home meeting the ERI reference design (2006 IECC), mmBTU: 254.5

-Gross energy use of the home as designed (regardless of energy generation source), mmBTU: 155.3

Step 2: Calculate the Preliminary ERI score:

155.3 mmBTU ÷ 254.5 mmBTU= 0.61

0.61 * 100 = 61

-The Preliminary ERI score is 61.

-Based on Table R406.4, the maximum ERI score of the rated design for climate zone 4 is 54. Therefore, the designer either needs to add more efficiency or may "make up the difference" in ERI score with on-site power production.

Step 3: Calculate the Purchased Energy Fraction

=[(Gross Energy Use of the Home As Designed)-(On-Site Power Production*Factor from Table R406.4.1)] ÷ [Gross Energy Use of the Home as Designed]

Inputs:

-For a home with a maximum ERI score of the rated design of 54, the Factor from Table R406.4.1 is 0.4

-For this example, On-Site Power Production is assumed to be 30% of the Gross Energy Use of the Home as Designed (46.57 mmBTU). This input would vary based on the size of the on-site power production system.

=[(155.3 mmBTU) – (46.57 mmBTU * 0.4)] ÷ [155.3 mmBTU]

=[(155.3 mmBTU) – (18.63 mmBTU)] ÷ [155.3 mmBTU]

=[137 mmBTU] ÷ [155.3 mmBTU]

Purchased Energy Fraction = 0.88

This means that the Final ERI Score is allowed to be 88% of the Preliminary ERI Score to account for the contribution of on-site power production.

Step 4: Final ERI Score

Preliminary ERI Score * Purchased Energy Fraction

=61 * 0.88

=54

The Final ERI score of the rated design is 54. The home is compliant with Table R406.4 using a mix of energy efficiency and on-site power production.

Note that this compliance method is dependent on both the contribution of the on-site power production system and the energy consumption of the home regardless of power production. An on-site power production system contributing less than a certain percentage of a home's energy consumption may not be enough to make that home compliant with Table R406.4 if it the home does not have enough efficiency.

This proposal has been designed to ensure that efficiency is prioritized, but that a reasonable amount of credit is allowed for on-site power production in the form of renewable energy generation.

Enforcement

Enforcement of compliance with Table R406.4.1 is straightforward. The code official or plan reviewer only has to do the following:

-Verify that the ERI required for the climate zone in Table R406.4 has been documented and is identified in the compliance report.

- Verify that that the percentage of on-site power cited in the compliance report does not exceed the limits listed for the "ERI for the Rated Design" in new Table 406.4.1.

There is a companion proposal embedded in this public comment to require that the factor used for on-site power in the ERI is found in the compliance report.

Conclusion

This proposal promotes both improvements in the building envelope and a reasonable method for allowing a limited amount of on-site power production. It ensures that consumers are protected and reap the benefits of energy efficiency while allowing flexibility for builders and designers. It accommodates state flexibility and future improvements to the ERI score in a way that is straightforward for code officials.

This proposal should be approved as modified.

RE165-16

RE166-16

R406.3 (IRC N1106.3), R406.3.1 (IRC N1106.3.1), R406.6.1 (IRC N1106.6.1), R406.7 (IRC N1106.7), R406.7.1 (IRC N1106.7.1), R406.7.2 (IRC N1106.7.2), R406.7.3 (IRC N1106.7.3)

Proposed Change as Submitted

Proponent : Eric Makela, Cadmus Group, representing RESNET

2015 International Energy Conservation Code

Revise as follows:

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be ~~a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change~~ determined in ~~the total energy use of the rated design relative to the total energy use of the *ERI reference design*~~accordance with ANSI/RESNET/ICC 301. ~~The ERI shall consider all energy used in the *residential building*.~~

Delete without substitution:

~~**R406.3.1 (N1106.3.1) ERI reference design.** The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements.~~

~~The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.~~

Revise as follows:

R406.6.1 (N1106.6.1) Compliance software tools. ~~Documentation verifying that~~
Software tools used for determining the ~~methods and accuracy of the compliance software tools conform to the provisions of this section~~ ERI shall be ~~provided to the *code official*~~Approved Software Rating Tools in accordance with ANSI/RESNET/ICC 301.

~~**R406.7.2**~~ **R406.6.4 (N1106.6.4) Specific approval.** Performance analysis tools meeting the applicable sections of Section R406 shall be *approved*. ~~Tools are permitted~~ Documentation demonstrating the approval of performance analysis tools in accordance with Section R406.6.1 shall be provided to ~~be *approved* based on meeting a specified threshold for a jurisdiction~~ the code official. ~~The *code official* shall approve tools for a specified application or limited scope.~~

~~**R406.7.3**~~ **R406.6.5 (N1106.6.5) Input values.** When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from ~~an approved source~~ ANSI/RESNET/ICC 301.

Delete without substitution:

~~**R406.7 (N1106.7) Calculation software tools.** Calculation software, where used, shall be in accordance with Sections R406.7.1 through R406.7.3.~~

~~**R406.7.1 (N1106.7.1) Minimum capabilities.** Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:~~

1. ~~Computer generation of the *ERI reference design* using only the input for the *rated design*.The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.~~
2. ~~Calculation of whole building, as a single *zone*, sizing for the heating and cooling equipment in the *ERI reference design* residence in accordance with Section R403.7.~~
3. ~~Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.~~
4. ~~Printed *code official* inspection checklist listing each of the *rated design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.~~

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

ANSI/RESNET/ICC 301-2014 Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using an Energy Rating Index First Published March 7, 2014 Republished January 2016

Reason: During the 2015 code development cycle, a collaborative code change proposal (RE188-13) to include the ERI approach in the code was submitted by the Institute for Market Transformation, Natural Resources Defense Council and Britt/Makela Group. The ERI approach was adopted in the code as Section R406 and is currently being adopted by states and local jurisdictions.

The collaborative team based the ERI code language on the yet to be approved standard ANSI/RESNET/ICC-301. This required the team to include language from the standard concerning the development of the Energy Rating Index (see Section R406.3), compliance software tool approval (R406.6.1) and the minimum capabilities of the software used to determine an ERI for a project (R406.7.1). Overall the language that was included in the proposal provides the basic concepts for developing a program to meet the ERI approach but referencing the RESNET/ICC-301 would ensure that the ERI approach is deployed using a standardized process from a consensus document.

This proposal references RESNET/ICC – 301 RESNET/ICC – 301 and strikes all language in C406 that is duplicated in the Standard or that is no longer needed in the code because the concept is covered in the Standard.

RESNET/ICC - 301 Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using an Energy Rating Index provides a consistent, uniform methodology for evaluating and labeling the energy performance of residences. The methodology compares the energy performance of an actual home with the energy performance of a reference home of the same geometry, resulting in a relative energy rating called the Energy Rating Index. Where the energy performance of the actual home and the reference home are equal, the Energy Rating Index is 100 and where the actual home requires no net purchased energy annually, the Energy Rating Index is 0 (zero). Per the provisions of R406, the Energy Rating Reference Home used for this comparative analysis has the energy attributes of the 2006 International Energy Conservation Code (IECC) Standard Reference Design. Thus, the Energy Rating Index is relative to the minimum building energy efficiency requirements of the 2006 IECC.

Cost Impact: Will not increase the cost of construction

As stated in the Reason Statement, the ERI approach submitted during the 2015 IECC code development cycle (RE188-13) was based on the yet to be approved Standard 301. The ERI values that populate Table R406.4 were calculated and based on the protocol described in Standard 301 so referencing this standard will not lead to an increase in the stringency of the ERI values and will not result in an increase in first cost for the construction of the house. This proposal DOES NOT propose to change the Section R406.2 requiremets for Mandatory Requirements or the 2009 IECC as minimum requirement which would increase first cost. The Energy Rating Index described in Section R406.3 is consistent with Standard 301. The requirements for Calculation Software Tools in Section R406.7 will not increase the cost to develop software as the requirements are consistent with the requirements in Standard 301. Standard 301 does not place additional requirements into C406 but provides a stadardized method for generating ERI scores and demonstrating compliance with the R406.

Analysis: A review of the standard proposed for inclusion in the code, BRS/RESNET/ICC 301-2016, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016)

RE166-16 : R406.3-MAKELA12647

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The ERI path needs to be standardized and the RESNET standard does that. The difference in ventilation rate might need to be resolved but the experts can solve that through public comments.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Craig Conner, representing self (craig.conner@mac.com); Joseph Lstiburek, representing self (joe@buildingscience.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301~~.~~ except for buildings constructed in accordance with the International Residential Code, the ERI the reference design ventilation rate shall be in accordance with the following:

Ventilation rate in cubic feet per minute = (0.01 x total square foot area of house) + [7.5 x (number of bedrooms + 1)] **(Equation 4-1)**

Commenter's Reason: As written the ERI ventilation rate specification is in conflict with the ventilation rate specified by the IRC. The current language references ANSI/RESNET/ICC Standard 301 which references the ASHRAE 62.2-2013. The ventilation rate in the ASHRAE Standard 62.2 is significantly higher than the ventilation rate in the IRC. The IRC rate was reaffirmed in Group A changes this code cycle. Without this ventilation rate correction, the higher ventilation rate would use more energy unnecessarily and thereby increase ERI scores for no good reason. Interestingly the ASHRAE 62.2-2010 used the same rate as is in the current IRC.
Third party organizations should not set ventilation rates for the IRC and the IECC. Ventilation rates in the IRC and IECC should be set by the ICC code development process.

This proposal brings the IECC/IRC ERI calculation into compliance with the IRC ventilation rate by using the same ventilation equation as will be in Section 1507.3.3 of the 2018 IRC.

The published committee reason expected this update, stating: *"The difference in ventilation rate might need to be resolved but the experts can solve that through public comments."* This is the public comment they were reffering to.

Public Comment 2:

Proponent : Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1 percent change in the total energy use of the *ERI reference design*. The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301 or another approved energy rating method, subject to the intent, provisions and limitations of this code.

Commenter's Reason: This public comment modification is proposed to recognize RESNET 301 as one method to determine ERI, but also permit other *approved* alternative rating methods to RESNET 301, with all such ERI rating methods subject to the intent, provisions and limitations of the IECC. The latter language will help to ensure that RESNET 301 or any other method still meets the overall intent and requirements of the code.
The IECC should not designate a single entity to control an entire compliance method. While we can appreciate RESNET's interest in standardizing a rating methodology, particularly the one that they developed, it would be more appropriate to add the necessary details directly into the IECC, rather than referencing a single outside standard. However, the proponent has not identified which portions of the current Section R406 (if any) are not already working well. Instead, RE166 simply proposes deleting most of the specific requirements of the code and replacing them with a reference to RESNET 301.

We recognize that HERS Ratings are widely used, and that the current language was modeled somewhat after the requirements of RESNET 301. Thus, this public comment would specifically recognize the use of RESNET 301 as an *approved methodology* for the ERI – but *not the only methodology*. We believe that naming a single standard would work to the disadvantage of builders and homeowners who may want another alternative. Going forward, if proponents are interested in updating or tweaking Section R406, we strongly encourage them to fix or supplement the actual code language, rather than delete it in favor of an outside standard. While we prefer RE166 to be disapproved, this modification should at least be approved so as to allow the possibility of competitive standards and systems and the ability to add additional requirements in the future.

Public Comment 3:

Proponent : Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301, except the ERI calculation shall not include on-site power production or provide any credit for such production.

Commenter's Reason: This public comment proposes a modification to close a potentially massive loophole that could be created by the approval of RE166, specifically by clarifying that adoption of RESNET 301 does not permit energy efficiency to be traded off for on-site power production under the ERI. Our views in opposition to on-site power production as a means to reduce energy efficiency requirements are also set forth in some detail in RE164 and the related public comment. While we would prefer to see RE166 disapproved, if it moves forward, we would like to at least see it modified to eliminate the risk of any credit for on-site power production in calculating the ERI.
Some stakeholders at the Committee Action Hearings argued that RESNET 301 establishes a pathway to include on-site power production in its calculation of the ERI. By contrast, the current ERI does not include on-site power production. As a result, the impact of RE166 could be overwhelmingly negative to energy efficiency, if on-site generation is permitted to replace energy efficiency measures. According to a study by RESNET, permitting trade-offs between energy efficiency and on-site power production (specifically a 4 kW solar system in this case) could easily cost 20 to 40 ERI points worth of energy efficiency, **which amounts to 36% to 73% increased energy use** (using a 55 ERI target score). (See Dillon, B., *The Impact of Photovoltaic Arrays on the HERS Index* (2015)). This level of trade-off credit for electric generation will, by itself, eliminate the energy efficiency savings achieved over many code cycles.

When ERI was first introduced into the IECC, there was no proposal to include any on-site power production (such as solar PV) in the ERI calculation; had there been such a proposal, we doubt the ERI would have been approved. Although HERS had included an option for on-site power production to be included in a final HERS rating, the scope of HERS (which had mostly been used for voluntary, above-code, tax credit or "green" program certification) is not the same as the IECC's mandatory code-compliance format. The residential IECC has never established requirements for solar or other on-site generation or recognized on-site power production as a trade-off of any type, and the new ERI path in Section R406 does not reference any sort of on-site power in Section R406. Likewise, EPA's Energy Star program, which also uses the HERS rating system, generally does not award credit for on-site power production against energy conservation measures.

Some have exploited a lack of direct reference to or limit on on-site power production as a sort of "green light" to contend that they can count up to 100% of all on-site generation of all types as a reduction in energy use – a practice that clearly conflicts with the history of, and the intent of the IECC to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building." This problem will be significantly exacerbated by adoption of RE166 and RESNET 301.

On-site power, and particularly solar PV, has benefitted from a number of very generous federal and state tax credits, utility incentives and favorable net electric metering rates, and other incentives that have driven new technologies and reduced installation costs. Proponents of on-site power trade-offs are now arguing that all of these incentives could now be used as a means of weakening building efficiency. We simply do not believe that ratepayer funds, tax dollars, and other incentives aimed at reducing fossil fuel use should now be used to allow builders to increase energy use in buildings served by on-site generation. And, conversely, if these trade-offs are allowed, it is highly likely that some or all of these renewable energy incentives for new homes could be eliminated by federal or state jurisdictions, and by utilities and their regulators, since these systems would no longer be producing a net reduction in conventional electricity or fuel use, creating environmental benefits or providing a net savings to the homeowner.

Power generation has been the regulatory responsibility of public service and utility regulatory commissions for over a hundred years and has not been the responsibility of the energy conservation code. There should remain a clear line between energy conservation measures that are part of creating resilient, efficient buildings, and electricity generation technologies.

Potentially allowing direct trade-offs between electric generation – whether renewable or not – and energy conservation raises a number of serious unintended consequences. This public comment maintains a clear distinction between the regulation of residential energy conservation (the historic mission of the IECC and Model Energy Code), and energy generation of any type. To blend these two missions together in the code would bring unnecessary complications and would not improve energy efficiency in any way. We recommend that RE166 be modified as proposed in this public comment.

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Disapprove.

Commenter's Reason: This code change adopts RESNET 380: Outsourcing of residential compliance path, and was approved by the committee.

The AIA believes that this proposal essentially outsources the ERI compliance path to RESNET by adopting RESNET 301 as the exclusive source for ERI compliance. This is also problematic in that it allows the unlimited use of on-site power production in lieu of energy efficiency improvements.

Using a single source for compliance is not beneficial and raises questions of ICC denying competition by others. The code should set the criteira, and those that have systems or means to accomplish those should be allowed to submit them for consideration and approval. Integrating a system that undermines the principles in the code for higher energy efficiency in buildings by providing more energy production is not a positive approach for the IECC.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition requests Disapprove.

Commenter's Reason: RE166 should be disapproved because it outsources control over an entire IECC compliance option (ERI) to an outside organization (RESNET, which develops standard 301) and it further confuses the issue of whether on-site power production (renewable or not) counts as a substitute for energy efficiency measures toward compliance with ERI, putting at risk an enormous loss of energy efficiency.

ERI is an important new compliance method. We recognize that ERI emulates some aspects of RESNET's Home Energy Rating System (HERS) as set forth in RESNET 301, and that the RESNET process is currently expected to be the primary compliance pathway utilized to comply with ERI. However, ERI currently is a stand-alone compliance path in the IECC. This proposal would replace the requirements for calculating ERI in the code with only a reference to a very lengthy standard, which is controlled by RESNET and potentially subject to constant revision.

We expect ERI to become a widely-used IECC compliance path and believe that the IECC, not RESNET, should establish and control the basic components of this compliance path. Further, we believe RE166 would complicate code development and enforcement and would lead to a number of unintended consequences. The ERI compliance path was just established last cycle. This is not the time to fundamentally alter the ERI, just as it is just being adopted and/or implemented in many states.

It should be noted that, even though we recommend disapproval of this proposal, we do not oppose the use of RESNET 301 (without on-site power production credit) to calculate ERI scores, so long as the standard is applied consistently with the IECC requirements. We simply do not think it is healthy for the IECC (or RESNET for that matter) for RESNET 301 to wholly control the ERI calculation.

In terms of differences between the requirements of the current IECC Section R406 and RESNET 301, there is one difference that has enormous significance. Although it can be argued that RESNET 301 establishes a pathway to include on-site power production in its calculation, the current ERI does not. As shown by a recent RESNET study, 4 kW solar PV system could be used under RESNET 301, if permitted by the IECC, to offset 20 to 40 ERI points. This would lose an enormous amount of energy efficiency – 20 to 40 points amounts to 36% to 73% increased energy use (using a 55 ERI target score). (See the RESNET study: Dillon, B., *The Impact of Photovoltaic Arrays on the HERS Index* (2015)).

To further elaborate on some of our concerns:

- **IECC code development should remain at ICC and ERI requirements should be clearly spelled out in the code itself.** A very troubling aspect of RE166 is the specific reference to an outside standard to completely control virtually the entire compliance option. While reference national standards for product performance or standardized regulation of specific building components are more common, it is almost unprecedented to reference another organization's standard for an entire compliance path.

The only example that comes close is the reference to ASHRAE Standard 90.1 in the Commercial IECC. However, ASHRAE Standard 90.1 is unique – it is the standard for energy efficiency in commercial buildings referenced in federal law, and it has been part of the IECC for many years. RESNET 301 is not ASHRAE Standard 90.1.

To replace the specific requirements of Section R406 with a reference to RESNET 301 takes code development for this important compliance path out of the hands of the ICC – and out of the hands of the building code officials who must enforce the code – and hands this responsibility and authority over to another organization without the same membership or governmental representative decision-making structure.

- **The purpose and scope of RESNET 301 is different from the IECC's scope.** RESNET originally developed home energy ratings (HERS) to provide a yardstick to measure comparative home energy use for voluntary energy ratings for builders and homeowners, "above code" or "green" energy programs, tax credits, and other voluntary contexts that are not focused on building code compliance. Building code compliance is a recent afterthought for this rating system. While aspects of the rating methodology outlined in RESNET 301 might be an appropriate part of the Energy Rating Index, it should not be used as a means to change the scope of the IECC, which is focused on the "effective use and conservation of energy over the useful life of each building." The scope of the IECC and all of its compliance options should be established by the ICC Governmental Member Voting Representatives, not by RESNET.

- **RESNET 301 includes provisions that have not been part of the IECC (related to on-site power production) and will have huge negative impacts on the IECC and energy efficiency.** Many stakeholders pointed out at the Committee Action Hearings their view that RESNET 301 includes on-site power production (renewable and non-renewable) as an input option in the calculation of a HERS score. On-site power production has never been permitted as a trade-off in the residential IECC, and including the use of electricity production as an offset to energy efficiency would be a significant expansion of the IECC's scope and a large rollback in energy efficiency. EECC's views in opposition to including on-site power production in the residential IECC are set forth in much more detail in EECC's public comment on RE164 and other proposals. It is not appropriate to add provisions into the IECC simply because they are available in a piece of software or a rating system. Yet, replacing code requirements with a single reference to RESNET 301 will lead some to argue that the scope of the IECC has been expanded and that on-site power production is permitted in the ERI to offset required energy efficiency.
- **RESNET 301 is subject to constant change, outside of the ICC Code Development Process.** RESNET 301 can, and does, change frequently to reflect different calculation methods and other changes deemed appropriate by the RESNET Board. Specifically, it is subject to "continuous maintenance." Because software providers and HERS Raters use the HERS rating methodology for a variety of purposes, our understanding is that software and references are updated with each new change. We are concerned that even if a specific edition of RESNET 301 is referenced in the IECC, raters and software companies will update their practices with changes to 301 irrespective of whether these changes have been appropriately reviewed and vetted through the code development process and referenced in the IECC.

RE166 introduces an unprecedented variable into code development – one that is outside the direct control of ICC's Governmental Member Voting Representatives – as well as potentially introducing significant and unwanted changes to the ERI path and the scope of the residential IECC related to on-site power production. We urge voters to <u>disapprove</u> this proposal.

Proponent : Charles Foster (cfoster20187@yahoo.com) requests Disapprove.

Commenter's Reason: This code proposal substitutes HERS for the existing ERI approach. HERS is too restrictive.

Proponent : Darren Meyers, representing Illinois Office of Energy & Recycling (dmeyers@ieccode.com) requests Disapprove.

Commenter's Reason: U.S. code enforcement should DISAPPROVE RE166-16.

Despite DISAPPROVAL, by no means should this comment be considered an indictment of HERS Raters professionally, individually or collectively. Rather, the comment is offered based on historical record, testimonials from HERS Raters, and direct experience/observation of the Mortgage Industry's still evolving "National Home Energy Rating System" (HERS) Standard as a tool of code enforcement.

Summary. The Reason why U.S. code enforcement should DISAPPROVE RE166 is, regrettably, the Energy Rating Index 'ERI', formerly known as the RESNET's Home Energy Rating System 'HERS' (via RESNET Standard 301):

- Was retroactively renamed to suit previously developed IECC code language;
- The RESNET 300 Standards Council has issued interpretations that usurp the ICC governmental consensus process code officials use to establish IECC compliance paths;
- Has not reached consensus among its own members (HERS Raters) to address inadequacies in HERS Quality Assurance and Quality Control – Meaning, HERS raters evaluate and score the construction practices of the builders who hire them;
- Is rooted in "above-code" methodology, thereby requiring the use of proprietary software for compliance assessment that isn't always available or up to date; and
- Relies on a methodology that can vary 15 to 18 ERI/HERS points around a median set of IECC Baseline, code compliant building characteristics;

1. Larger houses (s.f.) receive more favorable (lower) ERI/HERS Indices compared to smaller houses. No solution to such relationship is included in the proposal.
2.
3. ERI/HERS points are granted for ceiling fans, refrigerators, dish washing equipment, microwave ovens and washer/dryer combinations that are considered "portable" and outside a code official's purview.
4.
5. If compliance is based on exceeding a single number, is the volatility of up to 18 ERI/HERS points acceptable to code enforcement in determining compliance vs. non-compliance?

Detail. Whether it was the intent or otherwise to create a nebulous "placeholder" during the 2015 IECC code development cycle (RE188-13), ultimately, the approval of RE188-13 is turning out to be a mistake. Simply stated, RESNET Standard 301 is not ready for use as an extension of the code compliance process at this time.

There are a number of supporting explanations:

- While RESNET 301 was first published on 3/7/2014 as an ANSI consensus developed standard, no less than a year later, it was retroactively "renamed" to match an IECC code section developed during the October 2013 ICC Code Development Cycle for the 2015 editions, prior to its existence.

- If RESNET 301 is adopted into the 2018 IECC, U.S. code enforcement (and ICC) relinquish their "authority" to determine, by governmental consensus vote, what "IS" and "IS NOT" IECC code compliant or suitable for an IECC "TRADE-OFF."

1. **Example:**On 1/15/2016, the RESNET 300 Standards Council adopted Addendum 'B' outside of the ICC Code Development Process to rename the Standard "RESNET**/ICC** 301-2014" to be promulgated and sold by both organizations to U.S. code enforcement.[ii] (https://cdpaccess.com/public-comment/edit/16283#_edn2)
2.
3. **Example:**On 1/15/2016, the RESNET 300 Standards Council adopted Addendum 'B' outside of the ICC Code Development Process to rename the ~~HERS Index~~ **Energy Rating Index (ERI)** retroactively, to match a code section developed during the October 2013 ICC Code Development Cycle for the 2015 editions, prior to its existence.
4.
5. **Example:** The action to rename its standard, retroactively, has been interpreted by many as giving RESNET a commanding and/or unique position over competing groups in States, unrelated to code compliance.
6.
7. **Example:**On 6/16/2016, the RESNET 300 Standards Council announced its intent to investigate an energy cost-based savings comparison on which to base the ERI/HERS Index. A provision already in Section 405 of the IECC.
8.
9. **Example:**On 7/1/2016, the RESNET 300 Standards Council announced its intent to adopt Addendum 'C' outside of the ICC Code Development Process, to permit trade-offs between the levels of ventilation for human health afforded by ASHRAE 62.2-2010 with those found in 62.2-2013. ASHRAE Standard 62.2 is not adopted by the I-Codes. However, if approved, Addendum 'C' would allow the builder/rater relationship to lessen indoor air quality in favor of "builder-selected" options.[iii] (https://cdpaccess.com/public-comment/edit/16283#_edn3) Unlike the 62.2 committee, the RESNET 300 Standards Council was not constituted to be balanced explicitly with knowledge and expertise on ventilation for acceptable indoor air quality.
10.
11. **Example:**In an interpretation issued 7/7/2016, outside of the ICC Code Development Process, the RESNET 300 Standards Council needed to clarify that a rated home without a water heater must use the Energy Factor formula prescribed by Federal law (CFR 430.32(d)). A provision already in Section 405 of the IECC.[iv] (https://cdpaccess.com/public-comment/edit/16283#_edn4)

- There are clear and present inadequacies in the RESNET HERS Quality Assurance process. So much so that a new RESNET Standard Development Committee (SDC) 900[v] (https://cdpaccess.com/public-comment/edit/16283#_edn5)was conceived out of a RESNET *Quality Improvement Working Group*[vi] (https://cdpaccess.com/public-comment/edit/16283#_edn6) investigation (10/3/2014) to address the financial interests that Raters and their Quality Assurance (QA) Providers have in the outcome of ERI/HERS scores issued to the builders who hire them. RESNET 900 is under development and will not be available for inclusion in the code until the 2021 IECC.

1. Raters evaluate and score the construction practices of the builders who hire them. Code officials inspect the construction practices of builders for the welfare, health-, life- structural-, and fire-safety interests of the public. Even the hint of a "less than arm's length" cash transactional relationship between the HERS RATER and the builder raises questions of impartiality.
2.
3. RESNET's Quality Improvement Working Group recommendations have received endorsements and rejections by HERS Raters nation-wide. The importance here is that among HERS Raters, there is no consensus:
4.
5. HERS Raters in Texas "...agree that the integrity of some Providers and Raters, who compete on price versus value of their service to the builder, play a role.[vii] (https://cdpaccess.com/public-comment/edit/16283#_edn7)
6.
7. "In many cases, ... builders encourage the mindset; they are only interested in the score and are not as interested in the accuracy or validity of the actual HERS index or verification of the rated features."[vii] (https://cdpaccess.com/public-comment/edit/16283#_edn7)
8.
9. "Yes, there are problems. Part of what's motivating RESNET is that if you hire several raters to come into a home to do a rating, you'll get a spread of results that's broader than it should be." [viii] (https://cdpaccess.com/public-comment/edit/16283#_edn8)
10.
11. "When a provider does QA on their raters, the results for the HERS Index are supposed to be within +/- 3%, but different providers and QA Designees (QADs) don't always interpret the standards the same way. So you can have variance in the results even without malfeasance." [viii] (https://cdpaccess.com/public-comment/edit/16283#_edn8)
12.
13. "There is widespread agreement that RESNET must take action to increase the consistency and quality of ratings for market confidence and consistency." However, "RESNET only has four (4) current full-time employees on staff." [ix] (https://cdpaccess.com/public-comment/edit/16283#_edn9)
14.
15. "The current HERS QA infrastructure allows rating companies who serve as their own QA Provider to perform internal QA review, as well as third-party Providers to perform QA on independent Raters who pay them for this QA. To many, the financial relationships between Raters and QA Providers pose too significant of a potential financial conflict of interest."[ix] (https://cdpaccess.com/public-comment/edit/16283#_edn9)
16.
17. Considering these QA improvements are "in process" as recommendations without consensus among the HERS Rating membership, the adoption of an ERI/HERS path in the 2018 IECC could be viewed as "changing the tires on a moving car."

- Not one home has received a codified Energy Rating Index since the 2015 IECC was published 6/30/2014. That's more than two years during which the ERI provisions of the 2015 IECC have not been used. This is a result of the three lone ERI/HERS software developers either delaying or not yet developing 2015 IECC ERI-compliant versions.

1. NORESCO released a 2015 IECC ERI-compliant version 7/1/2016. The Florida Solar Energy Center released a 2015 IECC ERI-compliant version 3/31/2016. Ekotrope plans to release a 2015 IECC ERI/HERS-compliant module in the fall of 2016.
2.
3. There remain "customizable" libraries for construction types, weather and utility data content that cannot be policed easily by code enforcement at plan review.
4.
5. There is not yet an open source interpretation layer for calculating an ERI/HERS Index that all HERS software programs must use for objective analysis by code enforcement.

- There is questionable validity of a volatile, single-solution-based ERI/HERS scoring system. In other words, the use of a single number to demonstrate IECC code compliance.[x] (https://cdpaccess.com/public-comment/edit/16283#_edn10)

1. In every Climate Zone, Conditioned Floor Area (CFA) is the most important and [most] volatile characteristic of ERI/HERS

Index. For Zones 4 and 5 [Corresponding ERI/HERS Indices] can vary 15 to 18 points around a median set of IECC Baseline, code compliant building characteristics.

2.
3. "It seems clear any HERS-based code compliance path in any location would need to account for house size using a logarithmic relationship," which is not the case in the language proposed for 2018 IECC.[x] (https://cdpaccess.com/public-comment/edit/16283#_edn10)This means, larger houses (s.f.) receive more favorable (lower) ERI/HERS Indices compared to smaller houses.
4.
5. "The Corresponding HERS Index is also quite volatile with respect to CFA and HVAC efficiency,"[x] (https://cdpaccess.com/public-comment/edit/16283#_edn10)allowing lower ERI/HERS Indices for homes with poorly performing building envelopes.
6.
7. "Understanding this volatility across multiple home characteristics reveals 'real-world differences' among homes complying with the IECC Section 406 ERI path and its Section 405 Performance path."[x] (https://cdpaccess.com/public-comment/edit/16283#_edn10)
8.
9. "The [proposed] ERI/HERS Index path ... keys on no [specific] building characteristics, making it easy to express—in a single number for each zone—at the expense of not being responsive to variations in [home] characteristics."[x] (https://cdpaccess.com/public-comment/edit/16283#_edn10)
10.
11. HERS/ERI calculations are more complicated than Prescriptive submittals or REScheck, and take more time to review, placing burdens on code enforcement. There is concern that these types of sophisticated reviews would simply not take place, thereby leading unverified structures to be built.

End Notes.

[i] (https://cdpaccess.com/public-comment/edit/16283#_ednref1) The History of RESNET (http://www.resnet.us/about/our-history (http://www.resnet.us/about/our-history%20accessed%207/20/2016%C2%A0accessed%207/20/2016))

[ii] (https://cdpaccess.com/public-comment/edit/16283#_ednref2) RESNET/ICC 301-2014 Addendum B-2015 (http://www.resnet.us/blog/resnet-consensus-standards/ (http://www.resnet.us/blog/resnet-consensus-standards/))

[iii] (https://cdpaccess.com/public-comment/edit/16283#_ednref3) RESNET/ICC 301-2014 Addendum C-201X, Whole-House Mechanical Ventilation (http://www.resnet.us/blog/resnet-consensus-standards/ (http://www.resnet.us/blog/resnet-consensus-standards/))

[iv] (https://cdpaccess.com/public-comment/edit/16283#_ednref4) Interpretation No. 301-2014-07, RESNET/ICC 301-2014 Water Heater EF (http://www.resnet.us/blog/resnet-consensus-standards/ (http://www.resnet.us/blog/resnet-consensus-standards/))

[v] (https://cdpaccess.com/public-comment/edit/16283#_ednref5) RESNET Forms Standard Development Committee 900 – Quality Assurance, September 23rd, 2014, (https://www.resnet.us/about/standard_development_committee_900)

[vi] (https://cdpaccess.com/public-comment/edit/16283#_ednref6) Quality Improvement Working Group on Quality Assurance RESNET Quality Assurance Options – Final Report 10/3/2014, (http://www.resnet.us/professional/about/QI_Working_Group_RESNET_QA_Options_10-03-14_to_QI_Taskforce.pdf)

[vii] (https://cdpaccess.com/public-comment/edit/16283#_ednref7) Texas HERO Member Response to Energy Vanguard Blog, Allison Bailes, Posted 8/29/2014. http://www.energyvanguard.com/blog-building-science-HERS-BPI/bid/76604/Why-Is-RESNET-Limiting-Its-Options-for-Improvement (http://www.energyvanguard.com/blog-building-science-HERS-BPI/bid/76604/Why-Is-RESNET-Limiting-Its-Options-for-Improvement)

[viii] (https://cdpaccess.com/public-comment/edit/16283#_ednref8) *Is RESNET Limiting Its Options for Improvement?* Energy Vanguard Blog, Allison Bailes, Posted 8/29/2014. http://www.energyvanguard.com/blog-building-science-HERS-BPI/bid/76604/Why-Is-RESNET-Limiting-Its-Options-for-Improvement (http://www.energyvanguard.com/blog-building-science-HERS-BPI/bid/76604/Why-Is-RESNET-Limiting-Its-Options-for-Improvement)

[ix] (https://cdpaccess.com/public-comment/edit/16283#_ednref9) *White Paper Report on Enhancing HERS QA Oversight*, by Building Energy Resources, 8/15/2014 (http://www.theber.com/EnhancedQAO.php)

[x] (https://cdpaccess.com/public-comment/edit/16283#_ednref10) PNNL Technical Report - *RESNET HERS Index Values Corresponding to Minimal Compliance with the IECC Performance Path*, PNNL-22560, Taylor T., Mendon. V, May 2014. https://www.energycodes.gov/sites/default/files/documents/HERSandIECCPerformancePath_TechnicalReport.pdf (https://www.energycodes.gov/sites/default/files/documents/HERSandIECCPerformancePath_TechnicalReport.pdf)

Proponent : Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org) requests Disapprove.

Commenter's Reason: There are many problems with this proposal. Under the current version of the ERI, multiple programs or standards could be used. Now, only one standard can be used. In addition, there are several problems with the HERS Index that have been documented by several parties (e.g., get a better score just by building a larger house). Also, there are issues with the process for making updates to the RESNET Standard.

RE166-16

RE167-16

R406.3 (IRC N1106.3), R406.3.1 (IRC N1106.3.1), Table R406.3.1 (New) [IRC Table N1106.3.1 (New)], R406.4 (IRC N1106.4), R406.6.2 (IRC N1106.6.2), R406.6.3 (IRC N1106.6.3), R406.7.1 (IRC N1106.7.1)

Proposed Change as Submitted

Proponent : Chris Mathis, Mathis Consulting Company (chris@mathisconsulting.com)

2015 International Energy Conservation Code

Revise as follows:

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total primary energy use of the ~~rated design~~*proposed design* relative to the total primary energy use of the *ERI reference design*. The ERI shall consider all energy used in the *residential building*.

Add new text as follows:

R406.3.1 (N1106.3.1) ERI Calculations Equations 4-1, 4-2 and 4-3 shall be used to calculate the ERI for the *proposed design.*

ERI = PEC / RPEC * 100 **(Equation 4-1)**

where:

PEC = Total Primary Energy Consumption of the *proposed design*
= Σ(TEUef * PEFef) **(Equation 4-2)**

RPEC = Total Primary Energy Consumption of the *ERI reference design*
= Σ(RTEUef * PEFef) **(Equation 4-3)**

and where:

TEUef = Total site energy use for the *proposed design*

RTEUef = Total site energy use for the *reference design*

PEFef = Primary energy conversion factor for each energy form as indicated in Table R406.3.1.

TABLE R406.3.1 (N1106.3.1)
PRIMARY ENERGY FACTORS BY ENERGY FORM

Energy Form	Primary Energy Factor (PEFef)
Imported Electricity	3.15
Imported Natural Gas	1.09
Imported Steam	1.45
Imported Hot Water	1.35
Imported Chilled Water	1.04
Imported Fuel Oil	1.19
Imported Propane	1.15
Imported Coal and Other	1.05
Exported Electricity	3.15
Exported Steam	1.45
Exported Hot Water	1.35
Exported Chilled Water	1.04

Revise as follows:

~~**R406.3.1**~~ **R406.3.2 (N1106.3.2) ERI reference design.** The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements for a residential building with electric heating, cooling, water heating, range oven, and dryer.

~~The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the~~

~~annual total loads of the *ERI reference design*.~~

R406.4 (N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the ~~*rated*~~ *proposed design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4 when compared to the *ERIreference design*.

R406.6.2 (N1106.6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the ~~*rated*~~ *proposed design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the ~~*rated*~~ *proposed design*. The inspection checklist shall show results for both the *ERI reference design* and the ~~*rated*~~ *proposed design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.6.3 (N1106.6.3) Additional documentation. The *code official* shall be permitted to require the following documents:

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

R406.7.1 (N1106.7.1) Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:

1. Computer generation of the *ERI reference design* using only the input for the ~~*rated*~~ *proposed design*.The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.
2. Calculation of whole building, as a single *zone*, sizing for the heating and cooling equipment in the *ERI reference design* ~~residence~~ in accordance with Section R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed *code official* inspection checklist listing each of the ~~*rated*~~ *proposed design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

Reason: This proposed revision focuses on three important changes to the code:

1. Shifting ERI-based compliance to PRIMARY ENERGY CONSUMPTION [rather than the "normalized modified end use loads (nMEUL)" – currently referenced in the code and used only in RESNET Standard 301 and therefore problematic with respect to proprietary exclusion within the code]. PRIMARY ENERGY CONSUMPTION is a well understood and proven technique used by ASHRAE and others, provides equitable treatment of all technologies based on their impact on primary energy resources rather than on nMEUL, and prevents gaming of the ERI compliance approach as currently exists. The use of PRIMARY ENERGY CONSUMPTION also allows for easy conversion of ERI-based compliance values to carbon equivalent metrics, for which there is growing demand in the residential market.
2. Establishing a SINGLE BASELINE home as the reference design. The 2006 IECC-compliant reference design home is set to be an all-electric one for consistent comparison when using the ERI compliance path. This prohibits gaming of ERI-based compliance by establishing a single baseline against which all ERI values are calculated.
3. Changing "rated design" to "proposed design" in this section, opting to utilize an already code-defined term. "Proposed design" has long been used in the code for performance-based compliance calculations. It is also the appropriate term for performance–based compliance using the ERI methodology.

Additional justification – Objective 1:

The nMEUL methodology currently in Section 406 creates (unintended) biases that unfortunately result in favoring one energy form over another. For example, homes using NAECA minimum efficiency electric resistance storage water heating receive an identical HERS score and ERI value as a NAECA minimum gas storage water heater, even though both the annual energy costs and primary energy consumption are higher for the resistance water heater than for the gas water heater (typically twice as high). This bias in nMEUL results in HERS ratings and ERI values that favor ultra-high efficiency gas technologies (such as gas heat pumps) and low-efficiency electric technologies. This proposal fully eliminates this fundamental technical flaw in ERI-based compliance currently in Section 406.

Site energy measurement — a calculation of the energy consumed by an appliance at the end-use point — neither accounts for combined fuel use (ex., electric component of furnaces or combined heat and power) nor the substantial energy lost and emissions created throughout the extraction, processing, transportation, conversion, and distribution components of energy use. Alternatively, PRIMARY ENERGY CONSUMPTION – by definition – does account for the energy losses that occur in the production and delivery of the many types of energy that may be used in residential buildings.

The energy meter(s) on a home is only the end of a long series of energy transformations and movements. To ignore the original source of the energy implies that energy appears as if by magic at the meter, and upstream energy losses are not relevant to the building. Using that argument, 1 Btu of electricity would be considered the same as 1 Btu of natural gas, propane, or fuel oil. This would be fine if each form of energy were equivalent. They are not. For example, the versatility of electricity – easily converted to light, heat, motion, etc. – is why users pay a premium for it over other forms (ex., wood, gas, oil).

Focusing on site energy efficiency alone promotes irrational design decisions. Codes, standards, regulations, voluntary initiatives, and incentive programs using site energy metrics create and maintain a perverse market advantage to a selection of technologies (ex., electric resistance heating) that have lower initial cost, but that have higher operating cost, lower full-fuel-cycle efficiency, and higher GHG emissions. This is a key reason source energy-based criteria are used by several private and public sector stakeholders, including RESNET (see referenced links below).

This proposal's primary energy performance methodology provides equitable treatment of ALL energy consuming technologies based on their primary energy impact, not their site energy impact (nor normalized modified site energy load impact). It does not prohibit any technology, but equitably rewards and penalizes technologies in the home rating based on their PRIMARY ENERGY performance. It uses single national primary energy conversion factors to avoid rewarding or penalizing a home simply based on its location (similar to the Section R405 performance option).

The primary energy conversion factors in proposed Table 406.3 are from Table J.1 of ANSI/ASHRAE Standard 105.

Primary energy methodologies are implemented easily and now are recognized and used in the United States and internationally. The following list illustrates the numerous domestic and international codes, standards, and initiatives that are successfully incorporating primary energy methodologies:

1. DOE Home Energy Score Tool, 2010. US Department of Energy.
2. 2012 California Green Building Standards Code (CALGreen), 2012.
3. LEED Programs. 2012. US Green Building Council.
4. International Green Construction Code. 2015. International Code Council.
5. EPA Energy Star Buildings and Plants rating and labeling program (including Portfolio Manager and Target Finder). 2012. EPA.
6. ASHRAE Building Energy Quotient Labeling Program (As Designed, and In Operation). 2012. ASHRAE.
7. DOE Commercial Building Asset Rating Program. 2012. US Department of Energy.
8. Green Globes for Commercial Buildings. 2012. Green Building Initiative.
9. PlaNYC's Greener, Greater Buildings Plan (annual benchmarking and disclosure of energy usage). 2012.
10. Standard Methods of Determining, Expressing and Comparing Building Energy Performance and Greenhouse Gas Emissions. ANSI/ASHRAE Standard 105-2014
11. Benchmarking of Federal Facilities Building Energy Use Benchmarking Guidance. 2010. EISA Section 432. US Dept of Energy/Energy Efficiency & Renewable Energy (EERE).
12. National Academy of Sciences Review of Site (Point-of-Use) and Full-Fuel-Cycle Measurement Approaches to DOE/EERE Building Appliance Energy-Efficiency Standards. 2009.
13. DOE Policy to use full-fuel-cycle measures of energy use and greenhouse gas and other emissions in the national impact analyses and environmental assessments included in rulemakings for future energy conservation standards.
14. The Greenhouse Gases, Regulated Emissions and Energy Use in Transportation Model. 2015. Argonne National Laboratory.
15. Source Energy and Emission Factors for Energy Use in Buildings. 2007. National Renewable Energy Laboratory, Authors M. Deru and P. Torcellini.
16. Providing Credit Toward Energy Efficiency Goals for Cost-Effective Projects Where Source Energy Use Declines But Site Energy Use Increases. Section 502(e) Guidance. 2004. US Department of Energy/Energy Efficiency & Renewable Energy (EERE).
17. European Standard EN 15603 Energy performance of buildings. Overall energy use and definition of energy ratings. 2008. European Committee for Standardization.
18. European Standard EN 15217 Energy Performance of Buildings – Methods for Expressing Energy Performance and for Energy Certification of Buildings. 2007. European Committee for Standardization.

    All of these codes, standards, rating programs, and policies acknowledge the limitations and deficiencies of site energy-based metrics in achieving their energy efficiency and GHG emission reduction objectives, and have selected primary energy efficiency metrics and related GHG emission calculations as the technical basis of compliance requirements or analysis methodology. These voluntary and regulatory initiatives illustrate the strong technical justification and support for the use of PRIMARY ENERGY as the basis of the ERI compliance path in place of the flawed nMEUL approach.

Additional Justification – Objective 2:

This revision also specifies a single electric reference design for heating, cooling, water heating, range, oven, and dryer systems in R406.3.2.

A single baseline reference design provides an equitable credit or penalty to all technologies irrespective of energy form or technology design. It establishes fixed reference home performance requirements BEFORE making the technology and energy choices for the residential building. It is critical for equitable implementation of ERI compliance requirements. A single reference design methodology creates a level playing field for all technology and energy forms and provides equitable treatment of advanced renewable, waste heat recovery, hybrid, and multi-fuel technology options. It is especially important for equitable and consistent evaluation of on-site power generation and combined heat and power systems.

This revision is consistent with the single reference building methodology in the performance path in IgCC; ASHRAE Standards 90.1, 100, and 189.1; ASHRAE's bEQ program; EUI calculations from the EPA in the Energy Star Buildings program; and the DOE Home Energy Score Tool. Each of these methodologies establishes a single reference building as the basis of their energy rating and efficiency compliance requirements. A consistent single standard reference design methodology will improve the adoptability of the ERI compliance path by ensuring transparency and equity for all technologies and eliminating confusion at jurisdictional levels.

Cost Impact: Will not increase the cost of construction
This proposal does not change the minimum compliance requirements. The proposal does change the methodology used to determine the Energy Rating Index. This methodology provides greater design flexibility due to primary energy benefits not captured in the current normalized modified end use loads method and thus does not affect the cost of construction.

RE167-16 : R406.3-MATHIS13264

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The Committee's prior action for approval on RE166-16 was to provide a simple method for the ERI compliance path.This proposal adds more complexity that isn't needed. Use of the terms "import" and "export" are confusing to the design professional.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Ted Williams, representing American Gas Association (twilliams@aga.org) requests Approve as Submitted.

Commenter's Reason: The "Committee Reason" for disapproval is based on simplification; however, this simplification comes at the cost of accurately measuring energy consumption in consistent and comprehensive terms. Soure or "primary" energy metrics are well-understoond and used in many federal and state energy performance programs. However, to "simply" these approaches by removing the source energy multiplier approach produces misleading results. After all, is an electric resistance furnace really providing consumers with 96%+ efficiency? If that were true, it would be appropriate to press these inherently "wasteful" products as the baseline for space heating efficiency. All the proponent's approach does is to make this common sense and comparatively consistent perspective quantitative. To ignore the logic of these sorts of metrics is to take the path for wasting energy and climate resources.

RE167-16

RE168-16

R406.3.1(IRC N1106.3.1), R406.4(IRC N1106.4), Table R406.4.1 (New) [IRC Table N1106.4.1 (New)], R406.6(IRC N1106.6), R406.6.1(IRC N1106.6.1), R406.7(IRC N1106.7), R406.7.1 (IRC N1106.7.1) R406.7.2(IRC N1106.7.2), R406.7.3(IRC N1106.7.3)

Proposed Change as Submitted

Proponent : Lauren Urbanek, Natural Resources Defense Council, representing NRDC (lurbanek@nrdc.org)

2015 International Energy Conservation Code

Revise as follows:

R406.3 (N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be ~~a numerical integer value that is based on a linear scale constructed such that the *ERI reference design* has an Index value of 100 and a *residential building* that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the rated design relative to the total energy use of the *ERI reference design*~~accordance with RESNET/ICC 301. ~~The ERI shall consider all energy used in the *residential building*.~~

R406.3.1 (N1106.3.1) ERI reference design. The *ERI reference design* shall be configured~~ such that it meets~~ in accordance with the ~~minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements~~ HERS Reference Home as described in RESNET/ICC 301.

The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.

R406.4.1 Renewable energy systems. The use of renewable energy systems is permitted to be considered in meeting the values listed in Table R406.4 only if the ERI for the proposed residential building without renewable energy systems is less than or equal to the appropriate value listed in Table R406.4.1.

TABLE R406.4.1
Maximum Energy Rating Index

Climate Zone	Energy Rating Index
1	57
2	57
3	57
4	61
5	61
6	61
7	58
8	58

R406.6 Documentation. Documentation of the software used to determine the ERI and the parameters for the residential building shall be in accordance with Sections R406.6.1 through ~~R406.6.3~~ R406.6.5.

R406.6.1 Compliance software tools. ~~Documentation verifying that~~
Software tools used for determining the ~~methods and accuracy of the compliance software tools conform to the provisions of this section~~ ERI shall be ~~provided to the *code official*~~Approved Software Rating Tools in accordance with RESNET/ICC 301.

~~**R406.7.2**~~ **R406.6.4 Specific approval.** Performance analysis tools meeting the applicable sections of Section R406 shall be *approved*. ~~Tools are permitted~~ Documentation demonstrating the approval of performance analysis tools in accordance with Section R406.6.1 shall be provided to ~~be~~ the*approved* *code official*. ~~based on meeting a specified threshold for a jurisdiction. The *code official* shall approve tools for a specified application or limited scope.~~

~~**R406.7.3**~~ **R406.6.5 Input values.** When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from ~~an approved source~~ RESNET/ICC 301.

Delete without substitution:

~~**R406.7 Calculation software tools.** Calculation software, where used, shall be in accordance with Sections R406.7.1 through R406.7.3.~~

~~**R406.7.1 Minimum capabilities.** Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:~~

1. ~~Computer generation of the *ERI reference design* using only the input for the *rated design*.The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.~~
2. ~~Calculation of whole building, as a single *zone*, sizing for the heating and cooling equipment in the *ERI reference*~~

~~*design* residence in accordance with Section R403.7.~~

3. ~~Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.~~
4. ~~Printed *code official* inspection checklist listing each of the *rated design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.~~

Reference standards type: This reference standard is new to the ICC Code Books

Add new standard(s) as follows:

<u>ANSI/RESNET/ICC 301-2014: Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using an Energy Rating Index First Published March 7, 2014 Republished January 2016</u>

Reason: The purpose of this proposal is two-fold: (a) to formally link the definition of the Energy Rating Index (ERI) to the ANSI/RESNET/ICC 301-2014 standard and (b) create a reasonable pathway to allow a limited amount of credit for on-site renewable energy in the 2018 code.

(a) The ERI compliance alternative adopted in the 2015 code outlines a framework for a builder to comply with the code via a generically-designed energy rating index. While the HERS score, as defined in ANSI/RESNET/ICC 301-2014, is the industry standard and the most commonly used method to comply with the ERI compliance alternative, the 2015 code does not explicitly reference the ANSI/RESNET/ICC 301-2014 standard. The HERS score is currently recognized as *one possible* ERI method, not the *exclusive* ERI method. This proposal formalizes that relationship by defining the ERI score as determined by the ANSI/RESNET/ICC 301-2014 standard.

As written, the 2015 code allows for the possibility that an entity may invent an alternative energy rating index system that complies with the letter of Section R406, but results in dramatically different energy consumption of a home built to this compliance alternative. Explicitly referencing ANSI/RESNET/ICC 301-2014 closes this potential loophole and ensures that all homes built in compliance with Section R406 meet the same standard. The rest of the IECC references established standards to ensure that the code is as unambiguous as possible. Explicitly referencing ANSI/RESNET/ICC 301-2014 makes Section R406 structurally consistent with the rest of the code.

The 2015 code is ambiguous about whether or not renewable energy systems are permitted to count toward the ERI value. The current language specifies that the proposed residential building shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the ERI reference design. The presence of a renewable energy system will not affect the building's total load. However, the code also refers to a scenario where a residential building that uses zero net purchased energy would have an Index value of zero. This creates an internal contradiction within the existing code language that is currently left open for interpretation by individual jurisdictions, creating uncertainty for builders and consumers. This ambiguity will be resolved by referring to the ANSI/RESNET/ICC 301-2014 standard.

(b) Referencing the ANSI/RESNET/ICC 301-2014 resolves the ambiguity of whether or not renewable energy systems are permitted to count toward the ERI value, but creates an additional issue which must be resolved. The HERS rating system outlined in ANSI/RESNET/ICC 301-2014 allows a home to have unlimited renewable energy: a home can have a HERS score of zero, which necessitates a significant contribution of renewable generation. This is the right approach for a *rating system*, but is not the right approach for a *code*. While a rating system encourages competition among home builders and can be used effectively to assess both new and existing homes, the purpose of a conservation code is to *conserve* energy by increasing a home's energy efficiency.

The ERI levels set in the 2015 code were set based on calculations of cost-effective energy efficiency levels, including trade-offs made against various building envelope options. The analysis during the development of the 2015 ERI levels did not account for the impact of renewable energy generation. A medium-sized solar installation is worth approximately 35 points. If unlimited renewable generation was allowed to count toward the ERI score, there is the potential for a substantial portion of the ERI score to be met with renewable systems, resulting in homes that are even less efficient than the 2009 code. Allowing unlimited renewable generation would mean that homes could be built with fewer efficiency measures, which would move the stringency of the conservation code backward. It is NRDC's view that the code should be made more stringent with subsequent iterations, as long as there are cost-effective improvements to be had.

Builders may have additional incentive to prioritize PV over efficiency. Given the innovative financing options available, builders may be able to work with solar companies to install PV at no cost of materials or construction. In this situation, the homeowner then enters into a power purchase agreement directly with the solar provider. If solar is allowed as a substitute for efficiency, the baseline home will use more energy, the solar system will need to be larger (and therefore more expensive), and the home will be more vulnerable to higher bills if and when the solar system is removed. None of these issues factor into the *builder's* decision-making, but they directly affect the *homeowner* over the lifetime of the home. The code is in place to ensure that home buyers receive a high-quality product that is relatively standardized, no matter where or by whom the home is built. Allowing unlimited renewable credit to take the place of efficiency measures in the code adds uncertainty for the home buyer.

In addition to the energy conservation intent of the code, homeowners benefit from a more efficient home even if much of their load is offset by PV or another renewable source. Energy efficiency upgrades promoted in the code, like insulation and air sealing, are essentially permanent and difficult to remove. While the lifespan of solar panels is improving, the output of the panels decreases over time. A homeowner will eventually need to replace the panels, which will come at an added expense. Furthermore, the homeowner could choose to remove the panels at virtually any time. If a home is designed to be built less-efficiently, with solar panels making up the difference, then the homeowner is left with a baseline home that will consume more energy over its lifespan.

NRDC proposes allowing renewable energy to contribute to the ERI score, but only if the home without renewable energy meets a certain threshold value, reflected in Table R406.4.1.

Cost Impact: Will not increase the cost of construction
This proposal offers clarification of code language by linking the ERI compliance option to the RESNET standard and specifying how to account for renewable energy. The proposal only affects homes installing solar panels and using the ERI compliance path, which is only one compliance *option* available to builders. The code *requirements* are not proposed to be changed, rather clarified for builders choosing this very specific scenario. This proposal does not affect the cost of construction available to the builder under other compliance options.

Analysis: A review of the standard(s) proposed for inclusion in the code, ANSI/RESNET/ICC 301-2014 (Republished January 2016), with regard to the ICC criteria for
referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 1, 2016.

RE168-16 : R406.3-URBANEK12997

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is a similar concept to what the Committee already approved in their prior action on RE166-16. The langauge concerning HERS reference might be problem.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Center for the Polyurethanes Industry of the American Chemistry Council and the Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.4.1 Renewable energy systems. The use of renewable energy systems is permitted to be considered in meeting the values listed in Table R406.4 only if the ERI for the proposed residential building without renewable energy systems is less than or equal to the appropriate value listed in Table R406.4.1. When on-site renewable energy is included for compliance using the ERI analysis in accordance with this section, the building shall meet the mandatory requirements with Section R406.2 and the building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

Commenter's Reason: RE 168-16 was submitted to clarify the use of ANSI/RESNET/ICC 301-2014 (RESNET 301). While RESNET 301was not ready for adoption into the 2015 IECC, it was generally understood that it would be proposed for inclusion into the 2018 IECC as an option for compliance via the ERI path. This modification specifies eligible and mandatory requirements for compliance under the ERI.

The 2015 IECC ERI path does not address the inclusion of onsite renewable power generation for code compliance using ERI calculation tools, including RESNET 301. The application of the ERI path and use of software compliance tools require a full consideration of several pieces of the code, including climate zone, mandatory provisions including backstops, and approved software tools; none of these code provisions stand alone. A review of the bibliography included with the reason statement for RE173 provides additional background on the inclusion of RESNET 301 into the IECC; and the HERS Index paper (Dillon) includes a reference to the inclusion of onsite power production.

The Center for the Polyurethanes Industry (CPI) of the American Chemistry Council (ACC) recommends an approach that provides for the use of onsite renewable power production for ERI path compliance while maintaining rigorous energy conservation standards.

ACC recommends approval of RE 168-16 as modified by this public comment, which will:

• Permit onsite power production to be used to offset energy use and included in the ERI calculation under Section R406.

• Establish a more stringent backstop for the ERI path when on-site renewable energy is included in the ERI analysis by setting the baseline for mandatory minimum envelope efficiency with the 2015 IECC prescriptive path.

• Retain the current 2009 IECC prescriptive path backstops for ERI calculation of buildings that do not incorporate on- site power production.

As the use of distributed generation in homes becomes more prevalent, it is important to address its role in the building energy code. This public comment establishes an easily enforceable path that safeguards current efficiency levels and allows for the responsible use of onsite power that does not cannibalize current efficiency levels.

Public Comment 2:

Proponent : Lauren Urbanek, representing NRDC (lurbanek@nrdc.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~**R406.3.1 (N1106.3.1) ERI reference design.** The *ERI reference design* shall be configured in accordance with the HERS Reference Home as described in RESNET/ICC 301.~~

~~The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.~~

Commenter's Reason: This proposal should be approved as modified. The proposal serves two purposes: (a) to formally link the definition of the Energy Rating Index (ERI) to the ANSI/RESNET/ICC 301-2014 standard and (b) create a reasonable pathway to allow a limited amount of credit for on-site renewable energy in the 2018 code.

Purpose (a) of this proposal serves the same function as RE166-16, the RESNET proposal to reference the ANSI/RESNET/ICC 301 standard in the ERI path of the code. The language in this part of the proposal was modified by striking out section R406.3.1, to be identical to the language approved by the Technical Advisory Committee for RE166-16 at the hearings held in April 2016 in Louisville, KY.

However, the ANSI/RESNET/ICC 301 standard does not include a limit on the amount of on-site power generation that may be used to comply with the ERI score. If RE166-16 was to be adopted without adopting any other proposal to limit on-site generation, there is the real risk that a substantial portion of the ERI score could be met with renewable generation systems, thereby undercutting the energy efficiency goals of the code. A medium-sized solar PV installation is worth approximately 35 ERI points, meaning homes could be built with fewer efficiency measures, which would result in homes that are less efficient than the 2009 code. This would create chaos for both state and local adoption levels, as this would result in a rollback of the state's code. An unlimited solar provision would also create confusion for code officials enforcing the code, as they would have little idea if the system was optimally installed. That being said, it is reasonable to recognize the benefits of on-site renewable energy generation in the code and to provide a limited amount of credit to builders who choose to utilize this option for their customers. Therefore, purpose (b) of this proposal is necessary in order to protect consumers and ensure that efficiency is prioritized while recognizing the code's power as a policy tool.

This proposal should be approved regardless of the other proposals that passed the TAC. Leading Builders of America's proposal RE173-16 proposes to increase the ERI scores in Table 406.4. Even if that proposal is upheld (which NRDC does not support), this proposal, RE168-16, can and should be approved. As states adopt the ERI path with various modifications to the scores, this proposal puts in place a reasonable, easy-to-understand framework for allowing a limited amount of renewable energy.

Builders may have additional incentive to prioritize renewable energy, particularly PV, over efficiency. Given the innovative financing options available, builders may be able to work with solar companies to install PV at no cost of materials or construction. In this situation, the homeowner then enters into a power purchase agreement directly with the solar provider. If solar is allowed as a substitute for efficiency, the baseline home will use more energy, the solar system will need to be larger (and therefore more expensive), and the home will be more vulnerable to higher bills if and when the solar system is removed.

None of these issues factor into the *builder's* decision-making, but they directly affect the *homeowner* over the lifetime of the home. A recent study by the Florida Solar Energy Center (available at http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-2025-16.pdf (http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-2025-16.pdf)) found that **complying with the 2015 ERI scores is highly cost-effective for consumers in all climate zones**, with a savings-to-investment ratio of greater than two in all cases (meaning that homeowners save more than double their investment in increased efficiency). The same study found that **it is much more cost-effective for a homeowner to comply with the ERI scores using only energy efficiency than by using renewable energy**. *The code is in place for the benefit of the end user: the homeowner.* A strong code ensures that home buyers receive a high-quality product that is relatively standardized, no matter where or by whom the home is built. Allowing unlimited renewable credit to take the place of efficiency measures in the code adds uncertainty for the home buyer.

In addition to the energy conservation intent of the code, homeowners benefit from a more efficient home even if much of their load is offset by PV or another renewable source. Energy efficiency upgrades promoted in the code, like insulation and air sealing, are essentially permanent and difficult to remove. While the lifespan of solar panels is improving, the output of the panels decreases over time. A homeowner will eventually need to replace the panels, which will come at an added expense. Furthermore, the homeowner could choose to remove the panels at virtually any time. If a home is designed to be built less-efficiently, with solar panels making up the difference, then the homeowner is left with a baseline home that will consume more energy over its lifespan.

NRDC proposes allowing renewable energy to contribute to the ERI score, but only if the home without renewable energy meets a certain threshold value, reflected in Table R406.4.1. This proposal should be approved as modified.

RE168-16

RE170-16

R406.3.1 (IRC N1106.3.1)

Proposed Change as Submitted

Proponent : Craig Conner, representing self (craig.conner@mac.com); Kendra Cardinale, representing Building Quality

2015 International Energy Conservation Code

Revise as follows:

R406.3.1 (N1106.3.1) ERI reference design. The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements.

The proposed *residential building* shall be shown to have an annual ~~total normalized modified load~~ energy cost less than or equal to the annual ~~total loads~~ energy cost of the ~~*ERI reference design*~~ERI reference design based on RESNET 301. The ERI shall be computed based on the energy cost of the proposed building compared to the energy cost of the reference design building in accordance with Equation 4-1 instead of Section 4.1 of RESNET 301.

ERI = (proposed design) / (reference design). **(Equation 4-1)**

where,

proposed design = annual energy cost for proposed building

reference design = annual energy cost for reference design building

Reference standards type: This reference standard is new to the ICC Code Books

Add new standard(s) as follows:

ICC/RESNET 301-2014, Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using the HERS Index,(Republished January 15, 2016)

Reason: This change retains most of the RESNET calculation, but specifies the use of energy cost. Energy cost is already used in the IECC. A proposed building with an energy cost less than or equal to the IECC building would comply.

The part of the HERS index calculation replaced by this change is inconsistent with the IECC. That calculation, shown below, is effectively proprietary. The IECC should not require a calculation that is only used by those associated with RESNET. The "proprietary" calculation would become "energy cost" with this change. To see how odd that calculation is, just try to read the RESNET calculation below.

The language in ANSI/RESNET 301-2014 that is **removed** by this change is shown below:

4.1 **Determining the HERS Index**.The HERS Index for a residential building shall be determined in accordance with Sections 4.1.1 and 4.1.2.

4.1.1. Calculating End Use Loads. The normalized Modified End Use Loads (nMEUL) for space heating and cooling and domestic hot water use shall each be determined in accordance with Equation 4.1-1:

nMEUL = REUL * (nEC_x / EC_r) (Eq 4.1-1)

where:

nMEUL = normalized Modified End Use Loads (for heating, cooling, or hot water) as computed using an Approved Software Rating Tool.

REUL = Reference Home End Use Loads (for heating, cooling or hot water) as computed using an Approved Software Rating Tool.

nEC_x = normalized Energy Consumption for the Rated Home's end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.

EC_r = estimated Energy Consumption for the Reference Home's end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.

and where:

nEC_x = (a* EEC_x – b)*(EC_x * EC_r * DSE_r) / (EEC_x * REUL)   (Eq 4.1-1a)

where:

EC_x = estimated Energy Consumption for the Rated Home's end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.

EEC_x = Equipment Efficiency Coefficient for the Rated Home's equipment, such that EEC_x equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer's Equipment Performance Rating (MEPR) such that EEC_x equals 1.0 / MEPR for AFUE, COP or EF ratings, or such that EEC_x equals 3.413 / MEPR for HSPF, EER or SEER ratings.

DSE_r = REUL/EC_r * EEC_r

For simplified system performance methods, DSE_r equals 0.80 for heating and cooling systems and 1.00 for hot water systems [see Table 4.2.2(1)]. However, for detailed modeling of heating and cooling systems, DSE_r may be less than 0.80 as a result of part load performance degradation, coil air flow degradation, improper system charge and auxiliary resistance heating for heat pumps. Except as otherwise provided by these Standards, where detailed systems modeling is employed, it must be applied equally to both the Reference and the Rated Homes.

EEC_r = Equipment Efficiency Coefficient for the Reference Home's equipment, such that EEC_r equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer's Equipment Performance Rating (MEPR) such that EEC_r equals 1.0 / MEPR for AFUE, COP or EF ratings, or such that EEC_r equals 3.413 / MEPR for HSPF, EER or SEER ratings and where the coefficients 'a' and 'b' are as defined by Table 4.2.1(1) below:

Table 4.2.1(1) Coefficients "a" and "b"

Fuel type and End Use	**a**	**b**
Electric space heating	2.2561	0
Fossil fuel* space heating	1.0943	0.4030
Biomass space heating	0.8850	0.4047
Electric air conditioning	3.8090	0
Electric water heating	0.9200	0
Fossil fuel* water heating	1.1877	1.0130

*Such as natural gas, liquid propane gas, fuel oil

4.1.2. Calculating the HERS Index. The HERS Index shall be determined in accordance with Equation 4.1-2:

HERS Index = PEfrac * (TnML / TRL) * 100   (Eq 4.1-2)

where:

TnML = $nMEUL_{HEAT} + nMEUL_{COOL} + nMEUL_{HW} + EUL_{LA}$ (MBtu/y).

TRL = $REUL_{HEAT} + REUL_{COOL} + REUL_{HW} + REUL_{LA}$ (MBtu/y).

and where:

EUL_{LA} = The Rated Home end use loads for lighting, appliances and MELs as defined by Section 4.2.2.5.2, converted to MBtu/y, where MBtu/y = (kWh/y)/293 or (therms/y)/10, as appropriate.

$REUL_{LA}$ = The Reference Home end use loads for lighting, appliances and MELs as defined by Section 4.2.2.5.1, converted to MBtu/y, where MBtu/y = (kWh/y)/293 or (therms/y)/10, as appropriate.

and where:

PEfrac = (TEU - OPP) / TEU

TEU = Total energy use of the Rated Home including all rated and non-rated energy features where all fossil fuel site energy uses (Btu_{fossil}) are converted to equivalent electric energy use (kWh_{eq}) in accordance with Equation 4.1-3.

OPP = On-Site Power Production as defined by Section 5.1.1.4 of this Standard.

$$kWh_{eq} = (Btu_{fossil} * 0.40) / 3412 \qquad \textbf{(Eq 4.1-3)}$$

Cost Impact: Will not increase the cost of construction
The RESNET 301 standard uses a significantly different calculation from the IECC's energy cost calculation. As a consequence, some have set the required "score" lower to ensure that a RESNET-scored house is really going to meet the IECC. Moving the RESNET calculation to the IECC-type cost calculation will tend to reduce the need to make the ERI score so low. Therefore, by aligning the IECC and RESNET calculation this proposed change will tend to reduce the cost of construction.

RE170-16 : R406.3.1-CONNER12917

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The Committee approved a prior proposal for using the RESNET 301 standard for the ERI compliance path. That directs these discussions of source energy issues and energy cost issues into the hands of those involved in that standard process. As such this isn't something that the cost needs to have in it.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Craig Conner, representing self (craig.conner@mac.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.3.1 (N1106.3.1) ERI reference design. The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements.

The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301.

Alternatively, the proposed *residential building* shall be shown to have an annual energy cost less than or equal to the annual energy cost of the ERI reference design based on RESNET 301. The ERI shall be computed based on the energy cost of the proposed building compared to the energy cost of the reference design building in accordance with Equation 4-1 instead of Section 4.1 of RESNET 301.

ERI = (proposed design) / (reference design). **(Equation 4-1)**

where,

proposed design = annual energy cost for proposed building

reference design = annual energy cost for reference design building

Commenter's Reason: This change allows the option for an ERI based on energy cost. It accommodates an energy cost change RESNET is currently considering for the ERI. It accelerates broader use of the ERI for those already using energy cost.

RESNET has a task group looking at using energy cost for the ERI. As in IECC Section R405.3, the energy cost of the proposed home would be compared to the energy cost of the RESNET 301 reference design home. The 2018 IECC can only reference the existing ANSI/ICC/RESNET 301-2014, not a future version. However, the 2018 IECC/IRC can be set up to allow that future RESNET change by making energy cost an option in the ERI.

Cost-based tradeoffs are preferred by most. The IECC uses energy cost as described in the IECC's performance calculation in Section R405.3 Section. Because cost-based tradeoffs are already widely used, this change means others will have less to change to use the ERI path.

RESNET 301's primary functions are to define a base case ("reference design"), specify the minimum rated features, and specify certification/labeling. This change would retain all those RESNET 301 functions without modification. This change simply allows energy cost instead of the complicated equation with the odd name ("normalized modified end use load"), shown above in the original proposal.

The RESNET existing equation was developed as a "compromise" between gas and electric interests many years ago. Neither gas nor electric interests like that equation now. Gas and electric parties recently made competing and significantly different proposals for gas and electric calculations. Both gas and electric parties view energy cost as an acceptable second choice, an acceptable option. Both gas and electric parties are involved in the RESNET task group to explore how energy cost could be integrated into RESNET 301.

A different proposal (RE166) corrects another RESNET 301 standard issue with ventilation. RE166 and this change work fine together. Both changes should be approved.

This change helps to set up RESNET 301 and the ERI for greater use in the future.

RE170-16

RE173-16

Table R406.4 (IRC Table N1106.4)

Proposed Change as Submitted

Proponent : Amanda Hickman, InterCode Incorporated, representing Leading Builders of America (amanda@intercodeinc.com)

2015 International Energy Conservation Code

Revise as follows:

TABLE R406.4 (N1106.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	~~52~~57
2	~~52~~57
3	~~51~~57
4	~~54~~62
5	~~55~~61
6	~~54~~61
7	~~53~~58
8	~~53~~58

Reason: Some estimates have put the ERI scores for homes built to the 2015 prescriptive code as high as 79. This proposal is intended to produce substantial additional energy savings compared to the current or proposed levels of prescriptive requirements in the 2015 IECC, while allowing considerably greater flexibility to builders using a method with which a large segment of the market is already familiar. This flexibility is likely to result in lower construction costs for any given level of energy efficiency. Builders who do not make use of this proposed method are still able to comply with the code using any of the existing compliance pathways.

The revised ERI values in the proposal were based on an additional 10 percent savings beyond 2012 with 2014 NAECA HVAC and water heating equipment efficiencies. The values can also be achieved using heating, cooling, and water heating equipment efficiency levels higher than NAECA minimum levels in the Northern and Southern parts of the country. The resulting ERI values are considered cost effective in all climate zones and will result in increased efficiency for residential construction over the 2012 IECC.

While the ERI values will provide flexibility, the 2009 IECC residential envelope requirements have been set as a backstop in the ERI path for the least efficient level of efficiency for insulation R-values, glazing U-factor and SHGC. This proposal also requires complying with the applicable mandatory requirements to be consistent with the Above Code section in the IECC. And because energy losses in the domestic hot water distribution system fall outside the scope of the energy rating index as it can be calculated with 2012 methodology, current code provisions relating to hot water pipe insulation are mandatory as well.

Since the final action hearings and publication of the 2015 IECC, the "Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using the Energy Rating Index" (ANSI/RESNET/ICC 301-2014) was published. This standard development change required software vendors to make changes to their software to comply with the requirements of the new standard.

These changes have caused the ERI scores to increase by an estimated 2 to 3 points due to infiltration and ventilation changes, and decrease by an estimated 1 to 2 points due to changes related to efficient domestic water heating. This results in a net change of 1 to 2 points in ERI Scores.

The proposed ERI numbers take all of the aforementioned adjustments into account.

Sources:

1. RE188-13 Public Comment #2 Reason statement: Eric Makela, Britt/Makela Group, representing self, Ron Burton, representing Leading Builders of America, David Goldstein, representing National Resource Defense Council, and Meg Waltner, representing National Resource Defense Council

2. *"Upcoming Changes to the HERS Index and Potential Impact on HERS Index Scores"*

Bibliography:

Cost Impact: Will not increase the cost of construction
Because this proposal provides more flexibility, it is likely to result in lower construction costs for any given level of energy efficiency.

RE173-16 :
TABLE R406.4-
HICKMAN13156

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The revised index numbers are realistic and are still difficult to achieve. There have been changes in the RESNET standards because of water heating equipment so the revised index numbers cannot be compared to the current index numbers. The revised index numbers are a compromise that can advocate for the adoption of the IECC without having the ERI method being ammended out at adoption. In one state where the IECC is adopted and the ERI method is left intact, no one uses the ERI method because the index numbers are far too difficult to achieve. The revised index numbers might encourage use of the ERI method to achieve higher performing buildings.

Assembly Motion: **Disapprove**
Online Vote Results: **Failed**
Support: 48.58% (120) Oppose: 51.42% (127)
Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Center for the Polyurethanes Industry of the American Chemistry Council and the Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R406.4 (N1106.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX[a]
1	57
2	57
3	57
4	62
5	61
6	61
7	58
8	58

<u>a. When on-site renewable energy is included for compliance using the ERI analysis per Section R406.4, the building shall meet the mandatory requirements with Section R406.2 and the building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.</u>

Commenter's Reason: RE 173-16 was submitted by the Leading Buiders of America (LBA) to adjust the ERI as quantified by the Energy Rating Index (ERI) values in Table R406.4. (N1106.4) in order to correlate changes with the published version of ANSI/RESNET/ICC 301-2014 (RESNET 301). While RESNET 301was not ready for adoption into the 2015 IECC, it was generally understood that it would be proposed for inclusion into the 2018 IECC as an option for compliance via the ERI path. In fact, RESNET 301 was proposed for inclusion into the 2018 IECC via RE166-16, which was recommended for Approval as Submitted by the IECC-R Committee. This modification specifies eligible and mandatory requirements for compliance under the ERI.

The 2015 IECC ERI path does not address the inclusion of onsite renewable power generation for code compliance using ERI calculation tools, including RESNET 301. The application of the ERI path and use of software compliance tools require a full consideration of several pieces of the code, including climate zone, mandatory provisions including backstops, and approved software tools; none of these code provisions stand alone. A review of the bibliography included with the reason statement for RE173 provides additional background on the inclusion of RESNET 301 into the IECC; and the HERS Index paper (Dillon) includes a reference to the inclusion of onsite power production.

The Center for the Polyurethanes Industry (CPI) of the American Chemistry Council (ACC) recommends an approach that provides for the use of onsite renewable power production for ERI path compliance while maintaining rigorous energy conservation standards.

ACC recommends approval of RE 173-16 as modified by this public comment, which will:

• Permit onsite power production to be used to offset energy use and included in the ERI calculation under Section R406.

• Establish a more stringent backstop for the ERI path when on-site renewable energy is included in the ERI analysis by setting the baseline for mandatory minimum envelope efficiency with the 2015 IECC prescriptive path.

• Retain the current 2009 IECC prescriptive path backstops for ERI calculation of buildings that do not incorporate on- site power production.

As the use of distributed generation in homes becomes more prevalent, it is important to address its role in the building energy code. This public comment establishes an easily enforceable path that safeguards current efficiency levels and allows for the responsible use of onsite power that does not cannibalize current efficiency levels.

Proponent : Vickie Lovell, InterCode Incorporated, representing Leading Builders of America (vickie@intercodeinc.com) requests Approve as Submitted.

Commenter's Reason: For comparison, the ERI Values in R406 published in the 2015 and the 2018 Editions of this International Energy Conservation Code are as follows:

Table R406 ERI Values

Climate Zone	2015 ERI	Proposed 2018 ERI
1	52	57
2	52	57
3	51	57
4	54	62
5	55	61
6	54	61
7	53	58
8	53	58

During the 2015 code development process 2014 final action hearings, a public comment that would have increased (higher) ERI values received more than 50% of the voting audience for Approval as Modified, but barely failed to reach the super majority of 66%. So, there was support at that time to consider adjusting the scores slightly upward.

Since the final action hearings in 2014, there is another reason to increase the scores - the publication of the "Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using the Energy Rating Index" (ANSI/RESNET/ICC 301-2014) has been published.

This new standard change requires software vendors to revise the software they had previously developed for home energy raters in order to comply with the requirements of the new standard and the new code requirements. These changes have been completed by all of the vendors. As a result, Energy Rating Index values will increase by 2 to 3 points simply based on the new requirements of Standard 301-2014 and the text of 2015 IECC. The paper published early in 2015 ("Upcoming Changes to the HERS Index and Potential Impact on HERS Index Scores", April 2015, predicted that this would occur.

To investigate the impact of the software changes to the calculation standard on the proposed ERI values, the Dillon Group*, a home energy rater and energy consulting firm, ran 52 simulations at those specific Index values using the latest software version from NORESCO. REM/Rate v15.0 is RESNET-accredited and compliant with ANSI/RESNET/ICC Standard 301-2014. The results are as follows:

A 2015 ERI score of 59 using old software increased to 62; 63 increased to 64; 62 increased to 63; and 60 increased to 62, respectively.

The results are based on a limited sample size based on ERI values, but align with results from other simulation runs in other analyses that compare the changes between old software versions (pre-301-2014 compliance to post-301-2014 compliance) and the predicted increase, including an analysis performed by Philip Fairey of the Florida Solar Energy Center. There have been a number of other Raters and Rating Providers that have stated that the Index values of simulations they have performed have increased beyond the predicted increase and results.

After considering a number of analyses from different sources, the increased ERI scores being proposed in this table would be a conservative increase in the ERI value in the 2018 IECC due to the changes in the software. However, even with the slight increase, an energy rated home using ANSI/RESNET/ICC 301 and the proposed 2018 ERI values would still generate a better score and better performing home than the minimum prescriptive requirements of the 2015 IECC or any older Edition of the IECC.

The basis for that claim is a review of RESNET findings. RESNET has reported ratings from more than 610,000 homes during the past 4 years, averaging a HERS Index of 64 (in the HERS world the Index is a whole integer rounded up to the next whole number so 63.5 would be published by RESNET as 64).

The Dillon Group* recently ran more than 2,500 simulations taking in to account various house sizes and foundation types using the 2015 IECC prescriptive path requirements. In those simulations in Climate Zone 1, the ratings were between 73-80. In Climate Zone 2, the ratings ranged from 71-78, for example.

Although the slight increase in ERI values in this proposal has been criticized as a "rollback" by some energy advocates in an attempt to discourage the use and adoption of the 2018 ERI, the new values are actually only a slight increase based on equivalency with the values generated from the software pre-2014 ANSI/RESNET/ICC 301 Standard and 2015 IECC Table R406.4.

Homes that achieve scores that are the proposed new ERI values will be homes that are more than 10% (+/-) energy efficient than the 2015 IECC prescriptive path, depending on climate zone. So "rollback" does not accurately describe this code change. More realistic target ERI scores will actually encourage the use of the ERI alternate compliance path, which will result in more code adoptions and enforcement of the 2018 IECC.

* The Dillon Group, Inc. (http://www.thedillongroupinc.com/consulting-services/), is a consulting firm specializing in strategy, sustainability, education, building science, and residential construction. (http://www.thedillongroupinc.com) (http://www.thedillongroupinc.com)

Proponent : David Bixby, Air Conditioning Contractors of America, representing Air Conditioning Contractors of America (david.bixby@acca.org) requests Approve as Submitted.

Commenter's Reason: ACCA supports the committee's action to approve as submitted. This proposal will lower costs and allow for easier transition to more costly and stringent energy codes. It will probably increase compliance with the section as well.

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Disapprove.

Commenter's Reason: This code change raises the required ERI scores. The committee approved the change and a floor motion for denial failed 49/51%.

The AIA believes that this proposal would roll back the energy efficiency of the IECC. Any changes to the ERI should not weaken the performance of the code but instead offer users flexibility and encourage innovation in how they achieve the required ERI score in their climate zone. Such a change is not justified and undermines the purpose of the IECC.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); William Prindle, ICF International, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net) requests Disapprove.

Commenter's Reason: This proposal should be <u>disapproved</u> because it **reduces the efficiency of the IECC for those homes that comply with the ERI compliance path by between 9% and 15%**, depending on climate zone. An increase in the ERI target index scores by any amount increases the allowable energy use of homes under that compliance path, making the 2018 IECC clearly and significantly less efficient than the 2015 IECC if RE173 is adopted. ICC voters rejected a similar set of higher ERI numbers in the previous cycle, and we strongly urge voters to reject such a huge code/efficiency rollback.

- **The current ERI scores were approved by U.S. DOE as part of its most recent IECC efficiency determination on the 2015 IECC; increasing these scores will roll back the 2015 requirements, and can be expected to result in a negative DOE determination and create problems for states.**

As required by federal law, U.S. DOE reviewed the 2015 IECC and determined that it represents an improvement in efficiency over the 2012 IECC. As part of that determination, DOE noted that "most homes built using the ERI path, as specified in the 2015 IECC, are likely to be at least as efficient as the homes built to meet the prescriptive requirements of the IECC, or the traditional performance path."

The proposed higher ERI scores in the 2018 IECC would create a range of problems for U.S. DOE and for states. For example, as with any large efficiency rollback, U.S. DOE can be expected to find that this rollback is a substantial decrease in energy efficiency under its determination. States that have already adopted the 2015 IECC ERI scores may have no option other than to skip adoption of the 2018 IECC, because some state statutes do not permit steps backward in energy efficiency. Furthermore, states may need to amend the ERI scores to ensure that the 2018 IECC does not result in a step backward. It is also not clear whether DOE would be able to continue to provide technical and financial support to states considering the 2018 IECC if the weaker ERI scores result in a "negative" determination by DOE. As building departments and state budgets have seen decreases in recent years, DOE funding and technical support has become increasingly important for many states.

- **The current ERI scores (51-55) are reasonably achievable.**

Because the ERI calculation methodology is similar to the HERS methodology, one need only look to the number of HERS ratings and ranges of scores to see that ERI scores in the 2015 IECC range are already being achieved around the country. RESNET recently reported that over 190,000 homes were HERS-rated in the U.S. in 2015 (HERS is largely comparable to ERI). Interestingly, RESNET also reported that the *average* HERS score nationwide was 62, even though most states have not yet completed the update to the 2015 IECC (with the ERI option). In several states that enforce the 2009 IECC, for example, the average HERS score was often only a few points off the 2015 IECC ERI numbers. We expect that as these states move to adopt the 2015 or 2018 IECC, those builders who are not already meeting the 2015 IECC ERI scores should be able to meet them without a great deal of additional effort. Indeed, when the weaker "compromise" scores proposed this cycle in RE173 were not approved last cycle, builders supported adoption of the current ERI compliance path with the current level of ERI scores.

- **The current ERI scores are consistent with the overall efficiency of the 2015 IECC.**

The proponent's original reason statement suggests that "some estimates" put IECC-equivalent ERI scores "as high as 79." Estimates like this are simply wrong and ignore the complexity and difficulty associated with comparing a component-based compliance path (such as the IECC prescriptive path) with an "all energy use" path like the ERI. A direct comparison between these compliance options is complicated at best. Analyses or statements that put forward a single ERI score as a representative "equivalent" to any edition of the IECC are far too simplified and ignore the reality that the results will vary substantially. Note that even within the current ERI, scores range between 51 and 55 among the various climate zones.

The most comprehensive published study of the IECC and energy ratings is an analysis undertaken by PNNL for the U.S. DOE that compared the HERS methodology with the 2012 IECC. *See* U.S. Department of Energy, *Identification of RESNET HERS Index Values Corresponding to Minimal Compliance with the IECC Performance Path* (May 2014). Given the similarities between HERS and ERI, and the 2012 and 2015 IECC, the study is a useful proxy for the discussion over the 2015 IECC and the ERI. After running nearly 60,000 model simulations, DOE concluded that **the "equivalent" HERS scores ranged broadly – by up to 26 points**, not even including HERS credits for water heating or on-site power production – and that there is no "single score" equivalent to the 2012 IECC. DOE ultimately concluded that "the [2015 IECC] ERIs are generally very near the conservative end of possible values, but not quite so low as to always guarantee that a home complying via the ERI path would also comply via the Performance Path." In other words, even the 2015 IECC ERI scores would be weaker than the efficiency required by the other compliance options in some cases; increasing the ERI scores would only increase the likelihood that more homes would be built to a weaker standard than what is already required by the IECC under other compliance paths. It should be clearly understood that the DOE analysis did not even take into consideration two key items that would reduce the scores even further – more efficient water heating and on-site generation.

- **The Committee reason statement for RE173 misses several critical points.**

The Committee Reason Statement for RE173 claims that "one state where the IECC is adopted and the ERI method is left intact, no one uses the ERI method because the index numbers are far too difficult to achieve." Here are some facts to consider on this point:

- At the time of the Committee Action Hearings, at least 5 states had already adopted the ERI with index numbers consistent with the 2015 IECC: Maryland, Illinois, Michigan, New Jersey, and New York. Several other states had also adopted the ERI with changes – some minor, some major – and other states have either adopted the ERI since then or are in the process of doing so.
- As outlined above, hundreds of thousands of homes are already HERS rated, and as the IECC ERI continues to be implemented, many of these HERS-rated homes may already be "ERI-ready," since the ERI methodology is similar to HERS.

The Committee also claimed that "The revised index numbers might encourage use of the ERI method to achieve higher performance buildings." Again, this comment misses a key issue – for those states that have already (or will soon) adopt the 2015 IECC ERI scores, this proposal will result in *lower performance* buildings, not higher.

To at least maintain the efficiency of the 2015 IECC, we recommend that RE173 be <u>disapproved</u>.

Proponent : Darren Meyers, International Energy Conservation Consultants, representing International Energy Conservation Consultants (dmeyers@ieccode.com) requests Disapprove.

Commenter's Reason: U.S. code enforcement should DISAPPROVE RE173-16.

Summary. The Reason why U.S. code enforcement should DISAPPROVE RE173 is, regrettably, the Energy Rating Index 'ERI', formerly known as the RESNET's Home Energy Rating System 'HERS Index' relies on a methodology that can vary 15 to 18 ERI/HERS points around a median set of 2015 IECC Baseline, code compliant building characteristics

In other words:

Larger houses (s.f.) receive more favorable (lower) ERI/HERS Indices compared to smaller houses. No solution to such relationship is included in the proposal.

ERI/HERS points are granted for ceiling fans, refrigerators, dish washing equipment, microwave ovens and washer/dryer combinations that are considered "portable" and outside a code official's inspection purview.

In every Climate Zone, Conditioned Floor Area (CFA) is the most important and [most] volatile characteristic of ERI/HERS Index. For Zones 4 and 5 [Corresponding ERI/HERS Indices] can vary 15 to 18 points around a median set of IECC Baseline, code compliant building characteristics.[i] (https://cdpaccess.com/public-comment/edit/16283#_edn10)

If compliance is based on exceeding a single number, is the volatility of up to 18 ERI/HERS points acceptable to code enforcement in determining compliance vs. non-compliance?

There is questionable validity of a volatile, single-solution-based ERI/HERS scoring system. In other words, the use of a single number to demonstrate IECC code compliance.[i] (https://cdpaccess.com/public-comment/edit/16283#_edn10)

"The HERS Index is also quite volatile with respect to conditioned floor area and HVAC efficiency,"[i] (https://cdpaccess.com/public-comment/edit/16283#_edn10) allowing lower ERI/HERS Indices for homes with poorly performing building envelopes, yet high performing equipment, "Understanding this volatility across multiple home characteristics reveals 'real-world differences' among homes complying with the IECC Section 406 ERI path and its Section 405 Performance path."[i] (https://cdpaccess.com/public-comment/edit/16283#_edn10)

"The [proposed] ERI/HERS Index path ... keys on no [specific] building characteristics, making it easy to express—in a single number for each zone—at the expense of not being responsive to variations in [home] characteristics."[i] (https://cdpaccess.com/public-comment/edit/16283#_edn10)

HERS/ERI calculations are more complicated than Prescriptive submittals or REScheck, and take more time to review, placing burdens on code enforcement. There is concern that these types of sophisticated reviews would simply not take place, thereby leading unverified structures to be built"It seems clear any HERS-based code compliance path in any location would need to account for house size using a logarithmic relationship," which is not the case in the language proposed for 2018 IECC.This means, larger houses (s.f.) receive more favorable (lower) ERI/HERS Indices compared to smaller houses.

End Notes.

[i] (https://cdpaccess.com/public-comment/edit/16283#_ednref10) PNNL Technical Report - *RESNET HERS Index Values Corresponding to Minimal Compliance with the IECC Performance Path*, PNNL-22560, Taylor T., Mendon. V, May 2014. https://www.energycodes.gov/sites/default/files/documents/HERSandIECCPerformancePath_TechnicalReport.pdf (https://www.energycodes.gov/sites/default/files/documents/HERSandIECCPerformancePath_TechnicalReport.pdf)

Proponent : Lauren Urbanek, representing NRDC (lurbanek@nrdc.org) requests Disapprove.

Commenter's Reason: This proposal should be disapproved.

The proposal increases the scores in the ERI path of the code from between 51 and 55 to between 57 and 62. This is a clear rollback in the energy efficiency of the ERI path of the code, and it would result in an increase in costs to home buyers and renters. As one of the architects of the ERI path during the 2015 IECC development cycle, NRDC agreed to the code numbers reflected in this proposal as a compromise with the builder community during the 2015 public comment process. However, the voting members chose to adopt the lower ERI numbers, which are now a part of the final 2015 code. NRDC's philosophy, which we hope that voting members share, is that the code should increase in stringency with each subsequent iteration whenever such an increase provides benefits to homeowners. We base our analysis and recommendations on the code as adopted.

The US Department of Energy is required by federal law to analyze the code and determine if it saves energy. Like NRDC, DOE performs their analysis as compared to the most recent version of the adopted code. If this proposal were to be adopted, it is clear that DOE would not be able to give a positive determination to the 2018 ERI path of the code. This outcome is sure to cause chaos for state implementation by diminishing the credibility of the IECC as a code that protects the interests of consumers. Given that NRDC advocates for clean adoption of the most recent version of the model code assuming it saves more energy than the previous version of the code, we and other efficiency advocates will likely press states continue adopting the 2015 ERI path and to not adopt the 2018 ERI path. Reducing the efficiency of the energy code erodes the credibility of the code development process and its end product, the IECC 2018.

A recent report from the Florida Solar Energy Center found the 2015 ERI numbers to be highly cost-effective for consumers. Complying with the 2015 ERI path results in higher lifecycle savings and higher net present values for a homeowner than complying with the prescriptive path. The comparison of lifecycle savings and net present values for homeowners for the 2015 prescriptive path and the 2015 ERI path are shown in the table below. **The purpose of the code is to provide benefits to the end user – the homeowner. It's clear that the ERI path provides the most benefit to the homeowner, and if the ERI numbers are made less stringent, there will be fewer benefits to homeowners.**

	2015 Prescriptive Path	2015 ERI Path

Lifecycle savings for homeowners	$3,750 - $6,745	$13,244 – 15,371
Net present value of energy improvements (Lifecycle savings minus Lifecycle costs)	$3,077 - $4,237	$6,948 - $9,332

Various participants in the code revision process are advocating that the ERI table be met either with or without any use of solar photovoltaics. The current ERI numbers in the 2015 code are achievable and realistic, even without the use of solar PV or any other type of on-site generation. The same report by the Florida Solar Energy Center found the ERI numbers in the 2015 code to be achievable with efficiency products and methods already widely in practice. There are a number of combinations of measures that builders can use to cost-effectively reach the 2015 ERI numbers. Doing so would likely include a combination of some of the following:

-100% high-efficiency lighting

-higher-efficiency HVAC (SEER 14-16 air conditioner and/or heat pump; 92-96% AFUE gas furnace depending on climate zone)

-higher-efficiency water heating (tankless or heat pump water heater)

-tighter air-handling systems

-enhanced envelope efficiency

-Energy Star refrigerator, dishwasher, and clothes washer

All of these improvements are common and many, like slightly-more-efficient HVAC equipment and Energy Star appliances, are already used on a regular basis by builders. SEER 14 air conditioners and gas furnaces with AFUE of 90 and higher are already widely popular in the market. Energy Star appliances are so prevalent that it's often difficult to buy common household appliances that are *not* Energy Star labeled. The costs of high efficiency lighting have dropped precipitously in recent years and are expected to keep declining in price.

In addition, the HERS Rating Index was recently updated to account for energy savings from certain hot water efficiency measures. When the ERI targets were set during the 2015 code cycle, the HERS system could not calculate energy savings from hot water energy efficiency measures, but now it can. This change means that *builders already get 1-3 additional ERI points for measures that are common practice*, like lower-flow plumbing fittings and efficient hot water layouts. Increasing the ERI scores even more is unnecessary and would lead to negative outcomes for homeowners.

Given that this proposal was voted down by the assembly in 2015, when the efficiency products were less available and more expensive than now, and given the various proposals being considered that give builders may receive some amount of credit for PV in the 2018 ERI method, and given the immense benefits homeowners receive from the current ERI path, this proposal should be disapproved.

RE173-16

RE174-16

R406.4 (N1106.4)

Proposed Change as Submitted

Proponent : Lauren Urbanek, Natural Resources Defense Council (lurbanek@nrdc.org)

2015 International Energy Conservation Code

R406.4 (N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4 when compared to the *ERIreference design*.

TABLE R406.4 (N1106.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	~~52~~51
2	~~52~~51
3	~~51~~49
4	~~54~~52
5	~~55~~52
6	~~54~~51
7	~~53~~50
8	~~53~~51

Reason: The purpose of this proposal is to increase the efficiency of homes built to the Energy Rating Index by 1-3 points to account for savings achievable through hot water efficiency improvements that were not previously considered in the target ERI scores. As building component technology and the efficiency of systems and equipment continues to improve, it is important to continue to promote ever-increasing levels of efficiency in the IECC. When the ERI targets were set during the 2015 code cycle, the primary rating system used to calculate compliance, the RESNET HERS system, could not calculate energy savings from certain hot water energy efficiency measures. The RESNET HERS system has since been modified to account for energy savings from certain hot water efficiency measures. These savings are based on simple and inexpensive measures such as lower-flow plumbing fittings and hot water layouts that minimize water waste.

By strengthening the ERI scores in Table R406.4, the IECC will drive further innovation, better building practices, and more energy cost savings for homeowners.

Cost Impact: Will not increase the cost of construction

This proposal adjusts the values for compliance in the ERI pathway by 1-3 points. However, this will not have an impact on the cost of construction under the ERI pathway because of recent changes made to the RESNET HERS system (the predominant rating system used for the ERI pathway). Previously, the HERS score was not able to account for energy efficiency savings from hot water efficiency measures. The HERS score was recently improved to account for these hot water efficiency measure that are already widely installed by builders at no incremental cost. These improvements include low-flow fixtures (a 1.6 GPM showerhead is equivalent in price to a higher-flow showerhead, per prices at Home Depot) and efficient plumbing layouts (this can actually reduce a builder's cost due to the use of fewer materials).

Analysis performed by the Florida Solar Energy Center determined the impact on the HERS score from these common hot water efficiency measures, and that analysis was directly used to adjust the scores in the proposal. There is no net impact on a builder – the HERS score is now just able to account for what is already happening as common building practice. This proposal simply takes into account what is already happening in the marketplace and adjusts the ERI pathway to account for changes in the way the HERS score operates.

Furthermore, this proposal makes changes to an optional path. A builder would only pursue this path voluntarily, or if they could comply more cheaply and easily than another path.

RE174-16 :
TABLE R406.4-

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This would make adoption of the code more difficult than it already is.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Center for the Polyurethanes Industry of the American Chemistry Council and the Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

TABLE R406.4 (N1106.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX[a]
1	51
2	51
3	49
4	52
5	52
6	51
7	50
8	51

a. When on-site renewable energy is included for compliance using the ERI analysis per Section R406.4, the building shall meet the mandatory requirements with Section R406.2 and the building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

Commenter's Reason: RE 174-16 was submitted by the NRDC to adjust the ERI as quantified by the Energy Rating Index (ERI) values in Table R406.4. (N1106.4) in order to correlate changes with the published version of ANSI/RESNET/ICC 301-2014 (RESNET 301). While RESNET 301was not ready for adoption into the 2015 IECC, it was generally understood that it would be proposed for inclusion into the 2018 IECC as an option for compliance via the ERI path. In fact, RESNET 301 was proposed for inclusion into the 2018 IECC via RE166-16, which was recommended for Approval as Submitted by the IECC-R Committee. This modification specifies eligible and mandatory requirements for compliance under the ERI.
The 2015 IECC ERI path does not address the inclusion of onsite renewable power generation for code compliance using ERI calculation tools, including RESNET 301. The application of the ERI path and use of software compliance tools require a full consideration of several pieces of the code, including climate zone, mandatory provisions including backstops, and approved software tools; none of these code provisions stand alone. A review of the bibliography included with the reason statement for RE173 provides additional background on the inclusion of RESNET 301 into the IECC; and the HERS Index paper (Dillon) includes a reference to the inclusion of onsite power production.
The Center for the Polyurethanes Industry (CPI) of the American Chemistry Council (ACC) recommends an approach that provides for the use of onsite renewable power production for ERI path compliance while maintaining rigorous energy conservation standards.
ACC recommends approval of RE 174-16 as modified by this public comment, which will:
• Permit onsite power production to be used to offset energy use and included in the ERI calculation under Section R406.
• Establish a more stringent backstop for the ERI path when on-site renewable energy is included in the ERI analysis by setting the baseline for mandatory minimum envelope efficiency with the 2015 IECC prescriptive path.
• Retain the current 2009 IECC prescriptive path backstops for ERI calculation of buildings that do not incorporate on- site power production.
As the use of distributed generation in homes becomes more prevalent, it is important to address its role in the building energy code. This public comment establishes an easily enforceable path that safeguards current efficiency levels and allows for the

responsible use of onsite power that does not cannibalize current efficiency levels.

RE174-16

RE175-16

R406.4.1 (New) [IRC N1106.4.1 (New)], Table R406.4.1 (New) [IRC Table N1106.4.1 (New)], R406.6.2 (IRC N1106.6.2)

Proposed Change as Submitted

Proponent : Vickie Lovell, InterCode Incorporated, representing Leading Builders of America (vickie@intercodeinc.com)

2015 International Energy Conservation Code

Add new text as follows:

R406.4.1 (N1106.4.1) On-site power production. Where on-site power is provided, the contribution of power produced on-site to the ERI shall not exceed the percentages specified in Table R406.4.1

TABLE R406.4.1 (N1106.4.1)
Credit for On-site Power Production

ENERGY RATING INDEX (ERI) of the Rated Design	% CREDIT FOR ON-SITE POWER PRODUCTION[a]
65 and above	0
64	5
63	10
62	15
61	20
60	25
59	30
58	35
57	40
56	45
55	50
54	55
53	60
52	65
51	70
50	75
49	80
48	85
47	90
46	95
45 and below	100

a. Percentage of power produced on-site applied per ERI value.

Revise as follows:

R406.6.2 (N1106.6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs, including the percentage of power produced on-site credited to the ERI, entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

Reason: This proposal creates an easy to enforce method that recognizes on-site power production, but LIMITS THE CREDIT FOR POWER PRODUCED ON-SITE THAT MAY BE APPLIED TO THE CALCULATION OF THE ERI.

The CONCEPT –

The International Code Conservation Code should not be inconsistent with the federal policy (and many state statutes) that encourage national energy independence through conservation, and incentivizes the use of on-site power generation in residential buildings. This proposal creates a compliance method that is easy to enforce and a design tool that is easy to use and understand.

A method for calculating for on-site power in the ERI is not currently required anywhere in Section 406. This proposal does NOT require on-site power production to be calculated in the ERI. It only limits how much on-site power is allowed to be considered in calculating the ERI if and when the designer chooses to incorporate on-site power in the total energy use of the rated design.

The new Table 406.6.1 promotes both energy conservation and energy production. It accomplishes this by driving improvements in the building enclosure and installed mechanical systems in order to earn greater contributions from the production of on-site power while maintaining the protections of meeting the code envelope requirements and mandatory measures in the 2009 IECC.

Homes currently have to meet the mandatory building requirements of the 2009 IECC. That does not change with the implementation of the new Table 406.4.1. Compliance with the 2009 "backstop" provisions ensure that the building itself is efficient.

The METHOD –

The proposed new Table 406.4.1 starts crediting on-site power at an ERI of 64 and moves in 5% increments per integer until 100% of on-site power produced may be applied to the ERI. The percentages in Table 406.4.1 represent those 5% increments.

The value of 65 for was selected for the Table 406.4.1 because it is the AVERAGE HERS RATING of over 610,000 new homes built since 2012 as reported by RESNET.

The designer can adjust the rated design by calculating exactly what percentage of the on site power may be utilized in the rated design to achieve a code compliant ERI scores found in Table 406.4

The new Table 406.4.1 is also designed to account for ERI scores that states and local jurisdiction may adopt that are both above and below the ERI values currently listed on Table R406.4. Table 406.4 is adaptable to states and local jurisdictions that are adopting different ERI scores different from what is contained in the 2015 IECC, such as Texas that adopted an ERI score of 65. The values in Table R406.4.1 can be applied to these higher ERI scores which would limit on-site power production consistently from state to state regardless of the ERI adopted by the states. The lower values (more stringent) than the current Table R406.4 values also "future proof" the table to account for more stringent ERI scores in later versions of the IECC.

The ENFORCEMENT –

Compliance with Table 406.4.1 is easy. The code official or plan reviewer only has to review the compliance report for the ERI score that is required for the climate zone in Table 406.4. The code official or plan reviewer then needs to verify that that the percentage of on-site power cited in the compliance report is consistent with percentage listed in Table 406.4.1.There is a companion proposal to this change to require that the percentage of onsite power used in the ERI in found in the compliance report.

The CONCLUSION

Enabling new paths to achieve energy efficiency creates new opportunities for even greater innovation is part of the stated purpose of the IECC. This is yet another option, the most stringent yet flexible of all the compliance options within the IECC, for consumers and builders. Power produced on-site is gaining steadily in popularity with homeowners and can help reduce the compliance costs for builders, making homes more affordable to build and to live in.

Cost Impact: Will not increase the cost of construction
Because on-site power production is not required to achieve code compliant Energy Rating Index values and this proposal only limits the amount of on-site power produced that can be applied to reduce the ERI to achieve code compliance, there is no direct cost impact.
Cost-effectiveness: This change is cost-effective because it is expected to provide neutral or positive energy impact and builders are not required to use on-site power production to reach code compliant Energy Rating Index values.

RE175-16 :
R406.4.1 (NEW)-
LOVELL12664

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: The Committee is not sure how this calculation method works with ERI.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Vickie Lovell, InterCode Incorporated, representing Leading Builders of America (vickie@intercodeinc.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.4.1 (N1106.4.1) On-site renewable power production. Where ~~on-site~~ renewable power produced on-site is provided, the contribution of on-site renewable power ~~produced on-site~~ that is permitted to be credited to the ERI shall not exceed the ~~percentages~~ factors specified in Table R406.4.1

TABLE R406.4.1 (N1106.4.1)
~~Credit for~~ Maximum On-site Renewable Power Production Credit

Factor for Maximum On-Site Renewable Power Production Permitted to be Applied to ERI Calculation[a]	ERI for Rated Design[b]
0.00	65 or higher
0.05	64
0.10	63
0.15	62
0.20	61
0.25	60
0.30	59
0.35	58
0.40	57
0.45	56
0.50	55
0.55	54
0.60	53
0.65	52
0.70	51
0.75	50
0.80	49
0.85	48
0.90	47
0.95	46
1.00	45 or lower

a. ~~Percentage~~ Where on-site renewable power is provided, Equation 4.1-2 of ~~power produced on-site applied per~~ ANSI/RESNET/ICC 301-2014 shall be permitted to be modified using the factors in Table R406.4.1 as follows:
Purchased Energy fraction = [(Total Energy Use) - (On-site Renewable Power Production - (On-site Renewable Power Production* (1 - factor from Table R406.4.1)))] / (Total Energy Use)
b. ERI ~~value~~ for rated designs in specific climate zones shall comply with Table R406.4.

R406.6.2 ~~(N1106.6.2)~~ Compliance report. Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection

checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs, including the ~~percentage~~ contribution of renewable power produced on-site ~~credited~~ applied to the ERI, entered by the user necessary to reproduce the results.

3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

Commenter's Reason: This proposal creates an easy to enforce method that recognizes the usefulness of on-site renewable power production, but LIMITS THE CREDIT FOR RENEWABLE POWER PRODUCED ON-SITE THAT MAY BE APPLIED TO THE CALCULATION OF THE ERI.

The International Energy Conservation Code cannot be inconsistent with the federal policy that encourages national energy independence and the use of on-site renewable power, particularly in residential buildings. This proposal creates an easy to enforce method that recognizes on-site renewable power production, but limits for renewable power produced on-site that may be applied in the calculation of the ERI. It creates an easy to enforce, code compliant pathway to net zero homes, which is the stated goal of our federal energy policy, without sacrificing the energy efficiency gains from previous code cycles that are currently in the IECC.

A method for calculating for on-site renewable power in the 2015 ERI is not currently required anywhere in Section 406. This proposal/public comment does NOT require on-site renewable power production to be calculated in the ERI. It only limits how much on-site renewable power is allowed to be considered in calculating the ERI if, and when, the designer chooses to incorporate on-site renewable power in the total energy use of the rated design.

The new Table R406.4.1 promotes both energy conservation and energy production. It accomplishes this by driving improvements in the building enclosure and installed mechanical systems in order to qualify for greater contributions from the production of on-site renewable power, while maintaining the envelope requirements and mandatory measures in the 2009 IECC.

Homes currently have to meet the mandatory requirements of the 2009 IECC. That does not change with the implementation of the new Table R406.4.1. Compliance with the 2009 are the "backstop" provisions to ensure that the building itself is efficient.

The Concept –

The Energy Rating Index is calculated as the ratio of energy loads for heating, cooling, water heating, lighting, and appliances between the rated design (a description of the proposed building used to determine the energy rating index) and the corresponding ERI reference design (a version of the rated design that meets the minimum requirements of the 2006 International Energy Conservation Code). The ratio would be permitted by this proposal to be modified by the Purchased Energy Fraction in the Equation # Eq. 4.1-2 in ANSI/RESNET/ICC 301 to adjust the Index for on-site renewable power production. The result would then be multiplied by 100 to turn it into a whole number (always rounded up) for the rated design.

The Method –

The proposed new Table R406.4.1 starts crediting on-site renewable power at an ERI of 64 and moves in 5% increments per integer until 100% of on-site renewable power renewable produced may be applied to the ERI. The factors in Table R406.4.1 represent those 5% increments.

An ERI of 65 without on-site renewable power production was selected for the Table R406.4.1 because it is the AVERAGE HERS RATING of over 610,000 new homes built since 2012 as reported by RESNET. It represents where most communities are today, and keeps the IECC consistent with current practice which facilitates code adoptions.

The new Table R406.4.1 is also designed to account for ERI scores that states and local jurisdiction may adopt that are both above and below the ERI values listed on Table R406.4. Table R406.4 recognizes that not all states and local jurisdictions are adopting the ERI scores contained in the 2015 IECC. The values in Table R406.4.1 can be applied to these higher ERI scores which would limit on-site renewable power production consistently from state to state regardless of the ERI adopted by the states. Table R406.4.1 also "future proofs" the ERI to account for more stringent ERI scores in later versions of the IECC.

The Example –

To be clear, the code official, the consumer, the designer, or the builder will NEVER NEED TO USE THIS CALCULATION. It is an adjustment that would be incorporated into the software defined in ANSI/RESNET/ICC 301 used to determine the ERI.

However, for those who want to understand how it works, LBA has provided an example for consideration. Using Climate Zone 4, the following is a mathematical illustration of how the ERI calculation could be adjusted in the software for consideration of limited credit for on-site renewable power production.

In CZ 4 –

Rated Design annual loads, millions of Btu's per year (MBtu/yr): 157.6

Reference Design annual loads, MBtu/yr: 254.5

On-site Renewable Power Produced, MBtu/yr: 0.0

Purchased Energy fraction: (157.6 - 0) ÷ 157.6 = 1

In this case, the calculation WITHOUT on-site power looks like this:

157.6 ÷ 254.5 = 0.62 x 1 = 0.62 x 100 = **62** ERI

Under the current 2015 code, if the home has a PV system installed, the numbers could look like this:

Rated Design annual loads, MBtu/yr: 157.6

Reference Design annual loads, MBtu/yr: 254.5

On-site Renewable Power Produced, MBtu/yr: 23.06

Purchased Energy fraction: (157.6 - 23.06) ÷ 157.6 = 0.85

In this case, the current calculation WITH 100% on-site renewable power (PV) looks like this: 157.6 ÷ 254.5 = 0.62 x 0.85 = 0.53 x 100 = **53**.

This home originally would have scored a **62** ERI without PV, but now scores **53** because of the full credit for on-site renewable power production. This home complies with the value in Table R406.4 for Climate Zone 4. 100% of the total energy produced on-site may applied to the ERI. That could incentivize some designers to minimize energy conserving features such as lighting, heating, cooling, water heating and appliances in the 2009 IECC by relying mostly on solar power, for example, to reduce the ERI. That is not the intent of the ERI nor is it in the best interest of consumers. The implementation of this new Table R406.4.1 can prevent that from occurring.

Under this proposed calculation method in this public comment, the contribution of on-site renewable power production applied to the ERI calculation shall not exceed the maximum percentage of the total renewable power produced on-site as specified in Table R406.4.1. The maximum percentages are expressed as factors in Table R406.4.

Under the proposed calculation method, if the home has on-site renewable power (a PV system installed), the numbers could look like this:

Rated Design annual loads, MBtu/yr: 157.6

Reference Design annual loads, MBtu/yr: 254.5

On-site Renewable Power Produced, MBtu/yr: 23.06

ERI BEFORE adjustment for on-site renewable power production = 157.6 ÷ 254.5 = 0.62 x 100 = 62

The builder wants to earn a 54 for code compliance in CZ4. Using proposed Table 406.4.1, a code compliant ERI of **54** is allowed a maximum credit of **55%** (.55) of the on-site renewable power produced, so the Purchased Energy fraction looks like this:

Purchased Energy fraction: (157.6 - (23.06 - (23.06 x (1 - **0.55**)))) ÷ 157.6 =

(157.6 - (23.06 - (23.06 x 0.45))) ÷ 157.6 =

(157.6 - (23.06 - 10.37)) ÷ 157.6 =

(157.6 - 12.69) ÷ 157.6 =

144.91 ÷ 157.6 = 0.92

Now, the calculation looks like this: 0.62 x 0.92 = 0.57 x 100 = 57. Instead of scoring the code compliant **54**, it scores a 57 on the ERI.

Using the proposed sliding 5% sliding scale to determine an ERI WITH on-site renewable power, the builder or designer recognizes that they have to build a better envelope in order to earn more credit for on-site renewable power production. They must make improvements to the building enclosure and mechanical systems so that total annual load on the rated design is 145.3 MBtu/yr.

Rated Design annual loads, MBtu/yr: 145.30

Reference Design annual loads, MBtu/yr: 254.50

On-site Renewable Power Produced, MBtu/yr: 23.06

ERI before adjustment for on-site renewable power production = 145.3 ÷ 254.5 = 0.57 x 100 = 57

The target Index of 54 is allowed a maximum credit of **55%** of the on-site power produced, so the Purchased Energy fraction looks like this:

Purchased Energy fraction:	(145.3 - (23.06 - (23.06 x (1 - **0.55**)))) ÷ 145.3 =
	(145.3 - (23.06 - (23.06 x 0.45))) ÷ 145.3 =
	(145.3 - (23.06 - 10.37)) ÷ 145.3 =
	(145.3 - 12.69) ÷ 145.3 =
	132.61 ÷ 145.3 = 0.91

Now, the calculation looks like this: 0.57 x 0.91 = 0.52 x 100 = **52**. Now the home is code compliant, with an ERI less than **54**.

The Code Enforcer –

Enforcement of compliance with Table R406.4.1 is extremely easy. The code official or plan reviewer only has to verify that the ERI required for the climate zone in Table R406.4 has been documented and is identified in the compliance report.

The code official or plan reviewer only needs to verify that the percentage of on-site renewable power cited in the compliance report does not exceed the limits listed for the "ERI for the Rated Design" in new Table R406.4.1.

There is a companion proposal embedded in this public comment to require that the factor used for on-site renewable power in the ERI is found in the compliance report.

The Conclusion –

The International Energy Conservation Code should not be inconsistent with the federal policy. Many state statutes encourage national energy independence through conservation and production, and the use of on-site renewable power production in residential buildings. This proposal creates a compliance method that is easy to enforce and a design tool that is easy to use.

Enabling new paths to achieve energy efficiency creating new opportunities for even greater innovation is part of the stated purpose of the IECC. This is yet another option, the most stringent yet flexible of all the compliance options within the IECC, for both consumers and builders. Although only 5% of NEW homes had the capability to produce renewable power on-site, renewable energy for residences is gaining steadily in popularity because the cost and technology is steadily improving.

Using renewable energy, PV for example, can help reduce the compliance costs for builders, making homes more affordable to build and to occupy. Other renewable technologies will become available and affordable in the future. It makes sense to have at least one pathway in the IECC that recognizes and accommodates the trends of the future.

In summary, this 5% sliding scale method drives improvements in the building enclosure/envelope and in efficient mechanical systems in order to earn greater ERI contributions from the production of on-site power.

Most importantly, it creates an easy to enforce, code compliant pathway to net zero homes, which is the stated goal of our federal energy policy, without sacrificing the energy efficiency gains from previous code cycles that are currently in the IECC.

RE175-16

RE177-16

R202 (New) [IRC N1101.6 (New)], R406.4.1(New) [IRC N1106.4.1 (New)], Table R406.4.1(New) [IRC Table N1106.4.1 (New)]

Proposed Change as Submitted

Proponent : Ryan Meres, Institute for Market Transformation (ryan@imt.org)

2015 International Energy Conservation Code

Add new definition as follows:

R202 (N1101.6) RENEWABLE ENERGY. Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth.

Add new text as follows:

R406.4.1 (N1106.4.1) Renewable energy. The use of on-site *renewable energy* is allowed to meet the values specified in Table R406.4 where the ERI for the proposed residential building without *renewable energy* is less than or equal to the value for the appropriate climate zone specified in Table R406.4.1.

TABLE R406.4.1 (N1106.4.1)
Maximum Energy Rating Index Without Renewable Energy

CLIMATE ZONE	ENERGY RATING INDEX
1	57
2	57
3	57
4	61
5	61
6	61
7	58
8	58

Reason: The purpose of this proposal is to create a reasonable pathway to allow credit for on-site renewable energy in the 2018 IECC.

The HERS rating system allows a home to have unlimited renewable energy: a home can have a HERS score of zero, which necessitates a significant contribution of renewable generation. This is the right approach for a *rating system*, but is not the right approach for a *code*. While a rating system encourages competition among home builders and can be used effectively to assess both new and existing homes, the purpose of a conservation code is to conserve energy by increasing a home's energy efficiency.

The ERI levels set in the 2015 code were set based on calculations of cost-effective energy efficiency levels, including trade-offs made against various building envelope options. The analysis during the development of the 2015 ERI levels did not account for the impact of renewable energy generation. A medium-sized solar installation is worth approximately 35 points. If unlimited renewable generation was allowed to count toward the ERI score, there is the potential for a substantial portion of the ERI score to be met with renewable systems, resulting in homes that are even less efficient than the 2009 code. Allowing unlimited renewable generation would mean that homes could be built with fewer efficiency measures, which would move the stringency of the code backward.

Builders may have additional incentive to prioritize PV over efficiency. Given the innovative financing options available, builders may be able to work with solar companies to install PV at no cost of materials or construction. In this situation, the homeowner then enters into a power purchase agreement directly with the solar provider. If solar is allowed as a substitute for efficiency, the baseline home will use more energy, the solar system will need to be larger (and therefore more expensive), and the home will be more vulnerable to higher bills if and when the solar system is removed. None of these issues factor into the *builder's* decision-making, but they directly affect the *homeowner* over the lifetime of the home. The code is in place to ensure that home buyers receive a high-quality product that is relatively standardized, no matter where or by whom the home is built. Allowing unlimited renewable credit to take the place of efficiency measures in the code adds uncertainty for the home buyer.

In addition to the energy conservation intent of the code, homeowners benefit from a more efficient home even if much of their load is offset by PV or another renewable source. Energy efficiency upgrades promoted in the code, like insulation and air sealing, are essentially permanent and difficult to remove. While the lifespan of solar panels is improving, the output of the panels decreases over time. A homeowner will eventually need to replace the panels, which will come at an added expense.

Furthermore, the homeowner could choose to remove the panels at virtually any time. If a home is designed to be built less-efficiently, with solar panels making up the difference, then the homeowner is left with a baseline home that will consume more energy over its lifespan.

Cost Impact: Will not increase the cost of construction
This code change proposal, in and of itself, will not increase the cost of construction. This proposal only affects homes installing solar panels and using the ERI compliance path, which is only one compliance option and will not increase the cost of construction available to the builder under other compliance options.

RE177-16 :
R406.4.1 (NEW)-
MERES12703

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This proposal is similiar to RE165-16, RE-165-16, RE7-16 and CE18-16 Part II. The proposal restricts use of some renewable energy sources.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Mike Fischer, Kellen, representing The Center for the Polyurethanes Industry of the American Chemistry Council and the Polyisocyanurate Insulation Manufacturers Association (mfischer@kellencompany.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R406.4.1 (N1106.4.1) Renewable energy. The use of on-site *renewable energy* is allowed to meet the values specified in Table R406.4 where the ERI for the proposed residential building without *renewable energy* is less than or equal to the value for the appropriate climate zone specified in Table R406.4.1. When on-site renewable energy is included for compliance using the ERI analysis in accordance with this section, the building shall meet the mandatory requirements with Section R406.2 and the building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

TABLE R406.4.1 (N1106.4.1)
Maximum Energy Rating Index Without Renewable Energy

CLIMATE ZONE	ENERGY RATING INDEX
1	57
2	57
3	57
4	61
5	61
6	61
7	58
8	58

Commenter's Reason: RE 177-16 was submitted by the IMT to adjust the ERI as quantified by the Energy Rating Index (ERI) values in Table R406.4. (N1106.4) in order to correlate changes with the published version of ANSI/RESNET/ICC 301-2014 (RESNET 301). While RESNET 301was not ready for adoption into the 2015 IECC, it was generally understood that it would be proposed for inclusion into the 2018 IECC as an option for compliance via the ERI path. In fact, RESNET 301 was proposed for inclusion into the 2018 IECC via RE166-16, which was recommended for Approval as Submitted by the IECC-R Committee. This modification specifies eligible and mandatory requirements for compliance under the ERI.

The 2015 IECC ERI path does not address the inclusion of onsite renewable power generation for code compliance using ERI calculation tools, including RESNET 301. The application of the ERI path and use of software compliance tools require a full consideration of several pieces of the code, including climate zone, mandatory provisions including backstops, and approved software tools; none of these code provisions stand alone. A review of the bibliography included with the reason statement for RE173 provides additional background on the inclusion of RESNET 301 into the IECC; and the HERS Index paper (Dillon) includes a reference to the inclusion of onsite power production.

The Center for the Polyurethanes Industry (CPI) of the American Chemistry Council (ACC) recommends an approach that provides for the use of onsite renewable power production for ERI path compliance while maintaining rigorous energy conservation standards.

ACC recommends approval of RE 177-16 as modified by this public comment, which will:

• Permit onsite power production to be used to offset energy use and included in the ERI calculation under Section R406.

• Establish a more stringent backstop for the ERI path when on-site renewable energy is included in the ERI analysis by setting the baseline for mandatory minimum envelope efficiency with the 2015 IECC prescriptive path.

• Retain the current 2009 IECC prescriptive path backstops for ERI calculation of buildings that do not incorporate on- site power production.

As the use of distributed generation in homes becomes more prevalent, it is important to address its role in the building energy code. This public comment establishes an easily enforceable path that safeguards current efficiency levels and allows for the responsible use of onsite power that does not cannibalize current efficiency levels.

RE177-16

RE178-16

R406.6.2 (IRC N1106.6.2), R406.6.2.1 (New) [IRC N1106.6.2.1 (New)], R406.6.2.2 (New) [IRC N1106.6.2.2 (New)]

Proposed Change as Submitted

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com)

2015 International Energy Conservation Code

Revise as follows:

R406.6.2 (N1106.6.2) Compliance report. Compliance software tools shall generate a report ~~that documents~~ documenting that the ~~ERI~~*proposeddesign* complies with sections R406.2 through R406.4. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a compliance report based on the as-built condition of the building shall be submitted to the ~~*rated design*~~ *code* ~~complies~~*official* before a certificate of occupancy is issued. Batch sampling of buildings to determine energy code compliance shall only be allowed for stacked multifamily units. Compliance reports shall include information in accordance with Sections R406.3 and R406.4. ~~The~~ Where the *proposed design* of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance ~~documentation~~ of the *proposed design* for the purposes of the application for the building permit shall ~~include~~ be based on the ~~following information:~~

1. ~~Address or other identification of the residential building.~~
2. ~~An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.~~
3. ~~Name of individual completing the compliance report.~~
4. ~~Name and version of the compliance software tool.~~

- ~~**Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.~~

worst-case orientation, worst-case configuration, worst-case building air leakage and worst case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

Add new text as follows:

R406.6.2.1 (N1106.6.2.1) Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the *proposed design* complies with Section R406.2.
3. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
4. A site-specific energy analysis report that is in compliance with Section R406.3 through R406.4.
5. The name of the individual performing the analysis and generating the report.
6. The name and version of the compliance software tool.

R406.6.2.2 (N1106.6.2.2) Compliance report for certificate of occupancy . A compliance report submitted for obtaining the certificate of occupancy shall include the following:

1. Building street address or other building site identification.
2. A statement indicating that the as-built building complies with Section R406.3.
3. A certificate indicating that the building passes the ERI matrix for code compliance and listing the energy saving features of the buildings.
4. A site-specific energy analysis report that is in compliance with Section R406.3 through R406.4.
5. The name of the individual performing the analysis and generating the report.
6. The name and version of the compliance software tool.

Reason: This proposal carries over the process map clarification for generating compliance documentation from the simulated performance path section R405 to the ERI path section R406 as the process is identical for generating permitting and final certificate of occupancy reports. It is important to further define the process so all understand what is required in addition to the generation of the ERI score.

Cost Impact: Will not increase the cost of construction
There is not cost implication for this proposal as everything outlined must already occur to utilize the ERI path. Rather this proposal ensures a common understanding of the process for utilizing section R406.

RE178-16 : R406.6.2-SCHWARZ12453

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: There seems to be a lot of steps indicated for compliance and where the small, possibly one man, building department is involved, this is going to be too onerous to handle the paperwork. The current language is preferred.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Robert Schwarz, representing EnergyLogic, Inc. (robby@nrglogic.com) requests Approve as Submitted.

Commenter's Reason: Creation of an ERI score follows the same process as creation of R405's Simulated Performance paths cost compliance report. In fact, since mostly energy raters are working with builders utilizing the simulated performance path, they are giving their builder clients the ERI (HERS) score as a byproduct of compliance using section R404. Before the 2015 IECC it was not clear how to utilize the pathway. The 2015 IECC incorporated language that laid a pathway for compliance, including the need to submit a compliance report for permitting and a new confirmed compliance report to obtain the certificate of occupancy, how to deal with assumptions that need to be made when modeling a home before construction, and what details need to be reported. Contrary to the committee's reason statement this has greatly increased the acceptance of the simulated performance path. In fact, in the Denver Metro area it is the most common path way used for energy code compliance.

Currently section R406.6.2.1 "Compliance report" does not have detail needed to make code jurisdiction comfortable with accepting the reports. Currently you have to create a report that demonstrates that the ERI of the rated design complies but what about the actually built home. This section does not require that a confirmed ERI score be created for the home that has moved from paper to a physical structure. The RESNET standard requires that not only a plans analysis be performed to generate an ERI score but also that a confirmed ERI score be created from data collected from the actually built home. The code language is not in alignment with the standards that Raters use to complete their work. This proposal creates that alignment.

The committee appears worried about the small one man building departments. It is my opinion if there is the infrastructure that can perform a rating to generate an ERI score in a rural small one-person jurisdiction, the real issue would be understanding what documentation and process needs to be followed to ensure compliance with the code. This code change proposal offers that clarity. As the steps outlined in this proposal are exactly the same as the steps outlined for the Simulated performance path they have proven not to be onerous. They lead to creation of a one-page compliance report.

RE178-16

RE179-16

R202 (New) [IRC N1101.6 (New)], R401.2 (IRC N1101.13), R407(New) [IRC N1107 (New)], R407.1 (New) [IRC N1107.1 (New)], R407.2 (New) [IRC N1107.2 (New)], Table R407.3.1 (New) [IRC Table N1107.3.1 (New)], R202(N1101.6) (New)

Proposed Change as Submitted

Proponent : William Fay, representing Energy Efficient Codes Coalition; Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; Maureen Guttman, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE), representing Energy Efficient Codes Coalition; Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy; William Prindle, ICF International, representing Energy Efficient Codes Coalition

2015 International Energy Conservation Code

Revise as follows:

~~**R401.2**~~ **R401.2(N1101.13) Compliance.** Projects shall comply with one of the following:

1. Sections R401 through R404 and Section R407.
2. Section R405, Section R407 and the provisions of Sections R401 through R404 labeled "Mandatory."
3. An energy rating index (ERI) approach in Section R406 and the provisions of Section R407.

Add new text as follows:

SECTION 407(N1107) ADDITIONAL ENERGY EFFICIENCY (MANDATORY)

R407.1(N1107.1) Scope. This section establishes additional mandatory requirements applicable to all compliance approaches to achieve additional energy efficiency.

R407.2(N1107.2) Points-based compliance. One or more energy efficiency measure(s) shall be installed in accordance with Section R407.3 that cumulatively equal or exceed 5 (five) Flex Points for the appropriate Climate Zone. Projects complying under the simulated performance alternative outlined in Section R405 shall demonstrate compliance with Section R405 without including in the proposed design any features that will be utilized to comply with Section R407. Projects complying under the energy rating index alternative outlined in Section R406 shall demonstrate compliance with Section R406 without including in the proposed design any features that will be utilized to comply with Section R407.

Exceptions: The requirements of this section shall not apply to:

1. Projects complying under the performance approach outlined in Section R405, where the *proposed design* under section R405.3 is shown to have an annual energy cost that is less than or equal to 95% of the annual energy cost of the *standard reference design.*
2. Projects complying under the energy rating index approach outlined in Section R406, where the project has a maximum energy rating index value at least 5% less than the index target specified in Table R406.4.
3. Additions with a *conditioned floor area* equal to or less than 1,000 square feet.
4. *Alterations*, renovations and *repairs* to an existing building.

R407.3.1(N1107.3.1) Flex Points for additional energy efficiency. Measures shall be selected from Table R407.3.1. Each measure chosen shall receive credit for the Flex Points as indicated in the Table for the specific Climate Zone. Interpolation of points between measures shall not be permitted.

Revise as follows:

TABLE R407.3.1(N1107.3.1)
FLEX POINTS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Flex Point Value								
		CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
1a	≥ 2.5% reduction in total UA [b]	1	1	2	2	2	2	3	4	4
1b	≥ 5% reduction in total UA [b]	3	3	3	3	3	4	5	5	5
1c	≥ 7.5% reduction in total UA [b]	5	5	5	5	5	6	7	8	8
1d	≥ 10% reduction in total UA [b]	6	7	7	7	8	8	9	10	10
2a	≥ 10% reduction in glazed fenestration area-weighted average SHGC	2	1	-	-	-	-	-	-	-
2b	≥ 20% reduction in glazed fenestration area-weighted average SHGC	4	1	-	-	-	-	-	-	-
3a	≤ 4 ACH50 air leakage rate with ERV or HRV installed [c]	1	2	-	-	-	-	-	-	-
3b	≤ 3 ACH50 air leakage rate with ERV or HRV installed [c]	2	4	5	7	7	7	7	8	8
3c	≤ 2 ACH50 air leakage rate with ERV or HRV installed [c]	2	5	7	9	9	9	10	11	11

4a	≤ 2 CFM of total duct leakage per 100 square feet of conditioned floor area when tested in accordance with Section R403.2.2	1	1	1	1	-	1	1	1	1
4b	100% of duct thermal distribution system located in *conditioned space*	1	1	1	1	1	1	2	2	2
4c	100% of duct thermal distribution system located in *directly conditioned space* [d]	8	8	9	11	8	12	15	17	17
4d	100% of ductless thermal distribution system located completely inside the *building thermal envelope*	8	8	9	11	8	12	15	17	17
4e	100% of hydronic thermal distribution system located completely inside the *building thermal envelope*	8	8	9	11	8	12	15	17	17
5a	≥ 16 SEER and ≥ 13 EER cooling system efficiency [e]	5	4	1	1	-	-	-	-	-
5b	≥ 18 SEER and ≥ 14 EER cooling system efficiency [e]	9	7	3	2	-	-	-	-	-
5c	≥ 16 EER cooling system efficiency [e]	10	7	3	2	-	-	-	-	-
5d	≥ 18 EER cooling system efficiency [e]	13	10	4	2	-	1	-	-	-
5e	≥ 20 EER cooling system efficiency [e]	16	12	5	3	-	1	-	-	-
5f	≥ 24 EER cooling system efficiency [e]	22	19	12	4	-	1	-	-	-
5g	≥ 28 EER cooling system efficiency [e]	25	21	13	5	-	1	-	-	-
6a	≥ 95 AFUE heating system efficiency [f]	-	2	6	8	9	10	11	12	13
6b	≥ 96 AFUE heating system efficiency [f]	-	2	6	9	10	10	11	12	14
6c	≥ 98 AFUE heating system efficiency [f]	-	3	7	10	11	12	13	14	15
7a	≥ 9.5 HSPF heating system efficiency [f]	-	-	1	2	2	2	2	2	1
7b	≥ 10.5 HSPF heating system efficiency [f]	-	1	2	4	4	5	4	3	3
7c	≥ 3 COP heating system efficiency [f]	-	1	2	3	3	4	3	3	2
7d	≥ 3.5 COP heating system efficiency [f]	-	2	4	6	6	8	7	6	5
7e	≥ 4 COP heating system efficiency [f]	-	2	5	8	9	10	10	9	7
7f	≥ 4.5 COP heating system efficiency [f]	-	2	5	9	10	11	11	10	8
7g	≥ 5 COP heating system efficiency [f]	-	3	6	10	11	12	12	12	9
8a	≥ 0.7 EF for fossil fuel service water heating system	2	2	-	-	-	-	-	-	-
8b	≥ 0.8 EF for fossil fuel service water heating system	7	5	4	3	2	2	2	1	1
8c	≥ 0.95 EF for electric service water heating system	-	-	-	-	-	-	-	-	-
8d	≥ 1.15 EF for electric service water heating system	7	7	7	4	5	3	3	2	2
8e	≥ 0.4 Solar Fraction for service water heating system	8	9	9	7	9	6	5	4	3

a. Climate Zone 4C is Climate Zone Marine 4.

b. The Total UA shall be calculated in accordance with Section R402.1.4 Total UA alternative.

c. Minimum Heat Recovery Ventilator (HRV) and Energy Recovery Ventilator (ERV) requirements, measured at the lowest tested net supply airflow, shall be ≥ 75% Sensible Recovery Efficiency (SRE), ≤ 1.1 W/CFM Fan Energy and shall not use recirculation as a defrost strategy. In addition, the Energy Recovery Ventilator (ERV) shall be ≥ 50% Latent Recovery/Moisture Transfer (LRMT).

d. To achieve 100% of the thermal distribution located in the actively conditioned space, no ducts used for the heating and cooling systems shall be located within walls or ceilings or other locations where all of the losses are not directly into the conditioned space.

e. For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in Table R407.3.1 and shall be sized to serve 100% of the cooling design load. As an alternative, each system installed shall receive credit for the percentage of the Flex Points for the measure equal to the percentage of the cooling design load served by the system.

f. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in Table R407.3.1 and shall be sized to serve 100% of the heating design load. As an alternative, each system installed shall receive credit for the percentage of the Flex Points for the measure equal to the percentage of the heating design load served by the system.

Add new definition as follows:

R202(N1101.6) DIRECTLY CONDITIONED SPACE An area within *conditioned space* that is directly heated or cooled to maintain heating and cooling temperature setpoints, including any habitable room. *Directly conditioned space* shall not include *indirectly conditioned space*.

R202(N1101.6) INDIRECTLY CONDITIONED SPACE. An area within *conditioned space* that is not directly heated or cooled, including wall cavities, floor cavities, ceiling cavities, storage rooms, closets, non-habitable attic, non-habitable basement, crawlspace, spaces or cavities that contain uninsulated ducts or thermal distribution systems or have an opening directly into an adjacent conditioned space. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

Reason: The purpose of this code change is to establish a new mandatory section to achieve additional energy efficiency. This proposal will allow builders the flexibility to choose from a menu of options to achieve 5% or more in energy savings beyond compliance with the current prescriptive, performance and ERI paths in the 2015 *IECC*. These new mandatory set of points-based options are predicated on the notion that because the current residential I-Codes require a solid foundation of "whole house" efficiency features, builders should have flexibility to determine the improvements that add onto that foundation. In addition to bringing about a reasonable, but modest, improvement in energy efficiency as compared to the 2015 *IECC*, the proposal will also lay the groundwork for emerging technologies and future improvements to the code. Similar options-based approaches are currently found in both the commercial provisions of the 2015 *IECC* (section C406) and in residential energy codes adopted in some states. As discussed below, this proposal improves the *IECC* in at least five important ways.

The proposal improves the overall energy efficiency of the *IECC* and *IRC* by about five percent, reducing the home's energy consumption and homeowner operating costs.

From a national energy policy standpoint, the need to improve the efficiency of America's buildings has not changed. Because buildings continue to consume over 50% of the natural gas and over 70% of the electricity consumed in America, the nation's building codes should incorporate reasonable measures to reduce energy use and peak demand wherever feasible. The residential requirements of the 2012 (also reflected in the 2015 *IECC*) represents a significant improvement over previous editions of the code, and we believe that an additional 5% improvement in efficiency over the 2012 and 2015 *IECC* is not only feasible, but is crucial to sound national energy policy and our nation's energy future. Each new building and substantial addition should bring the country one step closer to our national goal of energy independence.

In addition, energy efficient construction generates significant operating savings that quickly recoup the incremental cost of these improvements to new homebuyers. For example, when the US Department of Energy compared homes built to the 2012 *IECC* with homes built to the 2006 *IECC*, average homeowner life-cycle (30-year) cost savings ranged from $4,763 in Climate Zone 2 (the lowest savings in all climate zones) to $33,105 in Climate Zone 8 (the highest savings). And, even after accounting for the incremental up-front costs of mortgage fees and down payment, a homeowner's cumulative cash flow became positive within a year or two in all eight climate zones.

The proposal creates a highly flexible method to achieve additional energy savings that would be difficult to prescriptively require in the current *IECC* and *IRC* structure.

Although there are many possible improvements beyond the 2015 *IECC*, some of these improvements would be impractical or difficult to include as specific prescriptive requirements for all homes at this time. For example, some emerging technologies may save energy, but because of limited availability, high cost, or federal laws, it may not be reasonable – or even legal – to require these technologies in every building. The *IECC* does not currently have an organized method for recognizing specific prescriptive options beyond the baseline requirements.

This proposal creates such an approach and format that recognizes the energy savings potential of a range of systems and building features that otherwise would not be feasible to include in the baseline requirements at this time. For example, the proposal includes high-efficiency heating, cooling, and water heating options that the code may not be able to require outright because of federal preemption issues. The proposal also includes envelope-only measures that reward builders for going well beyond the current code requirements. The result is a reasonably flexible system of options that builders can choose from that goes beyond the 2015 *IECC* and *IRC* baseline, provides incentives for good building practice and technologies, and gives jurisdictions an easily-adaptable, and easy to administer method to set ever-improving efficiency requirements.

The proposal lays the groundwork for future improvement in the code by establishing a structure for both prescriptive- and performance-based compliance options.

In order to maximize flexibility and prepare for future improvements to the code, this proposal establishes multiple methods of compliance for new buildings and additions of more than 1,000 square feet (smaller additions, alterations, renovations and repairs are currently proposed to be exempt to avoid unnecessary complexity) and will make further efficiency improvements in future cycles much easier.

For code users who prefer a straightforward points-based approach to code compliance, Section R406 outlines a number of options for each climate zone that can be combined for a total of at least 5 points. Each point represents roughly a one percent decrease in the present value of energy costs over the life of the building (so 5 points equal roughly a 5% improvement in efficiency over the 2015 *IECC*).

- For code users who wish to use the simulated performance alternative in Section R405, the proposal also allows compliance where the proposed design demonstrates an energy cost less than or equal to 95% of the energy cost of the standard reference design. The proposal also allows, as an alternative, compliance with the points system so long as the user does not "double count" in its performance analysis any improvements used in points compliance.
- For code users who wish to use the ERI compliance alternative in Section R406, the proposal also allows compliance where the proposed design demonstrates an ERI five percent or more below the target ERI. The proposal also allows, as an alternative, compliance with the points system so long as the user does not "double count" in its ERI analysis any

improvements used in points compliance.

These compliance options can be easily updated in the future. For example, as additional technologies and building practices are improved in the future, these technologies can be added to the table, along with a corresponding point value, without a total rewrite of the code.

Points have been calculated based on the present value of energy cost savings over the current code (with recognition of relevant federal equipment standards), after reflecting the estimated useful life of each measure and an assumed 30-year life of the building for purposes of the analysis (consistent with a 30-year mortgage).

This approach factors in the durability and useful life of each additional option chosen, recognizing that it is not the energy cost savings in the first year that is critical, but the cost savings over the life of the home that is most important. Although no building energy simulation on this scale will be perfect, the analysis behind the Flex Points tables is among the most sophisticated and detailed of its type. The analysis used the Department of Energy building analysis and present value calculation methodology, which will allow for easy updates to the table in the future. The analysis includes 105 TMY3 weather locations and 12 building types to account for varying stories, foundations and fuel types for each of the baseline and upgrade measures. This analysis was conducted by ICF International, which conducts similar types of analyses for a number of governmental entities, utilities and others.

The proposal creates incentives for code users to consider installing high-efficiency heating, cooling, and water heating systems, as well as other alternatives, without degrading the thermal building envelope or violating federal law.

Code-writing organizations have long wrestled with the dilemma of how to incorporate high-efficiency heating, cooling, and water heating system requirements into the code without violating federal law and without sacrificing improvements to the thermal envelope in return. In past code cycles, EECC was instrumental in removing the equipment trade-offs from the code to resolve the issues these trade-offs and the federal laws created. We remain strongly committed to that approach today. However, this proposal takes the next step by leaving the 2012 *IECC* baseline requirements intact, while offering code users the choice of equipment upgrades among several other potential improvements beyond the baseline requirements. In an attempt to reduce significant free ridership, equipment choices are limited to those likely above the typical equipment that would be installed anyway.

The proposal allows jurisdictions to "try out" a wide variety of efficiency measures that would be difficult to require as prescriptive requirements.

Innovative building practices or emerging technologies can benefit from being listed in state and local building codes. However, states may have difficulty prescriptively requiring new technologies or building practices for all homes that are not yet widely available. For example, ground-source heat pumps can offer significant energy savings, but because of geological features or regulatory issues, they may not be appropriate in all circumstances. The proposal above provides an incentive to consider installing a ground source heat pump as one of several compliance options under Section R407, but also offers many other comparable options or combinations of such options to achieve the same level of savings.

By incorporating several of these practices and technologies among the multiple options of Section R407, the proposal above essentially gives these emerging technologies and practices a foothold, and allows consumers and the market to determine the most feasible options for any given project. As emerging technologies become more mainstream, Section R407 may also be a good source for additional improvements to the prescriptive baseline in future code editions.

In sum, a few final observations may be helpful:

This Flex Points proposal is not an "above-code" program. Rather it is an additional efficiency requirement that must be met by all residential buildings with the choice among a number of compliance options. The IECC commercial provisions already contain a similar approach (see section C406).

- This Flex Points proposal improves the 2015 IECC by 5% in three ways:
  - Homes can be built to the performance path and show an annual energy cost of no more than 95% of the standard reference design.
  - Homes can be built to the ERI compliance path and meet an ERI score 5% below the current requirement.
  - Homes can be built to any compliance path and code users can show that they have installed sufficient additional energy efficiency measures to equal at least 5 Flex Points from the table column appropriate to the climate zone.
- The Flex Points measures, in some cases, are not appropriate to require in the base code, either because of federal preemption issues or a lack of market penetration for new efficient products, but are reasonable options for the builder to consider to achieve the additional 5% energy efficiency targeted.
- The analysis is based on the Department of Energy Methodology for Evaluated Cost-Effectiveness of Residential Energy Code Changes and the present value calculation methodology, which will allow for easy updates to the table in the future. The analysis first uses a present value analysis over a 30-year useful life of the building to determine the present value of energy cost savings for each measure – specifically, the analysis calculates the energy cost savings on a present value basis for the estimated life of each measure up to 30 years. Then the estimate of energy cost savings is converted into

points for each measure. Each point is equal to the present value of 1% energy savings over 20 years; by using a 20 year benchmark for determining one point, the points allow more flexibility among measures and provide some greater recognition to those measures with longer useful lives. While some measures have a longer life than 30 years, using a 30-year useful life ensures that savings are capped at a commonly used 30-year metric for homes, such as a typical 30 year mortgage, which is conservatively low for measures that last for the entire lifetime of the home.

Cost Impact: Will not increase the cost of construction
For many builders, there will be no cost increase whatsoever from compliance with this new requirement, since many of the Flex Points options are commonly installed anyway -- such as improved HVAC equipment or ducts located indoors – and can satisfy all 5 flex points (or more). For others who install a Flex Point option that otherwise would not have been installed, there will be increased cost, but there are options available within the proposal to achieve the 5 points cost-effectively.

RE179-16 :
R401.2-FAY12487

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is yet another new compliance path. In prior actions, the Committee has disapproved other proposed new compliance paths. Contrary to the proposal's will not increase the the cost of of construction, it will increase costs for some builders where they don't already do what this proposal requires. This doesn't seem to work with the ERI option.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Vickie Lovell, InterCode Incorporated, representing Leading Builders of America (vickie@intercodeinc.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

R401.2(N1101.13) Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404 and Section R407.
2. Section R405, Section R407 and the provisions of Sections R401 through R404 labeled "Mandatory."
3. ~~An energy rating index (ERI) approach in Section R406 and the provisions of Section R407.~~

Commenter's Reason: Leading Builders of America (LBA) enthusiastically supports and promotes flexibility in the energy code and multiple methods of energy code compliance. The use of the flex points approach for either the prescriptive path or the performance path may be a viable option for some designers who want yet another approach to compliance. If approved, this "flex-point" method would become the fourth compliance option in the energy conservation code.

LBA would be able to support this modified proposal if the Energy Rating Index (ERI) Path were excluded from the flex points option. LBA does not agree that including the ERI path in R406 will make further efficiency improvements in future cycles much easier, at least for this 2018 cycle, and at this stage of the code development process.

The fact is that only a few states have adopted the 2015 Edition of the IECC, and that is the edition in which the ERI path was introduced. Only a few IECC members are familiar with this ERI approach, and even fewer have the experience of working with designers, builders, raters and other energy advocates who understand the ERI in its current form.

By way of review, the following direct extract is the proponents' explanation of how the ERI could be used with flex points:

> "For code users who prefer a straightforward points-based approach to code compliance, Section R406 outlines a number of options for each climate zone that can be combined for a total of at least 5 points. Each point represents roughly a one percent decrease in the present value of energy costs over the life of the building (so 5 points equal roughly a 5% improvement in efficiency over the 2015 IECC).
>
> For code users who wish to use the ERI compliance alternative in Section R406, the proposal also allows compliance where the proposed design demonstrates an ERI five percent or more below the target ERI. The proposal also allows, as an alternative, compliance with the points system so long as the user does not "double count" in its ERI analysis any improvements used in points compliance."

LBA does not support unnecessary complexity to the code. Including the ERI (which is also a points system) into this code change proposal is, in the opinion of the Leading Builders of America, adding a layer of complexity that most people could not explain, understand, or more importantly to the code official, enforce. Tying a new points system that uses one method of calculation to another points system that uses another different method of calculation is begging for designer and builder confusion, inconsistent application and interpretation, and anemic enforcement in the field. The ERI is adequate on its own. It's easy to understand, apply and enforce, and should remain as a separate compliance path, untethered to the proposed "flex points" method.

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com) requests Approve as Submitted.

Commenter's Reason: This change improves Energy Efficiency for all paths by adding menu of points allowed to achieve gains of 5%. The change was denied by the committee.

This proposal increases the energy efficiency of the code by 5% by offering a menu of points-based options for all compliance paths. The AIA believes that this is an achievable and sensible way forward to continue improving the performance offered by the IECC while allowing flexibility to the user on how to pursue that goal.

We urge the membership to appvove this change.

Proponent : William Fay, Energy Efficient Codes Coalition, representing Energy Efficient Codes Coalition; Maureen Guttman, Building Codes Assistance Project, representing Building Codes Assistance Project (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing Energy Efficient Codes Coalition (misuriello@verizon.net); Jeffrey Harris, Alliance to Save Energy, representing Alliance to Save Energy (JeffHarris22@outlook.com); Charlie Haack, ICF International, representing Energy Efficient Codes Coalition; William Prindle, ICF International, representing Energy Efficient Codes Coalition requests Approve as Submitted.

Commenter's Reason: We recommend approval of RE179 as submitted for all of the reasons provided in the original Reason Statement. We believe the Residential IECC Committee failed to fully appreciate the value of this proposal, as evidenced by their reason statement.

First, the Committee refers to RE179 as "yet another new compliance path." To be clear, **RE179 is not a new compliance path option** – instead, it is a set of improvements built into the existing three compliance options: prescriptive, performance, and ERI. Each of these compliance paths is improved by roughly 5% in the proposal:

- Users of the prescriptive path must comply with the prescriptive path and select one or more measures from Table R407.3.1 to achieve at least 5 points (worth roughly 5% improvement over the current code).
- Users of the performance path have two options: they may choose to either achieve 5 points from Table R407.3.1 or demonstrate annual energy cost less than or equal to 95% of the standard reference design.
- Users of the ERI option also have two options: they may either choose to achieve 5 points from Table R407.3.1 or demonstrate a 5% improvement in the ERI score required in that climate zone.

Second, the Committee claims that the proposal "doesn't seem to work with the ERI option." As explained above, RE179 provides two options for compliance under the ERI path – each of which is designed to work with the ERI index numbers specifically adopted by a jurisdiction. We do not understand the Committee's concern with the ERI options.

Third, the Committee claims that in some cases, this proposal will increase the cost of construction. That should not be a barrier to adoption by itself. We acknowledged in the Cost Impact that while many builders will likely see no cost increase (because they already locate ducts inside conditioned space or install high-efficiency equipment), some builders may choose options that will increase costs. However, we believe that most builders will pick the most cost-effective options.

Most importantly, RE179 helps ensure that the economics of choices made at construction work in favor of the homeowner. The various "flex point" options were carefully selected based on the energy conservation value over the useful life of the building, not on short-term profitability. This methodology places a higher value on longer-lived items such as improved UA or better duct designs over shorter-lived items.

No other proposal would comprehensively improve the residential IECC across all compliance paths by 5%, as proposed in RE179. It achieves this improvement by providing strong incentives for existing and new technology without compromising the current efficiency of the IECC. We strongly recommend approval of RE179 as submitted.

RE181-16

R407 (New) [IRC N1107 (New)], R407.1 (New) [IRC N1107.1(New)], Chapter 6 (IRC Chapter 44)

Proposed Change as Submitted

Proponent : Craig Conner, representing self (craig.conner@mac.com)

2015 International Energy Conservation Code

SECTION R407 (N1107) NATIONAL GREEN BUILDING STANDARD

Add new text as follows:

R407.1 (N1107.1) Compliance satisfied. A building in compliance with at least the Silver level of the energy requirements in ICC 700 in accordance with the Performance Path in Section 702 in ICC 700, the Prescriptive Path in Section 703 of ICC 700, or the HERS Index Target Path in Section 704 of ICC 700 shall be in compliance with all the requirements of this chapter.

Reference standards type: This reference standard is new to the ICC Code Books
Add new standard(s) as follows:

ICC 700-2016 (DRAFT Version) of the National Green Building Standard

Reason: The National Green Building Standard (NGBS, ICC 700) is part of the I-family and ANSI approved. The NGBS has multiple "green" parts including an Energy Chapter (chapter 7). At the lowest level, Bronze, the Energy Chapter is roughly equal to the IECC, perhaps with a few more requirements. At all higher levels the Energy Chapter is based on exceeding the energy efficiency required by the IECC. At the Silver level the NGBS Energy Chapter is about 7% better than the IECC in terms of reduced energy consumption. A home which has been approved by the NGBS verifiers (third party inspection) to go above the IECC should not be required to go through the code process to show it meets the IECC.
The NGBS energy options include several approaches, all of which have minimum requirements in common. The prescriptive approach is similar to the prescriptive in the IECC. The performance approach is a calculation of energy savings based on an energy calculation specified in the IECC. The HERS Index Target Path utilizes a calculation as defined by EPA for the Energy Star Program. The calculation computes a target score based on the specific home in question, then compares the proposed home to that target. Because the target is computed for each home based on its specific design and Energy Star specifications, it is a more accurate prediction of energy use than a generic HERS score. The calculation has the advantage of using only input already provided for Energy Star calculation, provided by those who do the RESNET/HERS ratings/others, and will be accomplished by the same software. No new people or processes are required.

Cost Impact: Will not increase the cost of construction
This is an option. Some who choose to go above the energy efficiency in the IECC, to the Silver lever of ICC 700 or above, may increase the cost of their home. However, levels of energy efficiency above the IECC could also be produced by good design, so it does not have to be a cost increase.

Analysis:
A review of the standard proposed for inclusion in the code, ICC 700-2016 (DRAFT), with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28), will be posted on the ICC website on or before April 1, 2016.

RE181-16 : R407 (NEW)-CONNER13490

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is covered by above-code program provision in R102.1.1. The proposed section seems to contradict that section in that in order to get to use this new section, there are mandatory code requirements. Perhaps the most stringent would apply. This language really belongs in Section R102.1.1.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Craig Conner, representing self (craig.conner@mac.com) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

R102.1.1 Above code programs. The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. Buildings *approved* in writing by such an energy-efficiency program shall be considered in compliance with this code. The requirements identified as "mandatory" in Chapter 4 shall be met. A building in compliance with at least the Silver level of the energy requirements in ICC 700 in accordance with the Performance Path in Section 702 in ICC 700, the Prescriptive Path in Section 703 of ICC 700 or the HERS Index Target Path in Section 704 of ICC 700, shall be deemed to exceed the energy efficiency required by this code.

Commenter's Reason: The committee said "This language really belongs in Section R102.1.1". My public comment is a replacement of my original proposal so nothing is being done to the existing langauge of Section R407.1.
My public comment adds the language to Section R102.1.1 per the Committee's request. Note that the existing Section R102.1.1 code text remains, including the sentence on "mandatory".

ICC 700's energy requirements are built on the IECC. At the "silver" level ICC 700 energy requirements are about 7% above the 2015 IECC, making that "above code". Meeting ICC 700 includes requirements for third party energy inspections, which will help in code enforcement.

RE181-16

RE183-16

R502.1.1.2 (IRC N1108.1.1.2), R503.1.2 (IRC N1109.1.2)

Proposed Change as Submitted

Proponent : Shaunna Mozingo, Colorado Code Consulting - City of Cherry Hills Village, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@coloradocode.net)

2015 International Energy Conservation Code

Revise as follows:

R502.1.1.2 (N1108.1.1.2) Heating and cooling systems. New heating, cooling and duct systems that are part of the addition shall comply with Section R403 ~~Sections R403.1, R403.2, R403.3, R403.5 and R403.6.~~

- **Exception:** Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.
-

R503.1.2 (N1109.1.2) Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with ~~Sections R403.1, R403.2, R403.3 and R403.6~~ Section R403.

Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

Reason: The charging statement for both of these sections let us know that these requirements only apply if you have "new heating, cooling and duct systems that are part of the addition or alteration". It's not talking about the house, it's talking about installing new systems. Why would we not want them to comply with all of the provisions of the code for systems in R403? If I put in a new system at any phase of construction I had better make sure it is sized for the building I'm putting it into. Don't tell me you can't do adequate sizing on an existing building. You can get it the absolute best that you can but you at least have to put some thought into it.

Maybe you don't require a Manual J or some type of load calculation if you are doing an addition or alteration and dealing with an existing system, although you should always look to see if your mechanical equipment can handle the new load you're placing on it but it doesn't say that anywhere in the code, but this isn't talking about existing systems. We always have to do load calcs for new construction but never have to look at the system again to see if it is sized correctly for any future work that may be done to the home, even if we add a 10,000 sq ft addition? Well if we put in a new piece of equipment, it should go through load calcs and sizing just like if it were being put in a new building.

These sections didn't just leave out load calcs/sizing for new equipment, it left out mechanical system piping insulation. Why? It left out new snow and ice melt systems. Why? It left out pool and spa requirements. Again, why? If any of them are new, they need to meet all of the code requirements.

These sections should have read that heating and cooling and ducts systems that are part of the addition or alteration... and left out the word "new" if that was their intent. But the way it is worded, they are talking about new systems and they should have to comply.

Cost Impact: Will increase the cost of construction

There would likely be a cost for having a load calculation done or for piping insulation to be done or whatever requirement would have normally applied had the building been new but no longer applies because the building isn't new, even thought he equipment is.

RE183-16 : R502.1.1.2-MOZINGO13306

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: The revised language makes it clear that new systems must comply with all requirements of the code.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Richelle McMurtry, HBA of Metro Denver, representing Home Builders Association of Metro Denver (rmcmurtry@hbadenver.com) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Energy Conservation Code

~~**R503.1.2 (N1109.1.2) Heating and cooling systems.** New heating, cooling and duct systems that are part of the alteration shall comply with Section R403.~~

- ~~**Exception:** Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.~~

Commenter's Reason: The original proposal proved to be impractical because, on an existing home, it's too difficult to determine actual building envelope; there would be too many assumptions. **The HBA of Metro Denver supports proposal RE183 as modified by removing reference to R503.1.2.**

Proponent : David Bixby, Air Conditioning Contractors of America, representing Air Conditioning Contractors of America (david.bixby@acca.org) requests Disapprove.

Commenter's Reason: ACCA opposes this proposal as an addition comes under the Existing Building Code and makes no sense to design a new part at a higher standard than the old part it is attaching to. Also, this proposal may require duct modifications to existing ductwork that is either impossible or financially unaffordable. ACCA Manual J can be used to assure that the existing system is large enough to handle the additional load.

RE183-16

RE187-16
Appendix RA (IRC Appendix T)

Proposed Change as Submitted

Proponent : Donald Surrena (dsurrena@nahb.org)

2015 International Energy Conservation Code

Delete without substitution:

~~APPENDIX RA (APPENDIX T) RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS UNDER R402.4 OR R405 CONDITIONS ≤ 5ACH~~$_{50}$

Reason: This Appendix RA, "Recommended Procedure for Worst Case Testing of Atmospheric Venting Systems Under R402.4 or R405 Conditions, is not appropriate as an appendix in the IECC. It is noted as "informative and is not part of the code." Appendices are typically included in code books to offer optional or supplement criteria to the provisions in the main chapters of the code that are written in mandatory language for adoption if chosen by the jurisdiction. Appendices provide additional information for administration of the Department of Building Safety as well as standards not typically administered by all building departments. Appendices have the same force and effect as the primary chapters of the code when explicitly adopted by the jurisdiction. This Appendix RA is intended only as a recommended procedure to test venting and it is more appropriate in a training manual or technical guide for those parties that are involved in testing. This informational appendix is more appropriate in a standard and is not written to be part of a code that becomes law.

Cost Impact: Will not increase the cost of construction
The code change proposal only serves to remove an optional appendix that appears to be misplaced in the IECC. As this Appendix is not a requirement, there is not a change in the cost of construction.

**RE187-16 :
APPENDIX RA-
SURRENA12409**

Public Hearing Results

Committee Action: **Approved as Submitted**

Committee Reason: This is information that needs to be only in the IFGC and not in the IECC.

Assembly Motion: **Disapprove**
Online Vote Results: **Failed**
Support: 36.45% (74) Oppose: 63.55% (129)
Assembly Action: **None**

Individual Consideration Agenda

Proponent : Darren Meyers, International Energy Conservation Consultants, representing Illinois Office of Energy & Recycling (dmeyers@ieccode.com) requests Disapprove.

Commenter's Reason: U.S. code enforcement should DISAPPROVE RE187-16.

U.S. code enforcement should DISAPPROVE RE187-16 and retain provisions in the IECC and IRC that provide an appropriate and readily accessible location for builders, code officials, HERS raters, insulation and air-sealing contractors to access provisions for building tightness affecting the safety of combustion appliances.

We agree with the assertion of the proponent that the procedures presented in this appendix are informational and written in mandatory language, not unlike any other appendices in the IRC. For example, the provisions for Passive Radon Control in Appendix 'F' or Straw-bale Construction in Appendix 'S' are located as such because they are either provocative, subject to debate or not typically administered by all building departments, nationwide. Accordingly, this Appendix is the perfect location to provide builders, code officials, HERS raters, insulation and air-sealing contractors with accessible provisions for building tightness affecting the safety of combustion appliances.

The provisions of this Appendix are rooted in the Combustion Safety Test Procedures for Vented Appliances promulgated by the Building Performance Institute (BPI) and codified. Simply put, they have now merely been accepted into newly developed ANSI accredited standards including ANSI/BPI-1200-S-2015, and are now even more suitable for use in this appendix.

The development of this appendix (Approved by code officials as RE193-13) is rooted in several Midwestern state-wide adoptions of the 2012 IECC (Iowa, Illinois, Minnesota and Nebraska). Recall, this was April of 2013. And, it turned out that combustion air guidelines were last revised in the fuel gas codes in 2001. So, our concern was that a present-day solution for the verification of safe venting of combustion appliances was not readily accessible to builders, code officials, HERS raters, insulation and air-sealing contractors, tightening homes at or below 5ACH50 in accordance with the 2012/2015 IRC or the 2012/2015 IECC editions.

In our case, the matter was further complicated in that these state-wide adoptions affected home-rule units of government that either did not adopt an up-to-date IRC (incl. fuel-gas provisions), or more often did not adopt a fuel-gas code altogether (NFPA54 or IFGC). Thereby, these jurisdictions had no way to verify the safe venting of combustion appliances for "tight" (less than or equal to 5ACH50) homes as required by the present-day IECC.

Since we knew that HERS Raters, insulation and air-sealing contractors do not look to the fuel gas codes for solutions to "tight" buildings. Also, that affected home-rule units of government do not adopt up-to-date IRC (fuel-gas provisions), or more often did not adopt a fuel-gas code altogether. The solution was to "codify" the BPI Combustion Safety Test Procedures for Vented Appliances, and propose code change RE193-13 so that HERS Raters, insulation and air-sealing contractors who perform this work could access the procedure directly from the body of the IECC/IRC.

Request DISAPPROVAL of RE187-16 such that these construction professionals can readily access these procedures for "tight" homes (less than or equal to 5ACH50), born out of an IECC or IRC Chapter 11 adoption.

Public Comment 1:

Proponent : Darren Meyers, International Energy Conservation Consultants, representing Illinois Office of Energy & Recyclng (dmeyers@ieccode.com) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

APPENDIX APPENDIX RA (IRC APPENDIX T)

RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS UNDER R402.4 (IRC N1102.4) OR R405 (IRC N1105) CONDITIONS

SECTION RA101 SCOPE

RA101.1 General. This appendix is intended to provide guidelines for worst-case testing of atmospheric venting systems. Worst-case testing is recommended to identify problems that weaken draft and restrict combustion air.

SECTION RA201 GENERAL DEFINITIONS

COMBUSTION APPLIANCE ZONE (CAZ).

A contiguous air volume within a building that contains a Category I or II atmospherically vented appliance or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside the building or dwelling unit. The CAZ includes, but is not limited to, a mechanical closet, a mechanical room, or the main body of a house or dwelling unit.

DRAFT.

The pressure difference existing between the *appliance* or any component part and the atmosphere that causes a continuous flow of air and products of *combustion* through the gas passages of the *appliance* to the atmosphere.

Mechanical or induced draft.

The pressure difference created by the action of a fan, blower or ejector that is located between the *appliance* and the *chimney* or vent termination.

Natural draft.

The pressure difference created by a vent or *chimney* because of its height and the temperature difference between the *flue* gases and the atmosphere.

SPILLAGE.

Combustion gases emerging from an appliance or venting system into the combustion appliance zone during burner operation.

SECTION RA301 TESTING PROCEDURE

RA301.1 Worst-case testing of atmospheric venting systems. Buildings or dwelling units containing a Category I or II atmospherically vented appliance; or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside of the building or dwelling unit, shall have the Combustion Appliance Zone (CAZ) tested for spillage, acceptable draft and carbon monoxide (CO) in accordance with ~~this section~~ the *International Fuel Gas Code*. Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal* envelope and prior to final inspection.

Exception: Buildings or dwelling units containing only Category III or IV direct-vent or integral vent appliances that do not draw combustion air from inside of the building or dwelling unit.

~~The enumerated test procedure as follows shall be complied with during testing:~~

- ~~0.1. Set combustion appliances to the pilot setting or turn off the service disconnects for combustion appliances. Close exterior doors and windows and the fireplace damper. With the building or dwelling unit in this configuration, measure and record the baseline ambient pressure inside the building or dwelling unit CAZ. Compare the baseline ambient pressure of the CAZ to that of the outside ambient pressure and record the difference (Pa).~~
- ~~0.2. Establish worst case by turning on the *clothes dryer* and all exhaust fans. Close all interior doors that make the CAZ pressure more negative. Turn on the air handler, where present, and leave on if, as a result, the pressure in the CAZ becomes more negative. Check interior door positions again, closing only the interior doors that make the CAZ pressure more negative. Measure net change in pressure from the CAZ to outdoor ambient pressure, correcting for the base ambient pressure inside the home. Record "worst case depressurization" pressure and compare to Table RA301.1(1).Where CAZ depressurization limits are exceeded under worst-case conditions in accordance with Table A301.1(1), additional combustion air shall be provided or other modifications to building air-leakage performance or exhaust appliances such that depressurization is brought within the limits prescribed in Table RA301.1(1).~~
- ~~0.3. Measure worst-case spillage, acceptable draft and carbon monoxide (CO) by firing the fuel-fired appliance with the smallest Btu capacity first.~~
  - ~~0.3.1. Test for spillage at the draft diverter with a mirror or smoke puffer. An appliance that continues to spill flue gases for more than 60 seconds fails the spillage test.~~
  - ~~0.3.2. Test for CO measuring undiluted flue gases in the throat or flue of the appliance using a digital gauge in parts per million (ppm) at the 10-minute mark. Record CO ppm readings to be compared with Table RA301.1(3) upon completion of Step 4. Where the spillage test fails under worst case, go to Step 4.~~
  - ~~0.3.3. Where spillage ends within 60 seconds, test for acceptable draft in the connector not less than 1 foot (305 mm), but not more than 2 feet (610 mm) downstream of the draft diverter. Record draft pressure and compare to Table RA301.1(2).~~
  - ~~0.3.4. Fire all other connected appliances simultaneously and test again at the draft diverter of each appliance for spillage, CO and acceptable draft using procedures 3a through 3c.~~
- ~~0.4. Measure spillage, acceptable draft, and carbon monoxide (CO) under natural conditions—without *clothes dryer* and exhaust fans on—in accordance with the procedure outlined in Step 3, measuring the net change in pressure from worst case condition in Step 3 to natural in the CAZ to confirm the worst case depressurization taken in Step 2. Repeat the process for each appliance, allowing each vent system to cool between tests.~~
- ~~0.5. Monitor indoor ambient CO in the breathing zone continuously during testing, and abort the test where indoor ambient CO exceeds 35 ppm by turning off the appliance, ventilating the space, and evacuating the building. The CO problem shall be corrected prior to completing combustion safety diagnostics.~~
- ~~0.6. Make recommendations based on test results and the retrofit action prescribed in Table RA301.1(3).~~

Commenter's Reason: We ask U.S. code enforcement to APPROVE of RE187-16 AS MODIFIED BY THIS PUBLIC COMMENT in order to retain provisions in the IECC and IRC that provide an appropriate and readily accessible location for builders, code officials, HERS raters, insulation and air-sealing contractors to access provisions for building air tightness and whole house ventilation affecting the safe venting of combustion appliances.

Despite knowing that HERS Raters, insulation and air-sealing contractors do not look to the fuel gas code for solutions to "tight" buildings and not all home-rule units of government adopt up-to-date IRC (fuel-gas provisions), this Public Comment references the latest procedures documented in newly harmonized *National Fuel Gas Code (2015)*, via the 2018 *International Fuel Gas Code* (IFGC). The proponent for DELETION of this Appendix has proposed this very idea.

Therefore, we ask U.S. Code Enforcement APPROVE of RE187-16 AS MODIFIED BY THIS PUBLIC COMMENT so that HERS Raters, insulation and air-sealing contractors who perform this work can access these referenced procedures for "tight" homes (less than or equal to 5 ACH50) directly from the body of the IECC/IRC.

RE187-16

RE189-16 Part II

R202 (New), R801.4 (New), R801.4.1 (New), R801.4.2 (New), R801.4.3 (New), R801.4.4 (New), R801.4.5 (New), R801.4.6 (New), R801.4.7 (New)

Proposed Change as Submitted

Proponent : Joseph Cain, SunEdison, representing Solar Energy Industries Association (SEIA) (joecainpe@aol.com)

2015 International Residential Code

Add new definition as follows:

SECTION 202 DEFINITIONS

ON-SITE RENEWABLE ENERGY.

Energy generated by a *renewable energy* system located on the building site.

SECTION 202 DEFINITIONS

RENEWABLE ENERGY.

Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth.

SECTION R202 DEFINITIONS

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.

Add new text as follows:

R801.4 Solar ready zone. New construction of detached one- and two-family dwellings, and townhouses not more than three stories in height above grade plane in height, 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 sections R801.4.1 through R801.4.7.

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.

R801.4.1 Construction document requirements for solar ready zone. Construction documents shall indicate the *solar-ready zone*.

R801.4.2 Solar-ready zone area. The total *solar-ready zone* area shall be not less than 300 square feet (27.87 m^2) exclusive of mandatory access or set back areas. New multiple single-family dwellings (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 (185.8 m^2) per dwelling shall have a *solar-ready zone* area of not less than 150 square feet (13.94 m^2). The *solar-ready zone* shall be composed of areas not less than 5 feet (1.52 m) in width and not less than 80 square feet (7.44 m^2) exclusive of required access or set back areas.

R801.4.3 Obstructions. *Solar-ready zones* shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R801.4.4 Roof load documentation. The structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents.

R801.4.5 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or plumbing from the *solar-ready zone* to the electrical service panel or service hot water system.

R801.4.6 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.

R801.4.7 Construction documentation certificate. A permanent certificate, indicating the *solar-ready zone* and other requirements of this section, shall be posted near the electrical distribution panel, water heater or other conspicuous location by the builder or registered design professional.

RE189-16 Part II : R202 RENEWABLE-CAIN13920

Public Hearing Results

Part II

Committee Action: **Disapproved**

Committee Reason: The committee felt this should remain an appendix. Moving it into the code will add significant load to the roof and significant cost since the roof would require a design.

Assembly Action: **None**

Individual Consideration Agenda

Proponent : Joseph Cain, representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com) requests Approve as Submitted.

Commenter's Reason: The Solar Energy Industries Association seeks Approval As Submitted for Part II of RE189-16. During the Committee Action Hearings, inaccurate testimony was entered into the record regarding the cost associated with relocating Solar Ready Roof provisions into Chapter 8 of the IRC. The Committee Reason statement focused on "significant load" and "significant cost since the roof would require a design. The Commitee Reason statement is repeated below.
Committee Reason: The committee felt this should remain an appendix. Moving it into the code will add significant load to the roof and significant cost since the roof would require a design.

Residential rooftop-mounted photovoltaic (PV) panel systems commonly weigh only about 2 to 3 pounds per square foot (2 psf to 3 psf) of dead load. IRC Section R324.4.1 allows the offset of live load when considering the design of portions of the roof covered by a photovoltaic panel system. Therefore, the portion of the roof directly beneath the photovoltaic panel system is first checked for the load case where PV is not present (i.e., typical live load) and then checked for a second load case where live load is not present but the incremental dead load of 2-3 psf is considered in its place. The load case with PV has a smaller total load than the load case without PV. Even though an additional load case must be checked, it is likely the roof structure does not require any further strength or cost in order to support the rooftop PV system.

As more states and local communities establish goals for higher percentages of power contributed by renewable energy sources, as well as pursuing Zero Net Energy (ZNE) buildings, Solar Ready Roofs can easily remove barriers to rapid deployment of renewable energy systems. Approval As Submitted to move (or copy) Solar Ready Roofs into Chapter 8 is consistent with goals of many green codes and community programs.

RE189-16 Part II

RE191-16

R403.5.3 (New) [IRC N1103.5.3 (New)], R403.5.3.1 (New) [IRC N1103.5.3.1 (New)], R403.5.3.2 (New) [IRC N1103.5.3.2 (New)], Table R403.5.3.2 (New) [IRC Table N1103.5.3.2 (New)], R403.5.3.3 (New) [IRC N1103.5.3.3 (New)], Table R405.5.2(1) [IRC Table N1103.5.2(1)]

Proposed Change as Submitted

Proponent : Karen Hobbs, Natural Resources Defense Council, representing Natural Resources Defense Council (khobbs@nrdc.org); Ed Osann (eosann@nrdc.org)

2015 International Energy Conservation Code

Add new text as follows:

R403.5.3 (N1105.5.3) Hot Water Proximity to Point of Use (Prescriptive) Hot water distribution systems for detached one- and two- family dwellings and townhouses shall be designed in accordance with Sections R403.5.1 through R403.5.3.

R403.5.3.1 (N1103.5.3.1) Scope The distance limitation in Section R403.5.3.2 shall apply to the following plumbing fixtures supplied with hot water in detached one- and two-family dwellings and townhouses:

1. lavatories.
2. kitchen sinks.
3. showers.
4. tub-shower combinations.

Exception: Plumbing fixtures connected to a hot water recirculation system.

R403.5.3.2 (N1103.5.3.2) Maximum distance to certain plumbing fixtures. For hot water distribution systems serving individual dwelling units, the maximum distance in plan view between the location of a water heater and a plumbing fixture receiving hot water from it shall be no more than the length shown in Table R403.5.3.2. For purposes of this determination, the location of a water heater shall be translated vertically to each floor on which a fixture served by such water heater is located.

TABLE R403.5.3.2 (N1103.5.3.2)
MAXIMUM DISTANCE BETWEEN A WATER HEATER AND CERTAIN PLUMBING FIXTURES

Dwelling Unit Floor Area (ft^2)	Maximum Distance in Plan View (ft)	
	Two- or More Story Structures	**One-Story Structures**
≤1000	20 ft.	30 ft.
>1000 to ≤1600	30 ft.	40 ft.
>1600 to ≤2200	40 ft.	50 ft.
>2200 to ≤2800	45 ft.	55 ft.
>2800	50 ft.	65 ft.

R403.5.3.3 (N1103.5.3.3) Points of measurement. The distance in plan view shall be determined by the length of a straight line between the center point of the water heater and the hot water outlet of a plumbing fixture indicated in Section R403.5.3.1.

Revise as follows:

TABLE R405.5.2(1) [N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of Table not shown remain unchanged

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Service water heating [d, e, f, g, i, j]	~~As proposed~~ ~~Use: same as proposed design~~ Use: gal/day = 30 + (10 × N_{br})	~~As proposed~~ ~~gal/day = 30 + (10 × N_{br})~~ Use: gal/day = 30 +((4 × DFF_p/MD_r +6) × N_{br})

For SI: 1 square foot = 0.93 m^2, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2, 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official*, testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_s \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

i. DFF_p = Distance in plan view from the hot water heater to the furthest fixture specified in Section R403.5.3.1. MD_r = Maximum Distance specified in Table R403.5.3.2.
j. Service water heating use shall be the same as the standard reference design for a proposed design with any of the following:
1. a hot water recirculation system.
2. a building type not specified in Section R403.5.3.1.
3. where DFF_p / MD_r is less than 1.0 and greater than 0.75.

Reason:
Purged Hot Water is Wasted Energy

Cold or tepid water in the initial draw from a hot water outlet is often unsuitable for its intended purpose and is frequently purged, resulting in a waste of water, energy, and time for residents.

A 2009 paper by Robert Hendron of the National Renewable Energy Laboratory and others quantified the waste of hot water in initial draws waiting for water to reach 105°F. Modeling the plumbing typical in a 3-bedroom, 2-bath single-story home with a hot water simulation tool found that an estimated 12% of all hot water used on an annual basis is wasted. When viewed by fixture, the results are as follows:

- Showers -- over 10% wastage
- Kitchen sinks -- 18% wastage.
- Lavatories -- over 30% wastage.

Purging at these fixtures is responsible for 95% of the estimated total of nearly 3,000 gallons of hot water wastage annually. Of course, many new homes are built with more hot water outlets than this model's base case. Both energy and water can be saved by reducing the volume of water that is subject to cool-down in the hot water distribution piping, by careful attention to the proximity of the hot water heater and the points of hot water use.

A Proposal for Reducing Hot Water Purging

This proposal seeks to reduce entrained hot water volume in one- and two-family homes and townhouses by --

- Adding a prescriptive requirement to Section 403 that sets accomodative but clear limits on the distance between a hot water heater and the furthest bathroom or kitchen fixture it serves; and
- Offering credit in the performance alternative in Section 405 for proposed designs that save energy by significantly increasing the proximity of hot water heaters and fixture outlets compared to the basic prescriptive level established in Section 403.

Providing greater proximity between the hot water heater and the fixtures using hot water will reduce the need for purging throughout the life of the building. This proposal is similar in intent and effect to Section 607.2 of the International Plumbing Code, which sets a maximum developed length of 50 feet for hot water supply piping between a heat source and any hot water fixture. (In most jurisdictions, however, the IPC applies to commercial and large multifamily residential buildings, rather than one-and two-family homes.) While not a limitation on pipe length or internal volume *per se*, this proposal offers a workable proxy for internal pipe volume and has the great advantage of requiring no special drawings nor any measurements or calculations at the job site. Rather, its simple provisions can be easily applied during project design and confirmed at plan check, and its graduated distance limits based on the square footage of the home meet the need for a flexible approach that respects the diversity of types and sizes of homes covered by the code.

An inefficient hot water distribution system is likely to remain in place for the life of a building, leaving owners without practical access to energy-saving options that would have only been feasible at the time of construction. This proposal will direct the attention of designers and code officials to the proximity between water heaters and those fixtures that are responsible for the great majority of hot water waste.

The Prescriptive Requirement

In this proposal, proximity between a dwelling's hot water heater and the fixture outlets it serves is measured by the straight-line distance in plan view between the water heater and the fixture outlet. For multi-story homes, the proposal specifies that the location of the hot water heater "shall be translated vertically to each floor on which a fixture served by such water heater is located." In other words, the maximum straight-line distance is applied separately on each floor, forming an arc from a point on each floor that is directly above the location of the hot water heater in the basement.

Plans for most two-story production homes should comply with the prescriptive provision with little or no adjustment. Most home designs where the principal length-to-width ratio of the building footprint is 2 to 1 or less should face few compliance issues. The concept may be more challenging for single-story structures, and for that reason an additional distance allowance is provided for single-story homes. Plans for homes with long and narrow configuration may require adjustment, largely to avoid positioning the hot water heater and its furthest fixture outlet at diagonally opposite corners of the building. Avoiding such inherently inefficient designs is the primary intent of the prescriptive proposal, and architects and builders can easily identify any compliance issues at an early stage.

The illustrations below (Figures 1-4) offer a demonstration of the simplicity of applying the proximity limits in practice.

Figure 1. This is a very basic schematic of a small single-story home of 1,000 square feet. As per the values in the proposal's table (Table R403.5.X.2), the straight-line distance allowed between the water heater and the outlet of a hot water fixture is 30 feet. In this example, the water heater is positioned in the corner of the house plan. If all kitchen and bathroom hot water fixtures are within the 30-foot arc, the plan is compliant. However, if the outlet of such a hot water fixture is located outside the 30-foot arc, the plan does not comply.

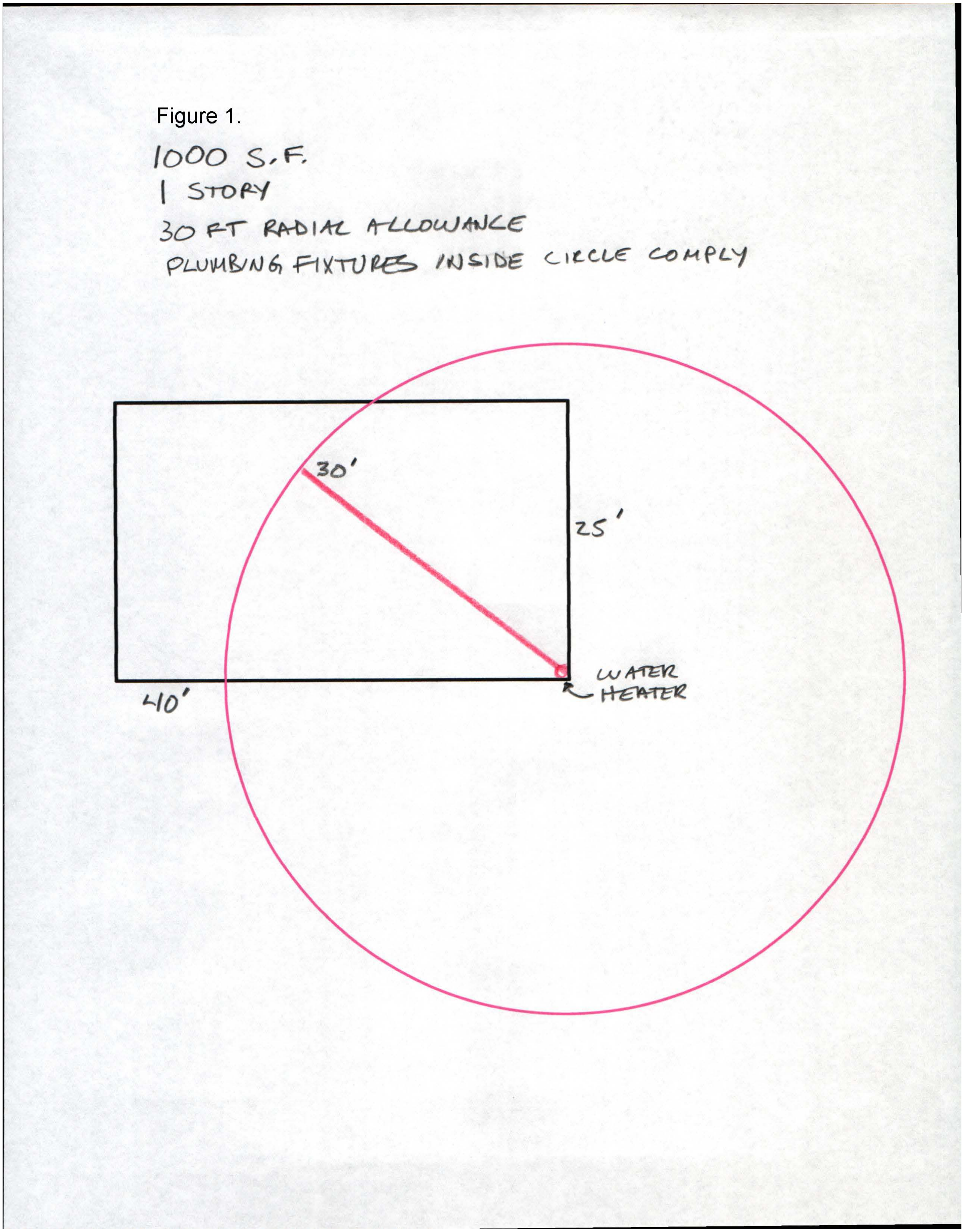


Figure 2. A second illustration of the same sized small home shows the effect of moving the hot water heater to a more central location. In Figure 2, the position of the hot water heater is at a more central point along an exterior wall. This entire home falls within the 30-foot arc, and the plan would be compliant for all possible locations of hot water outlets within this home.

Figure 2.

1000 S.F.

1 STORY

30 FT RADIAL ALLOWANCE

ALL PLUMBING FIXTURES IN DWELLING COMPLY

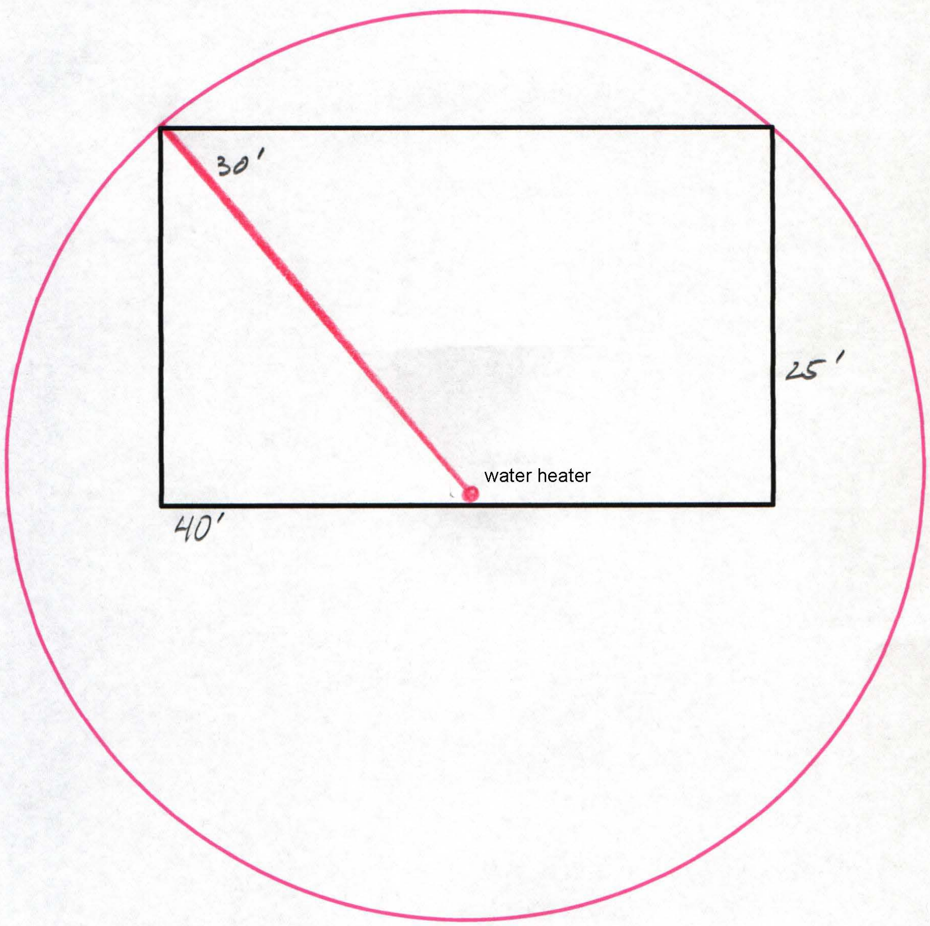


Figure 3. This third illustration shows the plan for a somewhat larger one-story home, with 2,200 square feet. In Figure 3, as per the values in proposed Table R403.5.X.2, the straight-line distance allowed between the water heater and the outlet of a hot water fixture listed in the first paragraph of the proposal is 50 feet. Here, all hot water outlets fall within the 50-foot arc, so

the plan complies. Note, however, that if the master bath had been placed in the location of the sitting room, it is possible that one or more hot water outlets would have fallen outside the 50-foot arc, and such a plan would not comply. But some adjustment of fixture locations within the master bath by the designer would likely have brought the plan into compliance.

Figure 3.

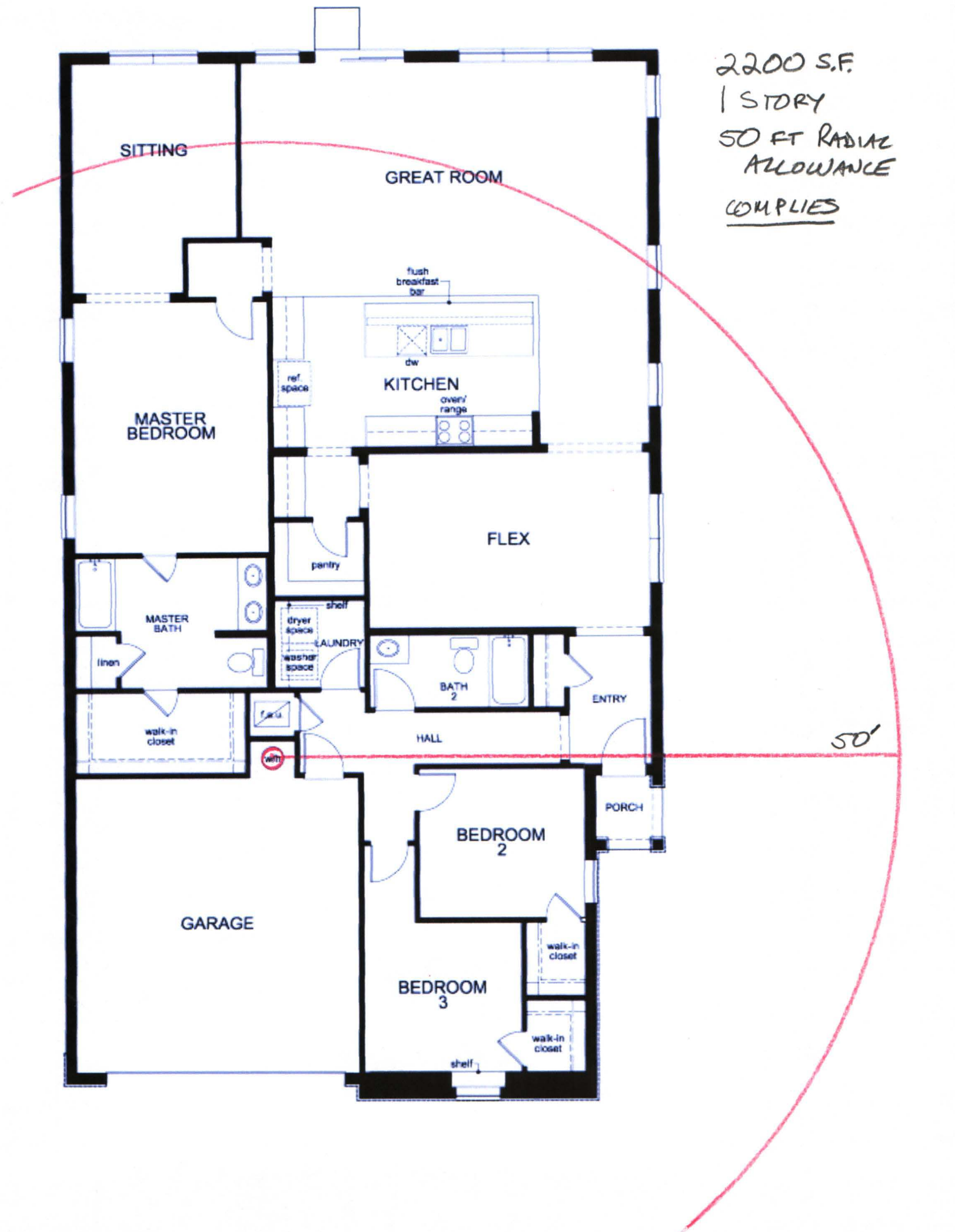
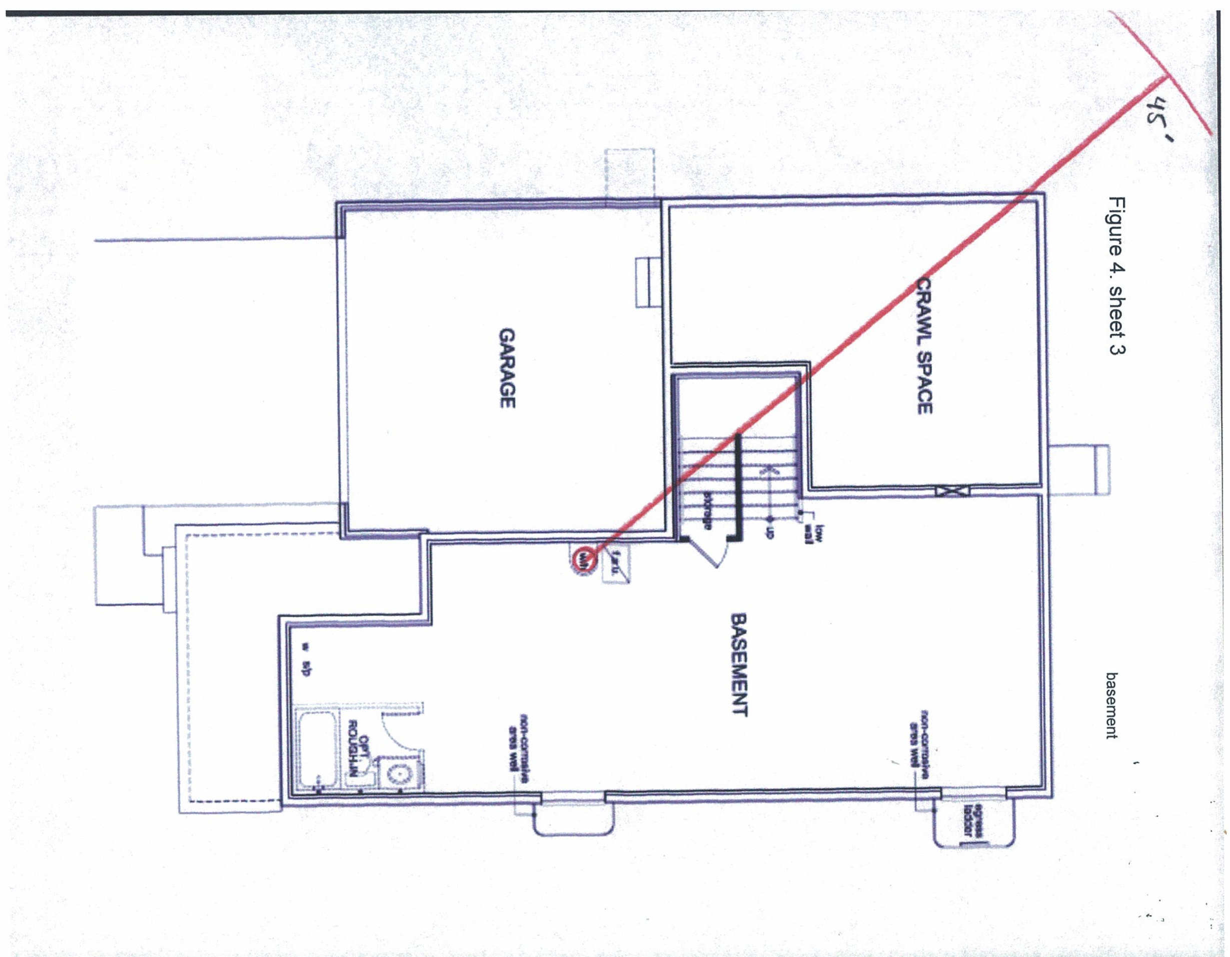
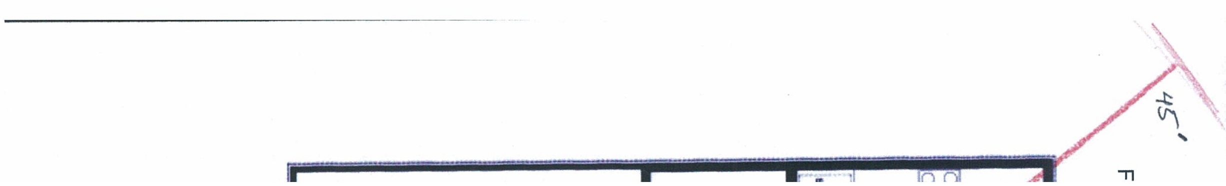
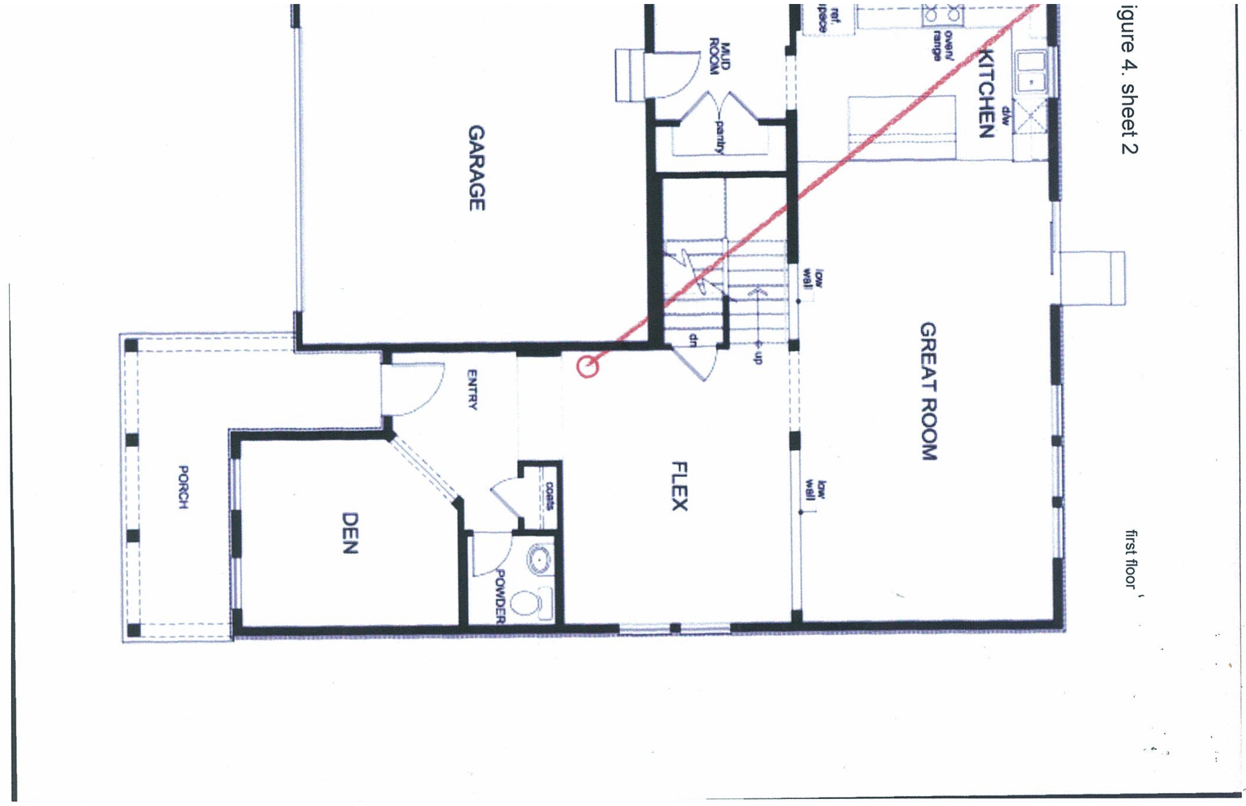


Figure 4, Sheets 1, 2, and 3. A fourth illustration (on 3 sheets) demonstrates the application of the proposal to multi-story homes, in this case, a home of 2,600 square feet and a maximum straight-line distance allowance of 45 feet. In this example, the hot water heater is located in the basement, as shown in Figure 4, Sheet 3. Section R403.5.3.2 of the proposal specifies that the location of the hot water heater "shall be translated vertically to each floor on which a fixture served by such water heater is located." In other words, the maximum straight-line distance is applied separately on each floor, measured from a point on each floor that is directly above the location of the hot water heater in the basement. In Figure 4, Sheets 2 and 1, one can see that the point of measurement on both the first and second floors is the same position in the plane of each floor as the position of the hot water heater in the plane of the basement. In this example, this relatively compact house design easily complies with the 45-foot maximum distance for a multi-story home of this square footage.


45'
Figure 4. sheet 3
CRAWL SPACE
GARAGE
BASEMENT
basement


45'


igure 4. sheet 2
first floor
KITCHEN
d/w
oven/
range
ref
space
MUD
ROOM
pantry
GARAGE
low
wall
GREAT ROOM
up
dn
ENTRY
FLEX
coats
PORCH
DEN
POWDER

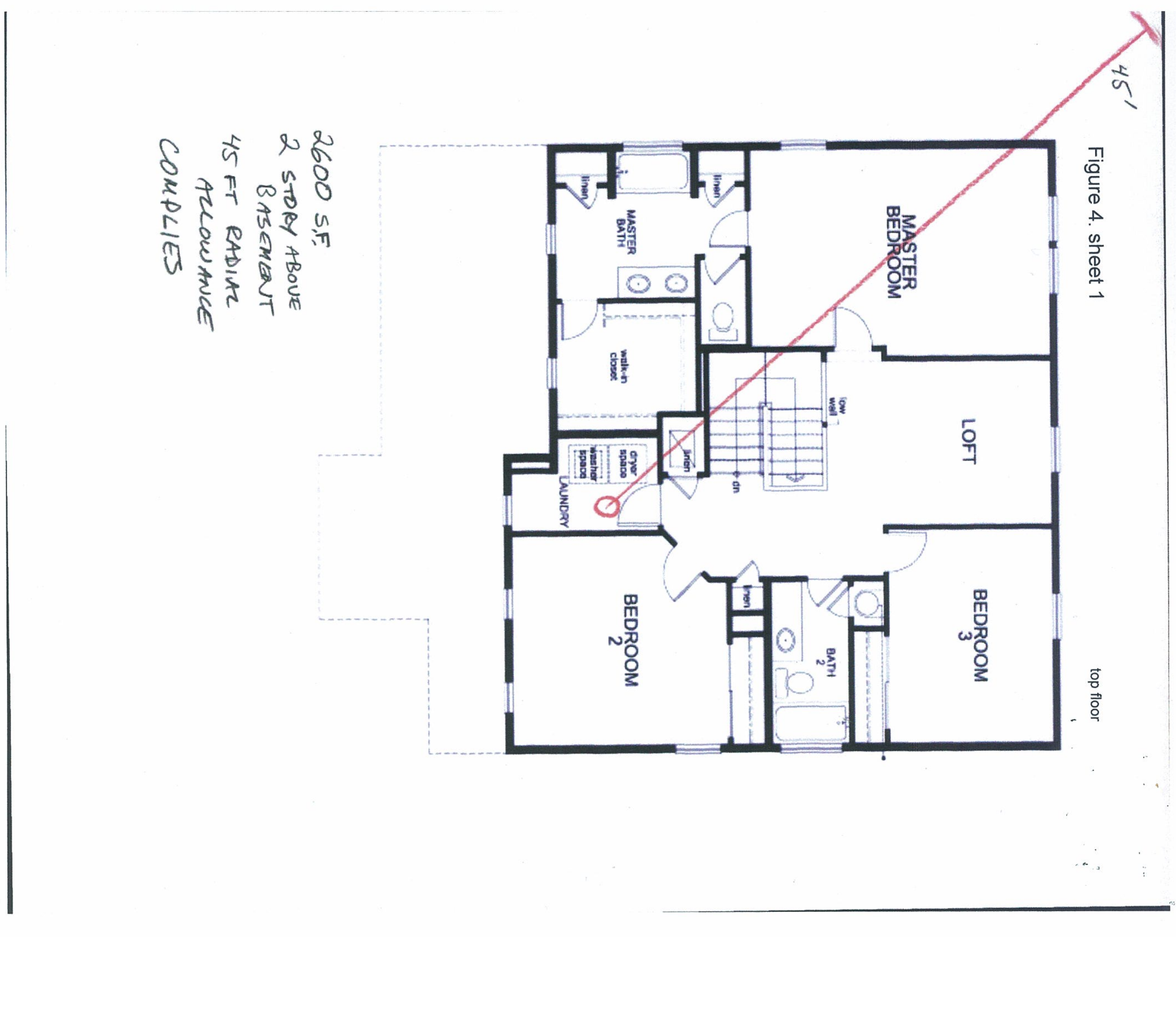


Figure 4. sheet 1
top floor
45'
MASTER
BEDROOM
linen
MASTER
BATH
walk-in
closet
low
wall
LOFT
linen
dryer
space
washer
space
LAUNDRY
dn
BEDROOM
2
linen
BATH
2
BEDROOM
3
2600 S.F.
2 STORY ABOVE
BASEMENT
45 FT RADIUS
ALLOWANCE
COMPLIES

The Performance Credit

The performance credit will encourage designs that achieve closer proximity between the water heater and fixture outlets than the maximum limits of the prescriptive proposal. A credit is provided in the form of a reduction in the deemed value for service water heating volume, and is shown in a revision to the row in existing Table R405.5.2 currently specifying how service water heating volume is to be calculated. The proposal maintains the same general formula, but makes downward adjustments in the additional volume specified for each bedroom.

Several low-cost strategies are available to designers and builders to reduce the distance between the hot water heater and fixture outlets and obtain this performance path credit, including fixture repositioning and water heater repositioning. This can often be accomplished by repositioning the proposed water heater location from an exterior garage wall to an interior garage wall; moving a basement water heater from a corner toward a more central location; or rearranging fixture locations in a bathroom to move hot water outlets closer to the water heater. Installation of a point-of-use hot water heater is also an option. (Note however, that installation of a hot water recirculation loop, while permitted, is not awarded performance credit in this proposal.)

A simple table shows how the performance credit will apply to common home configurations.

Illustrative Impact of Proximity:
Reductions in Hot Water Volume for the Proposed Design

Number of Bed Rooms	Standard Reference Design	Proposed Design @ 75% of prescriptive maximum distance in plan view		Proposed Design @ 50% of prescriptive maximum distance in plan view	
	Hot Water Volume (g/day)	Hot Water Volume (g/day)	**Reduction from standard reference design (%)**	Hot Water Volume (g/day)	**Reduction from standard reference design (%)**
2	50	48	**4**	46	**8**
3	60	57	**5**	54	**10**
4	70	66	**5.7**	62	**11.4**
5	80	75	**6.2**	70	**12.5**

As can be seen, for larger homes (as indicated by the number of bedrooms), the benefits of closer proximity are proportionately larger.

Credit for improved hot water distribution efficiency is now available to designers and builders following the energy rating index (ERI) approach under Section R406. This proposal will allow for comparable credits to be earned by builders following the performance path specified by Section R405. Without this proposal, improvements in hot water distribution efficiency will go unrecognized and unrewarded for performance path builders.

Bibliography: "Potential for Energy Savings through Residential Hot Water Distribution System Improvements," Proceedings of the 3rd International Conference on Energy Sustainability, San Francisco, CA, Herndon, Robert, et al, July 2009.
Single Family Water Heating Distribution System Improvements, Codes and Standards Enhancement Initiative (CASE), California Utilities Statewide Codes and Standards Team, draft May 2011.

Single Family Water Heating Distribution System Improvements, Codes and Standards Enhancement Initiative (CASE), California Utilities Statewide Codes and Standards Team, final September 2011.

Cost Impact: Will not increase the cost of construction
This proposal is a design requirement that can be met without increasing the cost of construction. Plans that may be initially out of conformance with the prescriptive proposal can most commonly be adjusted with strategies that need not carry a cost penalty, such as repositioning the proposed hot water heater location from an exterior garage wall to an interior garage wall, or by rearranging fixture locations in a bathroom to move hot water outlets closer to the water heater. Such changes typically result in shorter lengths of both cold and hot water piping, thereby rediucing costs. The CASE report referenced in the bibliography evaluated the cost-effectiveness of radial distance limits that were significantly *more stringent* than the prescriptive levels proposed here, and found them to be cost-effective in all cases. (See final report, pp. 20-21.) The report's estimate even assumed an initial cost of $390 for additional lengths of natural gas piping and water heater vent piping, even though repositioning a water heater from an outer garage wall to an inner garage wall need not increase gas service line length. Cost savings averaging $73 from reduced length of PEX hot water piping were estimated. Natural gas savings of 24 therms per year more than offset these costs on a life-cycle basis. What's more, no savings were calculated or credited for reduced water and sewer charges over the life of the building, which would further confirm the cost-effectiveness of this measure.
Energy- and water-saving designs encouraged by this proposal will enhance housing affordability by reducing unnecesary pipe matertial and installation costs and through reduced energy, water, and sewer bills of building owners and occupants over the life of the building.

**RE191-16 :
R403.5.X (NEW)-
HOBBS11734**

Public Hearing Results

Committee Action: **Disapproved**

Committee Reason: This is a plumbing code issue, not an IECC issue. Although conceptually the proposal has merit, this is hard to accomplish in a production home system where multiple designs and customer choices are involved.

Assembly Action: **None**

Individual Consideration Agenda

Public Comment 1:

Proponent : Ed Osann, Natural Resources Defense Council, representing Natural Resources Defense Council (eosann@nrdc.org) requests Approve as Modified by this Public Comment.

Replace Proposal as Follows:

2015 International Energy Conservation Code

**TABLE R405.5.2 (1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Service water heating d, e, f, g, i, j	~~As proposed~~ ~~Use: same as proposed design~~ Use: gal/day = 30 + (10 × N_{br})	~~As proposed~~ ~~gal/day = 30 + (10 × N_{br})~~ Same as standard reference design or Use: gal/day = 30 + ((4 × DFF_p/MD + 5) × N_{br}) employing values from Table R405.5.2(3)

For SI: 1 square foot = 0.93 m^2 , 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m^2 , 1 gallon (US) = 3.785 L, Â°C = (Â°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the *code official* , testing shall be conducted by an *approved* party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals* , or the equivalent shall be used to determine the energy loads resulting from infiltration.

b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* , page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals* , page 26.19 for intermittent mechanical ventilation.

c. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
$AF = A_s \times FA \times F$
where:
AF = Total glazing area.
A_S = Standard reference design total glazing area.
FA = (Above-grade thermal boundary gross wall area)/above-grade boundary wall area + .0.5 x below-grade boundary wall area).
F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:
Thermal Boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
Below-grade boundary wall is any thermal boundary wall in soil contact.
Common wall area is the area of walls shared with an adjoining dwelling unit.
L and *CFA* are in the same units.

i. DFFp = Straight-line distance (ft.) in plan view of the proposed project between a hot water heater and the furthest plumbing fixture specified in Table R405.5.2(3) receiving hot water from such water heater. MD = Maximum Straight-Line Distance specified in Table R405.5.2(3).

j. Service water heating use shall be the same as the standard reference design for a proposed design with any of the following:
1. a hot water recirculation system.
2. a building type not specified in Table R405.5.2(3).
3. where DFF_p/MD is greater than 1.0.

TABLE R405.5.2(3)
MAXIMUM DISTANCE BETWEEN A WATER HEATER AND CERTAIN PLUMBING FIXTURES IN DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES FOR DETERMINING WATER USE FOR SERVICE WATER HEATING

Proposed Dwelling Unit Floor Area (ft^2)	Maximum Straight-Line Distance in Plan View[a] Between a Water Heater and the Furthest Plumbing Fixture[b] it Serves	
	Two- or More Story Structures	One-Story Structures
≤1000	16 ft.	24 ft.

>1000 to ≤1600	24 ft.	32 ft.
>1600 to ≤2200	32 ft.	40 ft.
>2200 to ≤2800	36 ft.	44 ft.
>2800	40 ft.	52 ft.

a. For purposes of this determination, the location of a water heater shall be translated vertically to each floor on which a plumbing fixture served by such water heater is located. The distance in plan view shall be the length of a straight line between the center point of the water heater and the hot water outlet of the plumbing fixture.

b. Plumbing Fixture = lavatory, kitchen sink, shower, tub-shower combination.

Commenter's Reason: Although the Technical Committee noted that the original proposal had merit, testimony against the proposal largely focused on the *prescriptiveportion* of the proposal that would have required a compliance check for all house plans. In response, the modification proposed in this public comment removes the prescriptive portion of the original proposal entirely. As modified via this public comment, the code change would ONLY apply to the performance path in Section 405, adding an option for builders who elect the performance path to receive credit for installing more compact hot water distribution systems that will reduce the amount of purging and heat loss experienced in more extended distribution systems. (For a discussion of the waste of energy and water while a user waits for hot water to arrive, see the initial reason statement.) Performance path builders may continue to use the current formula to compute the volume of daily hot water use, or may use the new formula, at their option.

Credit for improved hot water distribution efficiency is already available to builders following the energy rating index (ERI) approach under Section 406, but is *not* available under the performance path of Section 405. The proposal presented in this public comment will allow a comparable credit to be earned by performance path builders.

As with the original proposal, the credit for compact hot water distribution is provided through a reduction in the deemed volume of domestic hot water (DHW) use in the proposed design. The formula for determining daily hot water volume in Table R405.5.2(1) is modified, taking into account the maximum distance between a hot water heater and the furthest fixture it serves as shown in new Table R405.5.2(3). Now, any plan that shows the straight-line distance between the water heater and the furthest fixture to be no more than the maximum distance in Table R405.5.2(3) will get credit. And the shorter the distance, the greater the credit.

And as also with the original proposal, compliance is verifiable at plan check. No measurements at the job site are required.

The following table can illustrate how achieving or improving upon the maximum distance values in new Table R405.5.2(3) will yield reductions in daily hot water volume in the proposed design. As can be seen, in homes with more bedrooms, the benefits of more compact DHW distribution systems are progressively larger.

Illustrative Impact of Hot Water Proximity:
Reductions in Hot Water Volume for the Proposed Design

Number of Bedrooms	Standard Reference Design	Proposed Design @ 100% of Maximum Distance in Plan View		Proposed Design @ 75% of Maximum Distance in Plan View		Proposed Design @ 50% of Maximum Distance in Plan View	
	Gallons per Day	Gallons per Day	% Savings	Gallons per Day	% Savings	Gallons per Day	% Savings
2	50	-2	4.0%	-4	8.0%	-6	12.0%
3	60	-3	5.0%	-6	10.0%	-9	15.0%
4	70	-4	5.7%	-8	11.4%	-12	17.1%
5	80	-5	6.3%	-10	12.5%	-15	18.8%

Proponent : David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com); LaurieSA Rich, representing test (cdpsalaurie@iccsafe.org) requests Approve as Submitted.

Commenter's Reason: This change adds a prescriptive limit on the distance between water heater and certain fixtures. The Committee recommended denial.

This proposal establishes a performance path calculation that includes the distance between the water heater and the fixtures. The AIA believe it has merit and would provide a secondary benefit of decreasing water consumption. The undeniable savings is justified and is based on good design principles often used by experienced designers and should be incorporated into the code setting a standard for all design.

RE191-16