IECC RESIDENTIAL CONSENSUS COMMITTEE RESULTS ON THE 2021 PUBLIC INPUT CHANGES TO THE INTERNATIONAL ENERGY CONSERVATION CODES

Introduction

On July 19, 2021, Energy.cdpACCESS.com was opened for 2021 Public Input Proposed Code Change submittals for consideration in the update to the 2024 International Energy Conservation Code and Chapter 11 of the International Residential Code. The submittal deadline was October 12, 2021. A total of 450 proposals were received (256 Commercial; 194 Residential). In addition, 17 committee proposals were submitted (7 Commercial; 10 Residential). Proposals are identified as follows:

- Commercial Energy Public Input (CEPI)
- Commercial Energy Committee Public Input (CECPI) (committee proposal)
- Residential Energy Public Input (REPI)
- Residential Energy Committee Public Input (RECPI) (committee proposal)
- Residential Energy IRC Public Input (IRCEPI)
- The "Part" listed after the code change indicates the respective items of the code change that involve possible coordination issues between the Commercial and Residential provisions. For example, CEPI – II - 21 Part I was a code change heard by the Commercial Consensus Committee and Part II was heard by the Residential Committee.

The process for consideration of the proposals included:

- Posting of the proposals on November 23, 2021.
- An open process of review by one of the Subcommittees established by the Consensus Committee, including interested parties
- Subcommittee recommended action on the proposals to the Consensus Committee
- Consensus Committee action on the proposals with an open process including posting of documents and participation by interested parties

This **Committee Action Report (CAR)** includes the following:

- A summary of the actions taken by the respective IECC Consensus Committee from November/2021 – June/2022 on each proposal. The Consensus Committee action is noted by one of the following: Approve (as submitted); Approved as Modified; or Disapproved along with the vote count and percentages for a successful action. In accordance with Section 9.3(d) of the ICC Consensus Procedures (ICC CP), the disposition of an item during the public input process required a simple majority. Those proposals that were withdrawn by the proponent are so noted.
- All approved proposals (approve and approved as modified) are included in the CAR in legislative format, including the reason(s) for the committee action. These proposals form the basis for the ballot process below.

The results of the balloting process by the Consensus Committee will be the basis for the next step in the process – issuance of Public Comment Draft #1. Public Comment Draft #1 will incorporate all text revisions to the 2021 IECC/Chapter 11 of the IRC based on those code changes which have achieved the voting majorities in Section 9.4 of the ICC CP (approval by at least a majority of the committee and at least two-thirds of those voting, excluding abstentions). Public Comment Draft #1 will be posted and open for code change submittals via Energy.cdpACCESS. Further information will be posted on ICC's Energy website.

Ballot Instructions

Ballot format

The ballot process will utilize a link to a single electronic ballot, structured below in accordance with Section 9.1 of the ICC CP. This ballot format will be used for subsequent ballots as well. On the signature page of the ballot, instructions will be included with direction for members to vote on the results of the approved code changes by selecting one of the following:

(*The annotation in italics will not be included in the ballot)*

- Affirmative (all code changes)
    - *An affirmative vote is a single vote to ratify approval of all the proposals approved by the committee.*

- Affirmative with comment (comments on separate file; send to Secretariat)
    - *An affirmative with comment vote is a single vote to ratify approval of all the proposals approved by the committee and allows the voting member to offer comments on specific proposals. Such comments must be identified by code change number on a separate file and sent to the Secretariat for reproduction as part of the recirculation ballot process for all committee members to view. Comments can be in favor, in opposition or neutral but in all cases such comments will not affect the single ratification vote cast on all the proposals. Comments provided with an affirmative vote are for information only, no action is required by the committee.*

- Negative, with reasons (the reasons for a negative vote shall be given and, if possible, should include specific wording or actions that would resolve the objection)
    - *This single vote identifies that the voting member has an objection to one or more of the approved proposals. On a separate file, the proposals must be identified by code change number and a reason for the negative vote on the proposal. If there are text revisions for the committee to consider that would resolve the negative vote, such revisions should be included as well. This file is to be sent to the Secretariat for reproduction as part of the recirculation ballot process for all committee members to view.*
    - *Negative votes to code changes without a reason "shall not be factored into the numerical requirements for consensus" (Section 2.7 (3); 2022 ANSI Essential Requirements).*
    - *Proposals not identified as receiving a negative vote are considered as an affirmative vote.*

In some cases, committee members may wish to abstain on voting on a specific proposal(s). If this is the case, be sure to vote as directed above and in a separate file identify the code change number(s) for which you are abstaining and send to the Secretariat for reproduction as part of the recirculation ballot process for all committee members to view. This abstention can be combined in the same file as an "Affirmative with comment" or "Negative, with reasons". See Section 9.4 of ICC CP for abstentions - such abstentions are excluded from numerical requirements for required voting majorities.

Ballot #1

The initial ballot, Ballot #1, initiates the balloting process of the CAR.

- Ballot #1 will be open for 30 days. The 30-day deadline requires both the completion of the online ballot as well as the submittal of any comments/reasons.
- Comments received with "Affirmative with comment" ballots will be compiled per proposal as well as reasons for abstentions.
- For each proposal receiving a negative comment, the reasons for the negative and any proposed text revisions to resolve the negative will be compiled per proposal, along with the vote tally on that proposal from Ballot #1.

Ballot #2

The results from Ballot #1 will be recirculated to the committee for review to give committee members an opportunity to review comments provided and, if they choose, to change their vote. See Section 9.6 of the ICC CP for a discussion on recirculation ballots.

- Ballot #2 will be open for 14 days. The 14-day deadline requires both the completion of the online ballot as well as the submittal of any comments/reasons.
- Unless a committee member records a vote change on a given proposal, that committee member's Ballot #1 vote is presumed to be unchanged. If additional comments are included with their ballot, these comments will be compiled and recirculated as done with Ballot #1.
- If the requisite majorities of Section 9.4 of the ICC CP are achieved on Ballot #2 with affirmative or affirmative with comment, this is final approval of the text revisions to be incorporated into Public Comment Daft #1. Ballot #3 and the remaining steps below are not required.
- If the requisite majorities of Section 9.4 are not achieved on Ballot #2 with affirmative or affirmative with comment, the negative votes and reasons and all other comments will be compiled per proposal, along with the vote tallies per proposal.

Ballot #3

The results from Ballot #2 will be recirculated to the committee for review to give committee members an opportunity to review comments provided and, if they choose, to change their vote.

- Ballot #3 will be open for 14 days. The 14-day deadline requires both the completion of the online ballot as well as the submittal of any comments/reasons.
- Unless a committee member records a vote change on a given proposal, that committee member's Ballot #2 vote is presumed to be unchanged. If additional comments are included with their ballot, these comments will be compiled and recirculated as done with Ballots #1 and #2.
- If the requisite majorities of Section 9.4 are achieved on Ballot #3 with affirmative or affirmative with comment, this is final approval of the text revisions to be incorporated into Public Comment Daft #1 and the remaining steps below are not required.
- If the requisite majorities of Section 9.4 are not achieved on Ballot #3 with affirmative or affirmative with comment, the negative votes and reasons and all other comments will be compiled per proposal, along with the vote tallies per proposal.
- Every code change that did do not achieve the requisite majorities of Section 9.4 will be considered at a Consensus Committee meeting for possible resolution. Meeting date to be determined.

Consensus Committee Meeting

The results of Ballot #3 for those code changes that did not achieve the requisite majorities of Section 9.4 will be compiled and distributed to the committee. These code changes will serve as the agenda for a meeting of the Consensus Committee. Any revisions to the code changes to be considered at the meeting must be developed and submitted at a time to be determined in advance of the meeting. The committee will discuss and vote on the code changes at this meeting. This meeting will be open to interested parties.

Ballot #4

The results of the Consensus Committee meeting will be compiled and sent to the committee. Ballot #4 will be a recirculation ballot sent to those not in attendance at the Consensus Committee meeting. This is the last step in the approval process of the CAR and the determination of the resulting text to be included in Public Comment Draft #1.

- The ballot will be open for 14 days. The 14-day deadline requires both the completion of the online ballot as well as the submittal of any comments/reasons.
- All code changes considered at the Consensus Committee meeting require the requisite majorities of Section 9.4 in order to be incorporated into Public Comment Draft #1.
- Code changes that do not meet these majorities will not be included in Public Comment Draft #1. Such code changes can be considered for submission as proposals to Public Comment Draft #1 at the discretion of the proponent with due regard for comments received and the outcomes of the ballot process.

Results of the Residential Consensus Committee Public Input Process November 2021-June 2022

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
CEPI-008-21 Part II	approve	38	10	0	79%
CEPI-011-21 Part II	disapproved	42	1	0	98%
CEPI-012-21 Part II	withdrawn				
CEPI-013-21 Part II	disapproved	41	0	1	100%
CEPI-015-21 Part II	approve	39	0	0	100%
CEPI-015-21 Part III	approve	41	0	0	100%
CEPI-016-21 Part II	disapproved	35	4	2	90%
CEPI-017-21 Part II	disapproved	29	9	2	76%
CEPI-019-21 Part II	approved as modified	37	0	0	100%
CEPI-024-21 Part II	approve	38	0	0	100%
CEPI-063-21 Part II	withdrawn				
CEPI-066-21 Part II	withdrawn				
CEPI-082-21 Part II	approve	37	0	0	100%
CEPI-145-21	disapproved	29	1	2	97%
CEPI-146-21 Part II	disapproved	35	0	0	100%
CEPI-218-21 Part II	disapproved	40	0	0	100%
CEPI-255-21 Part II	disapproved	33	0	2	100%
CEPI-258-21 Part II	withdrawn				
CEPI-258-21 Part III	withdrawn				
IRCEPI-001-21	approved as modified	40	0	0	100%
IRCEPI-002-21	disapproved	39	1	0	98%
IRCEPI-003-21	approved as modified	32	3	1	91%
IRCEPI-004-21	approved as modified	29	6	1	83%
IRCEPI-005-21	disapproved	38	2	0	95%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
IRCEPI-006-21	approved as modified	36	0	1	100%
IRCEPI-7-21	approve	35	1	0	97%
RECPI-1-21	withdrawn				
RECPI-2-21	approve	42	0	1	100%
RECPI-3-21	withdrawn				
RECPI-4-21	disapproved	22	21	1	51%
RECPI-5-21	disapproved	33	4	3	89%
RECPI-6-21	approved as modified	27	13	1	68%
RECPI-7-21	approved as modified	27	14	1	66%
RECPI-8-21	approve	23	16	1	59%
RECPI-9-21	disapproved	31	3	2	91%
RECPI-10-21	approve	29	11	3	73%
RECPI-11-21	approve	34	0	1	100%
REPI-001-21	withdrawn				
REPI-002-21	withdrawn				
REPI-003-21 Part I	disapproved	37	4	0	90%
REPI-003-21 Part II	disapproved	31	4	0	89%
REPI-004-21	approved as modified	35	9	1	80%
REPI-005-21	disapproved	19	15	1	56%
REPI-006-21	disapproved	21	16	0	57%
REPI-007-21	approved as modified	27	10	1	73%
REPI-008-21	withdrawn				
REPI-009-21	approved as modified	39	1	0	98%
REPI-010-21	disapproved	34	8	3	81%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-011-21	approved as modified	30	9	1	77%
REPI-012-21	disapproved	29	5	1	85%
REPI-013-21	approved as modified	32	1	0	97%
REPI-014-21	withdrawn				
REPI-015-21	disapproved	32	0	3	100%
REPI-016-21	withdrawn				
REPI-017-21	disapproved	22	15	1	59%
REPI-018-21	approved as modified	36	6	0	86%
REPI-019-21	disapproved	40	0	0	100%
REPI-020-21	approved as modified	28	10	0	74%
REPI-021-21	approved as modified	23	16	0	59%
REPI-022-21	disapproved	36	0	0	100%
REPI-023-21	disapproved	36	0	0	100%
REPI-024-21	disapproved	38	0	0	100%
REPI-026-21	approved as modified	39	1	0	98%
REPI-027-21	disapproved	25	9	0	74%
REPI-028-21	approved as modified	32	3	1	91%
REPI-029-21	withdrawn				
REPI-030-21	approved as modified	44	2	0	96%
REPI-031-21	disapproved	27	4	0	87%
REPI-032-21	disapproved	22	20	0	52%
REPI-033-21	approved as modified	20	18	3	53%
REPI-034-21	disapproved	40	0	0	100%
REPI-035-21	approve	37	3	0	93%
REPI-036-21	disapproved	40	0	0	100%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-037-21	approved as modified	36	3	1	92%
REPI-038-21	disapproved	26	8	2	76%
REPI-039-21	approved as modified	36	4	1	90%
REPI-040-21	approved as modified	40	0	0	100%
REPI-041-21	disapproved	26	18	0	59%
REPI-042-21	approve	30	3	0	91%
REPI-043-21	approved as modified	36	0	0	100%
REPI-044-21	disapproved	33	0	0	100%
REPI-045-21	disapproved	39	1	0	98%
REPI-046-21	disapproved	39	4	1	91%
REPI-047-21	approve	36	5	0	88%
REPI-048-21	disapproved	40	2	2	95%
REPI-049-21	disapproved	38	1	1	97%
REPI-050-21	approved as modified	34	9	0	79%
REPI-051-21	approved as modified	30	10	0	75%
REPI-052-21	approved as modified	38	2	0	95%
REPI-053-21	approved as modified	26	14	0	65%
REPI-054-21	approved as modified	26	12	1	68%
REPI-055-21	approved as modified	43	1	0	98%
REPI-056-21	disapproved	28	9	0	76%
REPI-057-21	approved as modified	40	0	1	100%
REPI-058-21	approve	36	3	1	92%
REPI-059-21	disapproved	36	2	0	95%
REPI-060-21	approved as modified	29	5	0	85%
REPI-061-21	approved as modified	25	11	1	69%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-062-21	disapproved	31	2	3	94%
REPI-063-21	approve	28	9	0	76%
REPI-064-21	approved as modified	21	17	1	55%
REPI-065-21	approve	20	16	1	56%
REPI-066-21	approved as modified	37	2	1	95%
REPI-067-21	disapproved	38	0	1	100%
REPI-068-21	approved as modified	22	20	0	52%
REPI-069-21	approve	24	18	1	57%
REPI-070-21	approved as modified	22	19	1	54%
REPI-071-21	disapproved	20	18	1	53%
REPI-072-21	disapproved	34	0	0	100%
REPI-073-21	approved as modified	35	2	2	95%
REPI-074-21	approve	39	2	0	95%
REPI-075-21	disapproved	30	3	1	91%
REPI-076-21	disapproved	26	7	2	79%
REPI-077-21	disapproved	45	0	1	100%
REPI-078-21	approved as modified	38	2	0	95%
REPI-079-21	approved as modified	38	6	1	86%
REPI-080-21	approved as modified	22	11	4	67%
REPI-081-21	withdrawn				
REPI-082-21	approved as modified	40	4	0	91%
REPI-083-21	approve	44	0	0	100%
REPI-084-21	withdrawn				
REPI-085-21	approved as modified	24	14	0	63%
REPI-086-21	approved as modified	35	1	2	97%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-087-21	approved as modified	30	9	0	77%
REPI-088-21	disapproved	34	5	2	87%
REPI-089-21	approved as modified	33	0	0	100%
REPI-090-21	approved as modified	31	3	2	91%
REPI-091-21	approved as modified	37	0	0	100%
REPI-092-21	disapproved	36	0	0	100%
REPI-093-21	approved as modified	20	18	3	53%
REPI-094-21	approved as modified	34	1	1	97%
REPI-095-21	approved as modified	37	0	0	100%
REPI-096-21	approved as modified	40	0	0	100%
REPI-097-21	disapproved	23	18	1	56%
REPI-098-21	disapproved	31	3	4	91%
REPI-099-21	approved as modified	22	15	3	59%
REPI-100-21	disapproved	34	6	0	85%
REPI-101-21	approved as modified	35	1	0	97%
REPI-102-21 Part I	approved as modified	32	5	2	86%
REPI-102-21 Part II	approved as modified	32	5	2	86%
REPI-103-21	disapproved	36	1	1	97%
REPI-104-21	withdrawn				
REPI-105-21	approve	30	2	0	94%
REPI-106-21	approved as modified	31	3	2	91%
REPI-107-21 Part I	withdrawn				
REPI-107-21 Part II	withdrawn				
REPI-108-21	approved as modified	33	1	0	97%
REPI-109-21 Part I	disapproved	34	1	0	97%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-109-21 Part II	disapproved	34	1	0	97%
REPI-110-21	disapproved	28	9	0	76%
REPI-111-21	approved as modified	22	19	0	54%
REPI-112-21 Part I	disapproved	29	10	0	74%
REPI-112-21 Part II	disapproved	32	5	2	86%
REPI-113-21	disapproved	28	10	2	74%
REPI-114-21	disapproved	21	16	0	57%
REPI-115-21	approved as modified	24	15	0	62%
REPI-116-21	withdrawn				
REPI-117-21	approved as modified	23	12	2	66%
REPI-118-21	approved as modified	36	3	0	92%
REPI-119-21	disapproved	43	0	0	100%
REPI-120-21	approved as modified	23	18	1	56%
REPI-121-21	approved as modified	30	6	2	83%
REPI-122-21	approved as modified	26	13	1	67%
REPI-123-21	disapproved	31	2	0	94%
REPI-124-21	approve	36	1	1	97%
REPI-125-21	disapproved	29	10	2	74%
REPI-126-21	approved as modified	26	18	0	59%
REPI-127-21	disapproved	40	2	0	95%
REPI-128-21	disapproved	25	15	0	63%
REPI-129-21	approve	23	18	0	56%
REPI-130-21	disapproved	38	0	0	100%
REPI-131-21	approved as modified	36	0	0	100%
REPI-132-21	disapproved	40	0	0	100%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-133-21 Part I	disapproved	23	18	0	56%
REPI-133-21 Part II	disapproved	23	17	0	58%
REPI-134-21	disapproved	24	17	0	59%
REPI-135-21	disapproved	35	5	0	88%
REPI-136-21	approved as modified	34	9	1	79%
REPI-137-21	disapproved	36	0	0	100%
REPI-138-21	disapproved	26	10	1	72%
REPI-139-21	withdrawn				
REPI-140-21	approved as modified	36	0	1	100%
REPI-141-21	withdrawn				
REPI-142-21	approved as modified	31	5	3	86%
REPI-143-21	approved as modified	24	12	2	67%
REPI-144-21	approved as modified	31	3	2	91%
REPI-145-21	approved as modified	34	0	2	100%
REPI-146-21	disapproved	39	0	0	100%
REPI-147-21	disapproved	34	4	0	89%
REPI-148-21	disapproved	31	3	1	91%
REPI-149-21	disapproved	31	1	1	97%
REPI-150-21	approved as modified	31	13	0	70%
REPI-151-21	approve	34	8	0	81%
REPI-152-21	approved as modified	41	0	0	100%
REPI-153-21	approve	31	1	1	97%
REPI-154-21	approve	33	0	0	100%
REPI-155-21	approved as modified	19	16	3	54%
REPI-156-21	approved as modified	31	6	0	84%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-157-21	approved as modified	30	9	1	77%
REPI-158-21	approved as modified	39	2	0	95%
REPI-159-21	disapproved	23	12	0	66%
REPI-160-21	approve	22	17	0	56%
REPI-161-21	approve	33	0	2	100%
REPI-162-21	disapproved	35	0	0	100%
REPI-163-21	approved as modified	24	15	0	62%

Proposal number	Committee Action	Vote Yes	Vote No	Abstain	%
REPI-164-21	disapproved	33	6	1	85%
REPI-165-21	approve	34	4	0	89%
REPI-166-21	disapproved	23	12	2	66%
REPI-167-21	disapproved	34	3	2	92%
REPI-168-21	disapproved	37	1	0	97%

CEPI-8-21 Part II

Proponents: Mike Nugent, representing Building Code Action Committee (bcac@iccsafe.org); David Collins, representing SEHPCAC (sehpcac@iccsafe.org)

2021 International Energy Conservation Code

SECTION R104
FEES

Revise as follows:

R104.1 Payment of Fees. A permit shall not be ~~issued~~ valid until the fees prescribed ~~in Section R104.2~~ by law have been paid ~~, nor~~ Nor shall an amendment to a permit be released until the additional fee, if any, has been paid.

R104.2 Schedule of permit fees. Where a permit is required, a fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.

Add new text as follows:

R104.3 Permit valuations. The applicant for a permit shall provide an estimated value of the work for which the permit is being issued at the time of application. Such estimated valuations shall include the total value of the work, including materials and labor. Where, in the opinion of the code official, the valuation is underestimated, the permit shall be denied, unless the applicant can show detailed estimates acceptable to the code official. The final valuation shall be *approved* by the code official.

Revise as follows:

~~R104.3~~ R104.4 Work commencing before permit issuance. Any person who commences any work before obtaining the necessary permits shall be subject to ~~an additional~~ a fee established by the *code official* that shall be in addition to the required permit fees.

~~R104.4~~ R104.5 Related fees. The payment of the fee for the construction, *alteration*, removal or demolition of work done in connection to or concurrently with the work or activity authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.

~~R104.5~~ R104.6 Refunds. The *code official* is authorized to establish a refund policy.

Reason: The intent is consistency in language for 'Fees' within the codes.

- Payment of fees – consistent title, always two sentences
- Schedule of permit fees – Not all projects require a fee - Commercial and Residential are currently different in this section.
- Permit valuation: This lets the jurisdiction establish fees for permits.
- Work commencing before permit issuance – remove redundant language
- Refunds – no change

The BCAC is working from the philosophy that ICC is a family of codes, so administrative requirements should be consistent across books. Most administrative and enforcement matters are the same for any code. Those matters unique for a specific code remain unchanged. This is one of a series of proposals being submitted relating to technical, editorial and organizational changes proposed for the Administrative chapters (Chapter 1) in all of the I-Codes.

This proposal is submitted by the ICC Building Code Action Committee (BCAC) and the ICC Sustainable and Energy and High Performance Code Action Committee (SEHPCAC).

BCAC was established by the ICC Board of Directors in July 2011 to pursue opportunities to improve and enhance assigned International Codes or portions thereof. In 2020 and 2021 the BCAC has held several virtual meetings open to any interested party. In addition, there were numerous virtual Working Group meetings for the current code development cycle, which included members of the committee as well as interested parties. Related documents and reports are posted on the ICC website at https://www.iccsafe.org/codes-tech-support/codes/codedevelopment-process/building-code-actioncommittee-bcac.

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 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous 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.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is an administrative allowance for a building department. This will not change any construction requirements.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Recommendation for approve proposal since this will synchronize the administrative provisions of the IECC with other I-Codes and as the IECC grows there may be a need in the future for Jurisdictions to permit energy related projects without the need for permits from other I-Codes

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CEPI-15-21 Part II

Proponents: Amanda Hickman, representing Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Add new definition as follows:

EMITTANCE. The ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody at the same temperature and under the same conditions.

Reason: This definition is needed because the term emittance is used in various sections of the code and in the definition for radiant barrier and reflective insulation. It is consistent with the definition found in the 2021 IBC, ASHRAE and ASTM standards. The term emittance is used in numerous sections of this code including for: Building Envelope Requirements, Equipment Buildings, Roof Solar Reflectance and Thermal Emittance, Minimum Roof Reflectance and Emittance Options, Specifications for the Standard Reference and Proposed Designs, Roofs, and for Specifications for the Standard Reference and Proposed Designs, Walls above-grade.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Adding a definition of EMITTANCE will neither increase or decrease construction costs. This is only a definition and is identical to the definition found in the 2021 IBC and existing ASHRAE and ASTM standards.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: This definition will be helpful to have to account for new technology coming into the field. This definition is consistent with ASHRAE and ASTM.

CEPI-15-21 Part III

Proponents: Amanda Hickman, representing Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Residential Code

N1101.6 Defined terms. The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

Add new definition as follows:

[RE] EMITTANCE. The ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody at the same temperature and under the same conditions.

Reason: This definition is needed because the term emittance is used in various sections of the code and in the definition for radiant barrier and reflective insulation. It is consistent with the definition found in the 2021 IBC, ASHRAE and ASTM standards. The term emittance is used in numerous sections of this code including for: Building Envelope Requirements, Equipment Buildings, Roof Solar Reflectance and Thermal Emittance, Minimum Roof Reflectance and Emittance Options, Specifications for the Standard Reference and Proposed Designs, Roofs, and for Specifications for the Standard Reference and Proposed Designs, Walls above-grade.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Adding a definition of EMITTANCE will neither increase or decrease construction costs. This is only a definition and is identical to the definition found in the 2021 IBC and existing ASHRAE and ASTM standards.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: This definition will be helpful to have to account for new technology coming into the field. This definition is consistent with ASHRAE and ASTM.

CEPI-19-21 Part II

Proponents: Darren Meyers, P.E., representing International Energy Conservation Consultants LLC (dmeyers@ieccode.com); Mark Graham, representing National Roofing Contractors Association (mgraham@nrca.net)

2021 International Energy Conservation Code

Revise as follows:

R303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and the *R*-value of the installed thickness shall be indicated on the certification. For insulated siding, the *R*-value shall be on a label on the product's package and shall be indicated on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

> **Exception:** For roof insulation installed above the deck, the *R*-value shall be labeled as required by the material standards specified in Table 1508.2 of the *International Building Code* or Table R906.2 of the *International Residential Code*, as applicable.

R303.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable at inspection. For insulation materials that are installed without an observable manufacturer's *R*-value mark, such as blown or draped products, an insulation certificate complying with Section R303.1.1 shall be left immediately after installation by the installer, in a conspicuous location within the building, to certify the installed *R*-value of the insulation material.

> **Exception:** For roof insulation installed above the deck, the *R-value* shall be labeled as specified by the material standards in Table 1508.2 of the *International Building Code* or Table R906.2 of the *International Residential Code*, as applicable.

Reason: The National Roofing Contractors Association authored identical exceptions to C303.1.1 and R303.1.1 several cycles ago. Our proposal here, is intent on averting similar confusion relative to field inspection observations. Rigid board insulation intended for above-deck installation is package-labeled. Once the package covering is removed, no permanent marking remains, as these respective sections imply. It is common for inspectors to perform their field inspection duties by collecting or observing unopened or pre-opened packaging materials while on site.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: simply a clarification that R value should be visible

Proposal # 570

CEPI-24-21 Part II

Proponents: Amy Boyce, representing Institute for Market Transformation

2021 International Energy Conservation Code

Revise as follows:

PROPOSED DESIGN. A description of the proposed *building* used to estimate annual energy use for determining compliance based on ~~total~~ simulated building performance.

STANDARD REFERENCE DESIGN. A version of the *proposed design* that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on ~~total~~ simulated building performance.

Add new definition as follows:

SIMULATED BUILDING PERFORMANCE. A process in which the proposed building design is compared to a standard reference design for the purposes of estimating relative energy use against a baseline to determine code compliance.

Revise as follows:

R401.2.2 ~~Total~~ Simulated Building Performance Option. The ~~Total~~ Simulated Building Performance Option requires compliance with Section R405.

R403.3.3.1 Effective R-value of deeply buried ducts. Where using the ~~Total~~ Building Simulated Performance Compliance Option in accordance with Section R401.2.2 , sections of ducts that are installed in accordance with Section R403.3.3, located directly on or within 5.5 inches (140 mm) of the ceiling, surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

SECTION R405
~~TOTAL~~ SIMULATED BUILDING PERFORMANCE

R405.1 Scope. This section establishes criteria for compliance using ~~total~~ simulated building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water-heating energy only.

R405.2 Simulated p~~P~~erformance-based compliance. Compliance based on ~~total~~ simulated building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. 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 Data System Prices and Expenditures reports. 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.

TABLE R405.2 REQUIREMENTS FOR ~~TOTAL~~ SIMULATED BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

R405.3 Documentation. Documentation of the software used for the ~~performance~~ proposed design and the parameters for the baseline *building* shall be in accordance with Sections R405.3.2.1 through R405.3.2.2.

R405.3.2.2 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. Declaration of the ~~total~~ simulated building performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section R405.3.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home, including component level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
7. Where on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

R405.4 Calculation procedure. Calculations of the ~~performance~~ proposed design shall be in accordance with Sections R405.4.1 and R405.4.2.

R502.2 Change in space conditioning. Any unconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

Exceptions:

1. Where the simulated building performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.
2. Where the Total UA, as determined in Section R402.1.5, of the existing building and the *addition*, and any *alterations* that are part of the project, is less than or equal to the Total UA generated for the existing *building*.
3. Where complying in accordance with Section R405 and the annual energy cost or energy use of the *addition* and the existing *building*, and any *alterations* that are part of the project, is less than or equal to the annual energy cost of the existing *building*. The *addition* and any *alterations* that are part of the project shall comply with Section R405 in its entirety.

R505.1 General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

Exception: Where the simulated building performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost allowed by Section R405.2.

Reason: The “Total Building Performance” path, as prescribed by the IECC, uses simulation software to compare elements of the *proposed building* with that of a *baseline building*. In this simulation, many building elements are simulated using default values, as those elements do not affect the results of the comparison. The path title leads many to the false conclusion that the results of this building simulation will align with the actual building energy use – its performance – once it is built and occupied; however, that is not the intent of the simulation in this case.
While generally confusing in the past, this misconception is more critical now with the adoption of Building Performance Standards (BPS) in many jurisdictions. While BPS govern existing buildings, they will apply to newly constructed buildings once those structures have been occupied for a set number of years. The misunderstanding of the purpose and the results of the code-required proposed building model may lead owners and operators to assume that a building was designed to meet the future BPS requirements and that that design intent is backed up by the model results. Changing the language to clarify that the results of the code-required proposed building model are not necessarily aligned with future building performance will adjust expectations and potentially minimize future legal concerns.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change affects the language only.

Cost Effectiveness: While the change itself will neither increase nor decrease costs, bringing awareness to the limitations of the current total building performance path will aid owners and designers in the conversation about predicted building performance and potentially reduce costs associated with changes made later on in the process.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: clarifies that the whole building modeling approach is based on simulation.

CEPI-82-21 Part II

Proponents: Nick Thompson, City of Aspen, representing Colorado Chapter of the ICC (nick.thompson@cityofaspen.com)

2021 International Energy Conservation Code

R403.9 Snow melt and ice system controls . Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is greater than 50°F (10°C) and precipitation is not falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is greater than 40°F (4.8°C).

Add new text as follows:

R403.10 Roof and gutter deicing controls. Roof and gutter deicing systems, including but not limited to self-regulating cable, shall include automatic controls configured to shut off the system when the outdoor temperature is above 40°F (4.8°C) maximum and shall include one of the following:

1. A moisture sensor configured to shut off the system in the absence of moisture, or
2. A programmable timer configured to shut off the system for 8 hours minimum at night.

Reason: Roof and gutter deicing, often in the form of heat tape, is used to prevent ice dams in buildings with inadequate roof insulation, air sealing, and/or attic/roof surface ventilation. These systems use energy and are often left running at times that are unnecessary for ice dam prevention. The intent is to have automatic controls limit the system from running when either of two conditions is present. The first condition is when the outdoor temperature is above 40°F (4.8°C). For the second condition, there is an option to either provide a moisture sensor or a timer. Running heat tape all day and night can lead to melt cavities with an air space that can insulate the ice from the heat tape. Shutting the system off at night or using moisture control helps alleviate this issue. Moisture control works well if done just right but can be problematic in practice on roofs. A timer provides an option to avoid this concern. A daylight sensor option was considered but deemed inappropriate for high latitudes that may be in darkness all day long.
This language applies to both self-regulating type cable and standard cable. Self-regulating cable automatically adjusts the wattage based on temperature; as temperature decreases, the heat output of the cable increases. However, controls are needed as some current will still flow through at temperatures above 40°F (4.8°C) and the moisture/timer condition is needed to avoid air cavities.

Cost Impact: The code change proposal will increase the cost of construction.
Upfront cost will increase but will be made up for by reducing energy bills over the useful life of the system. Electric resistant heat is very expensive to run when it is not needed. Manual controls require user interaction which is unlikely to be effective. Anecdotally, many people have systems installed without automatic controls and then wonder why their electric bills are so high until they realize their heat tape system has been running all summer long.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: the proposal reduces costs for occupants.

IRCEPI-1-21

Proponents: Jonathan Humble, representing American Iron and Steel Institute (Jhumble@steel.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1102.2.6 Steel-frame ceilings, walls, and floors. Steel-frame ceilings, walls, and floors shall comply with the ~~insulation requirements of Table N1102.2.6 or the~~ *U*-factor requirements of Table N1102.1.2. The calculation of the *U*-factor for steel-frame d ceilings and walls in an envelope assembly shall ~~use a series-parallel path calculation method~~ be determined in accordance with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the *U*-factor maximum, the *steel-framed wall* member spacing is permitted to be installed at any on-center spacing.
2. Where the steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23% framing factor or framing spaced at 16 inches (400 mm) on-center with a 25% framing factor, the lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23% framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

TABLE N1102.2.6 STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL-FRAME EQUIVALENT *R*-VALUE[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-frame Wall, 16 inches on center	
R-13	R-13 + 4.2 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1
R-13 + 5	R-0 + 15 or R-13 + 9 or R-15 + 8.5 or R-19 + 8 or R-21 + 7
R-13 + 10	R-0 + 20 or R-13 + 15 or R-15 + 14 or R-19 + 13 or R-21 + 13
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel-frame Wall, 24 inches on center	
R-13	R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4
R-13 + 5	R-0 + 15 or R-13 + 7.5 or R-15 + 7 or R-19 + 6 or R-21 + 6
R-13 + 10	R-0 + 20 or R-13 + 13 or R-15 + 12 or R-19 + 11 or R-21 + 11
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20 + 5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

For SI: 1 inch = 25.4 mm.

a. The first value is cavity insulation *R* value; the second value is continuous insulation *R* value. Therefore, for example, "R-30 + 3" means R-30 cavity insulation plus R-3 continuous insulation.

b. Insulation exceeding the height of the framing shall cover the framing.

Add new text as follows:

Chapter 44 Referenced Standards. AISI
American Iron and Steel Institute

25 Massachusetts Avenue, NW, Suite 800

Washington, DC 20001

AISI S250-21

North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing

Reason: The purpose of this proposal is to address the issue of having to submit to the code official a request to use the alternative means and methods provisions for cold-formed steel framing designs that are not shown in the IECC. For example, Section C402.1.4.2 addresses only wall framing spacing for 16 and 24 inch on center spacing and is limited to cavity plus continuous insulation options only, whereas, in the market there are many more framing spacing and insulation options used.
This proposal recommends that the Section be modified to recognize the ANSI/AISI/COFS S250 standard. This standard covers cold-formed steel wall framing spacings from 6 inches to 24 inches on center, covers member sizes from 3.5 inches to 12 inches wide, and covers member

thicknesses from 0.033 inches thick to 0.064 inches thick. This standard will provide greater latitude for the user of the IECC by mitigating the necessity of having to submit for approval under alternate means and methods provisions. Further, this standard also includes provisions for evaluation of wall assemblies where all the insulation is located outside the wall cavity, which is an option the IECC does not cover.

This standard also contains provisions for calculating ceiling assemblies constructed of cold-formed steel framing with either conventional c-shape framing members, or truss construction with insulation in the attic and with additional continuous insulation below the truss framing. Previous to this proposal we found users applying the 2003 IECC provisions, which contained the calculation procedures, as part of the alternative means and methods submission process to demonstrate compliance. This proposal is intended to mitigate that additional step.

The ANSI/AISI/COFS S250 was approved and published in September 2021.

As part of AISI's effort to make this document user friendly, an excel spread sheet containing all the necessary equations and back-ground data was generated so that users would merely input the basic assembly materials data (e.g. R-values of insulations, sheathings, etc.) and allow the spread sheet to calculate within seconds the result. This excel spread sheet is available at no cost to any potential user (e.g. code official, design professional, building owner, etc.)

The proponent wishes to schedule time to present to the IECC Residential Committee this proposal, discuss, and to take questions from the Committee.

Cost Impact: The code change proposal will decrease the cost of construction.
This proposed change we expect will decease the cost of construction by eliminating the need to prepare an application to the alternative means and methods process. This is because of the standards wider range of envelope assembly options that the user is permitted to calculate in order to demonstrate compliance

Bibliography: AISI, "Development of a U-factor Calculation Procedure for Cold-Formed Steel C-Shaped Clear Wall Assemblies," American Iron and Steel Institute, Washington, DC, Research Report RP20-2, April 2020.
AISI, "North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing," American Iron and Steel Institute, Washington, DC, AISI S250-21.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides clear and accurate way of determining wall and ceiling assemblies for closed form steel.

Proposal # 157

IRCEPI-3-21

Proponents: David Bixby, representing ACCA (david.bixby@acca.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Add new definition as follows:

DUCT AIRFLOW BALANCING.
The measurement and adjustment of the delivered airflow to the intended locations.

Reason: A definition for "Duct Airflow Balancing" is proposed to support terminology used in ACCA's proposed exception to **N1103.3.6 (R403.3.6) Duct leakage., 3. Test for ducts within thermal envelope.** Airflow balance procedures document the volume of air returned through the duct system and supplied to the dwelling. This information can be used to ascertain the duct system leakage, thereby accomplishing the same intended purpose. Additionally, airflow balancing directly impacts the delivery of the correct volume of air to a given space. This is drastically better than leak testing ducts as it can only measure the duct's leakage rate. Based on substantiation for the requirement to test ducts within the thermal envelope, airflow balancing will reduce energy costs by increasing the HVAC system's efficiency. A reference to ANSI/ACCA Standard 5 QI is added as it contains an airflow balancing procedure.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed definition does not increase or decrease the cost of construction as it merely supports a term used in another proposal.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Based on reason statement

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IRCEPI-4-21

Proponents: David Bixby, representing ACCA (david.bixby@acca.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1103.3.6 (R403.3.6) Duct leakage. The total leakage of the ducts, where measured in accordance with Section N1103.3.5, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3.0 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 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
3. Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the *building thermal envelope*, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.

   Exception: Duct systems designed so the individual room airflow shall be within the greater of ± 20%, or 25 CFM of the design/application requirements for the supply and return ducts. This shall be demonstrated by using a *duct airflow balancing* procedure as specified by ANSI/ACCA 5 QI or by other approved methods.

N1108.2.4 (R408.2.4) More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the *building thermal envelope*.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the *building thermal envelope*.
3. 100 percent of duct thermal distribution system located in *conditioned space* as defined by Section N1103.3.2.
4. Duct systems designed so the individual room airflow shall be within ±20% of the design/application requirements for the supply and return ducts. This shall be demonstrated by using a duct airflow balancing procedure as specified by ANSI/ACCA 5 QI or by other approved methods.

Staff Note: ANSI/ACCA 5 QI -2010 HVAC Quality Installation Specification is included as part of the code change proposal. The code change proposal will be updated by staff with the changes in the reference standard chapter of the IECC-R and IRC when the applicable cdpACCESS update is provided.

Reason: An exception is proposed for leak testing ducts located within the thermal envelope. Airflow balance procedures document the volume of air returned through the duct system and supplied to the dwelling. This information can be used to ascertain the duct system leakage, thereby accomplishing the same intended purpose. Additionally, airflow balancing directly impacts the delivery of the correct volume of air to a given space. This is drastically better than leak testing ducts as it can only measure the duct's leakage rate. Based on substantiation for the requirement to test ducts within the thermal envelope, airflow balancing will reduce energy costs by increasing the HVAC system's efficiency. A reference to ANSI/ACCA Standard 5 QI is added as it contains an airflow balancing procedure. In addition, a definition is proposed for "duct airflow balancing."

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal will not affect cost of construction as the current code requirement involves the cost to leak test ducts. The cost to perform a duct airflow balance test would amount to about the same cost for leak testing ducts, it would just utilize different types of equipment.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Based on reason statement

IRCEPI-6-21

Proponents: David Bixby, representing ACCA (david.bixby@acca.org)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1103.3 (R403.3) Ducts. Duct Supply and Duct Return shall be designed and sized in accordance with M1601.1 of the International Residential Code or Section 603.2 of the International Mechanical Code, as applicable. Ducts and air handlers shall be installed in accordance with Sections N1103.3.1 through N1103.3.7.

Add new text as follows:

N1103.3.1 (R403.3.1) Design and sizing. *Duct systems* shall be designed and sized in accordance with ANSI/ACCA Manual D.

Reason: Section N1103.7 (R403.7) in Chapter 11 specifies that heating and cooling equipment must be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J. However, Chapter 11 does not reference ACCA Manual D procedures for sizing residential duct systems. Manual D uses ACCA Manual J heating and cooling loads to determine space air delivery requirements, and matches duct system resistance (pressure drop) to blower performance (as defined by manufacture's blower performance tables). This assures that appropriate airflow is delivered to all rooms and spaces; and that system airflow is compatible with the operating range of primary equipment. It is widely understood that duct leakage and return path restrictions affect the efficiency of the duct system, the performance of the building envelope, the efficiency and effectiveness of the HVAC equipment, the capacity of the exhaust equipment, and the power of the vents for fuel burning components. In most cases these effects are interactive. For this reason, Manual D belongs in Chapter 11. The proposal references M1601.1 which is reproduced below.
[M1601.1 Duct design. *Duct systems* serving heating, cooling and *ventilation equipment* shall be installed in accordance with the provisions of this section and ACCA *Manual D*, the *appliance* manufacturer's installation instructions or other *approved* methods.**]**

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The reference to Manual D is already a mandatory requirement in the mechanical section of the IRC. Therefore, the addition of this reference to Chapter 11 will not affect the cost of construction.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Based on reason statement

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IRCEPI-7-21

Proponents: Craig Conner, representing self (craig.conner@mac.com); Joseph Lstiburek, representing Building Science Corporation (joe@buildingscience.com)

THIS PROPOSAL WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Residential Code

Revise as follows:

N1103.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space*, it shall comply with one of the following:

1. The duct system is located completely within the *continuous air barrier* and within the *building thermal envelope.*
2. Ductwork in ventilated attic spaces or unvented attic with vapor diffusion port is buried within ceiling insulation in accordance with Section N1103.3.3 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 N1103.3.6, 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.

3. Ductwork in floor cavities located over unconditioned space shall have the following:

   3.1. A *continuous air barrier* installed between unconditioned space and the duct.

   3.2. Insulation installed in accordance with Section N1102.2.7.

   3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.

4. Ductwork located within *exterior walls* of the *building thermal envelope* shall have the following:

   4.1. A *continuous air barrier* installed between unconditioned space and the duct.

   4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.

   4.3. The remainder of the cavity insulation fully insulated to the drywall side.

Reason: Research done by the Department of Energy through the Building America Program shows that sealed attics with vapor diffusion ports significantly reduce the risk of condensation on ductwork. The existing IRC language allows sealed attics with vapor diffusion ports. This language makes it clear that the buried duct language for vented attics also applies to sealed attics with vapor diffusion ports.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This adds an option but not necessarily a cost.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: To align with REPI-79-21 the recommendation would be to approve as modified by changing the term “sealed” to “unvented”.

RECPI-2-21

Proponents: Richard Potts, representing IECC Residential Consistency and Administration Subcommittee (ieccreadmin@iccsafe.org)

2021 International Residential Code

Revise as follows:

TABLE N1105.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

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, °C = (°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 that is 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 shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall 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 having 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 having 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 having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having 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 for ~~townhouses~~ townhouse units, 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 × 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.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. 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.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multiple-family buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

Reason: Last cycle, ADM5-19 Part 2 revised the IRC by dividing the term "townhouse" into either "townhouse" for the entire building, or "townhouse unit" for individual dwelling units in a townhouse. Although I had previously reviewed each occurrence of the term "townhouse" in the IRC at that time to make changes that appeared necessary to fully execute the terminology improvement under ADM5-19, I committed to repeat this review when the committee discussed that change. Initially, it was my intent to list each occurrence in the IRC in a public comment last cycle and explain the basis for using one term vs. the other. That time consuming exercise no longer seems necessary, given that the 2021 IRC has since been published with ADM5-19 included based on membership action on a public comment submitted by the Washington Association of Building Officials that overturned the committee recommendation.
Given that the term "townhouse" applies to a structure containing three or more "townhouse units," and by extension, it therefore applies to each individual townhouse unit in a townhouse building, I found only this one section in the IRC requiring further action in my opinion. This review and proposal fulfills my commitment to revisit this issue, and anyone with additional concerns is welcome to contact me to discuss drafting a floor amendment for consideration at the committee action hearing if any other changes are considered necessary.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The change is considered to be editorial to update terminology without changing intent or application of the code.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: The proposal is intended to correlate the term “Townhouse Unit” with the provisions of the latest adoption of the IRC. The proposal was submitted by the Code Correlation Committee. Footnote H in Table N1105.4.2(1) would be modified in the proposal.

Proposal # 590

RECPI-6-21

Proponents: Mike Stone, representing IECC Residential Electrical Subcommittee (ieccreelectrical@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

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

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

ELECTRIC VEHICLES SUPPLY EQUIPMENT (EVSE). Equipment for plug-in power transfer including the ungrounded, grounded and equipment grounding conductors, and the *electric vehicle* connectors, attachment plugs, personal protections system and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.

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

ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE). A designated *automobile parking space* that is provided with electrical infrastructure, such as, but not limited to, raceways, cables, electrical capacity, and panelboard or other electrical distribution equipment space, necessary for the future installation of an *EVSE*.

ELECTRIC VEHICLE READY SPACE (EV READY SPACE). An *automobile parking space* that is provided with a branch circuit and either an outlet, junction box or receptacle, that will support an installed *EVSE*.

Add new text as follows:

R404.4 Electric Vehicle Power Transfer Infrastructure. New *automobile parking spaces* for one- and two-family dwellings and townhouses shall be provided in accordance with Sections R404.4.1 through R404.4.5

R404.4.1 Quantity. New one- and two-family dwellings and townhouses with a designated attached or detached garage or other onsite private parking provided adjacent to the dwelling unit shall be provided with one *EV-capable, EV-ready, or EVSE installed space* per dwelling unit.

R404.4.2 EV Capable Spaces. Each *EV capable space* used to meet the requirements of Section R404.4.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the *EV capable space* and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with R404.4.4
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future *electric vehicle supply equipment* (*EVSE*)."

R404.4.3 EV Ready Spaces. Each branch circuit serving *EV ready spaces* shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within 3 feet (914 mm) of each *EV ready space* it serves.
2. Have a minimum circuit capacity in accordance with R404.4.4.
3. The panelboard or other electrical distribution equipment directory shall designate the branch circuit as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equpment (EVSE)."

R404.4.4 Circuit Capacity. The capacity of electrical infrastructure serving each *EV capable space*, *EV ready space* and *EVSE space* shall have a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each *EV capable space*, *EV ready space* or *EVSE* space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70.

R404.4.5 EVSE installation. EVSE shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594.

Add new standard(s) as follows:

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

UL 2202-2009	Electric Vehicle (EV) Charging System - with revisions through February 2018
UL 2594-2016	Standard for Electric Vehicle Supply Equipment

Reason: This is a Committee proposal that takes into account Proposals CEPI-146 Part II, CEPI-258-21 Parts II & III, REPI-15-21. This Committee proposal addresses EVSE installations in one- and two-family dwellings and townhomes with their associated parking facilities. Inclusion of this proposal in the text of the IECC will ensure that 100% of these types of occupancies will either have EVSE installed or be able to have EVSE installed at minimal cost at a future date. A separate Committee proposal RECPI-7-21 addresses R-2 occupancies.

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

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: This is a Committee proposal that takes into account Proposals CEPI-146 Part II, CEPI-258-21 Parts II & III, REPI-15-21. This Committee proposal addresses EVSE installations in one- and two-family dwellings and townhomes with their associated parking facilities. Inclusion of this proposal in the text of the IECC will ensure that 100% of these types of occupancies will either have EVSE installed or be able to have EVSE installed at minimal cost at a future date. A separate Committee proposal RECPI-7-21 addresses R-2 occupancies.

RECPI-7-21

Proponents: Mike Stone, IECC RE Electrical Power, Lighting, Renewables, Storage, representing IECC Residential Electrical Subcommittee (ieccreelectrical@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

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

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, *EVSE*, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). Equipment for plug-in power transfer including the ungrounded, grounded and equipment grounding conductors, and the *electric vehicle* connectors, attached plugs, personal protection system and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of tranferring energy between the premises wiring and the *electric vehicle*.

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

ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE). A designated *automobile parking space* that is provided with electrical infrastructure, such as, but not limited to, raceways, cables, electrical capacity, and panelboard or other electrical distribution equipment space, necessary for the future installation of an *EVSE*.

ELECTRIC VEHICLE READY SPACE (EV READY SPACE). An *automobile parking space* that is provided with a branch circuit and either an outlet, junction box or receptacle, that will support an installed *EVSE*.

Add new text as follows:

R404.4 Electric Vehicle Power Transfer Infrastructure. New residential automobile parking spaces for R-2 occupancies shall be provided with electric vehicle power transfer infrastructure in accordance with Sections R404.4.1 through R404.4.5

R404.4.1 Quantity. R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings shall be provided with an *EV capable space*, *EV ready space*, or *EVSE* space for each *dwelling unit* or *automobile parking space*, whichever is less.

R404.4.2 EV Capable Spaces. Each *EV capable space* used to meet the requirements of Section R404.4.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet (914 mm) of the *EV capable space* and a suitable panelboard or other on-site electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with R404.4.4.
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked. "For future electric vehicle supply equipment (EVSE)."

R404.4.3 EV Ready spaces. Each branch circuit serving *EV ready spaces* shall comply with all of the following:

1. Terminate at an outlet or enclosure, located within 3 feet (914 mm) of each *EV ready space* it serves.
2. Have a minimum circuit capacity in accordance with R404.4.4
3. The panelboard or other electrical distribution equipment directory shall designate the branch circuit as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."

R404.4.4 Circuit Capacity. The capacity of electrical infrastructure serving each *EV capable space, EV ready space* and *EVSE* space shall comply with one of the following:

1. A branch circuit shall have a rated capacity not less than 8.3kVA (or 40A at 208/240V) for each *EV capable space, EV ready space* or *EVSE* space it serves. Where a circuit is shared or managed it shall be in accordance with NFPA 70.
2. The requirements of R404.4.4.4.1.

Exceptions:

1. Where the local electric distribution entity has certified in writing that it is not able to provide 100% of the necessary distribution capacity within 2 years after the estimated date of the certificate of occupancy. The required EV charging infrastructure shall be reduced based on the available existing electric distribution capacity.
2. For R-2 occupancies, where substantiation has been approved that meeting the requirements of Section R404.4.4.1 will alter the local utility infrastructure design requirements on the utility side of the meter so as to increase the utility side cost to the builder or developer by more than $400.00 per dwelling unit.

R404.4.4.1 Circuit capacity management. The capacity of each branch circuit serving multiple *EVSE spaces, EV ready space* or *EV capable spaces* designed to be controlled by an energy management system providing load management in accordance with NFPA 70, shall have a capacity of not less than 2.7 kVA per space.

R404.4.5 EVSE installation. EVSE shall be installed in accordance with NFPA 70 and Section R404.4.5.1 and shall be listed and labeled in accordance with UL 2202 and UL 2594.

R404.4.5.1 EVSE minimum charging rate. Each installed EVSE shall comply with one of the following:

1. Be capable of charing at a rate of not less than 6.2 kVA (or 30A at 208/240V).
2. Where serving EVSE spaces allowed to have a circuit capacity of not less than 2.7 kVA in accordance with R404.4.4.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each EVSE space at a rate of not less than 2.1 kVA.

Add new standard(s) as follows:

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

UL 2202-2009	Electric Vehicle (EV) Charging System - with revisions through February 2018
UL 2594-2016	Standard for Electric Vehicle Supply Equipment

Reason: This is a Committee proposal that takes into account Proposals CEPI-146 Part II, CEPI-258-21 Parts II & III, REPI-15-21. This Committee proposal addresses EVSE installations in R-2 occupancies. Inclusion of this proposal in the text of the IECC will ensure that 100% of dwelling units in these occupancies will either have EVSE installed or be able to have EVSE installed at minimal cost at a future date. A separate Committee proposal RECPI-6-21 addresses one- and two-family dwellings and townhomes.

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

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: This is a Committee proposal that takes into account Proposals CEPI-146 Part II, CEPI-258-21 Parts II & III, REPI-15-21. This Committee proposal addresses EVSE installations in R-2 occupancies. Inclusion of this proposal in the text of the IECC will ensure that 100% of dwelling units in these occupancies will either have EVSE installed or be able to have EVSE installed at minimal cost at a future date.

RECPI-8-21

Proponents: Ian Finalyson, IECC RE Econ Modeling Metrics Subcommittee, representing IECC Residential Economics Modeling Whole Building Metrics Subcommittee

2021 International Energy Conservation Code

Revise as follows:

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces.*
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score and CO2e Index, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted and the compliance path used.

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

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

ICC

International Code Council, Inc.
500 New Jersey Avenue NW6th Floor
Washington, DC 20001

ANSI/RESNET/ICC 301—~~2019~~ 2022 Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index-Includes Addendum B

Reason: As stated in the Executive Summary of the “Path Forward on Energy and Sustainability to Confront a Changing Climate,” reduction of greenhouse gas emissions is part of our mission on this Committee. This proposal is a simple step toward that goal, by simply reporting an index, similar to ERI, that helps a builder/homeowner understand the performance of their home with respect to GHG. The software that calculates an ERI in 2024 IECC R406 path will be done so in accordance with ANSI 301-2022. That Standard requires software to list this CO2e Index on labels & certificates. It is intended to be published in time for reference within the 2024 IECC to include an update to GHG emission factors (Addendum B). This proposal doesn’t mandate a maximum CO2e Index although it paves the way for a future proposal to do so.

It would also be possible to report GHG emissions, as calculated in accordance with the same standard, if the concept of the CO2e Index is too new to receive enough support.Until ANSI 301-2022 is published, this approved Addendum D to ANSI 301-2019 is being shared, to provide context for the CO2e Index, which will be modified by Addendum B above.

https://www.resnet.us/wp-content/uploads/FS_301-2019AdndmD_webpost.docx

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The code change proposal will neither increase nor decrease the cost of construction since the reporting of this value is already part of compliance with the referenced Standard.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: The subcommittee determined there was benefit in adding a metric to the Certificate (R401.3) that demonstrates GHG emissions. There was modest opposition due to adding an unenforceable metric with uncertain value. After healthy discussion the Econ SC voted largely in favor of including a CO2e index when utilizing the R406 ERI Compliance Alternative.

RECPI-10-21

Proponents: John Hensley, representing IECC RE HVACR & Water Heating Subcommittee (ieccrehvacr@iccsafe.org)

2021 International Energy Conservation Code

Revise as follows:

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

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

Add new text as follows:

Table R408.2.3 Service water-heating efficiencies

OPTION	WATER HEATER	SIZE	TYPE	EFFICIENCY
1.	Gas-fired storage water heaters	≤55 gallons	Medium Draw Pattern	UEF≥0.64
	Uniform Energy Factor (UEF)		High Draw Pattern	UEF≥0.68
	First-hour rating FHR≥51 gallons per hour	>55 gallons	Medium Draw Pattern	UEF≥0.78
			High Draw Pattern	UEF≥0.80
2.	Gas-fired instantaneous water-heater	-	-	UEF≥0.87
3.	Electric water heaters	-	Integrated HPWH	UEF≥3.30
	Uniform Energy Factor (UEF)	-	Integrated HPWH, 120 Volt/15 Amp Circuit	UEF≥2.20
	First-hour rating FHR≥45 gallons per hour	-	Split-system HPWH	UEF≥2.20
4.	Solar water heaters	-	Electric backup	SUEF≥3.00
	Solar uniform energy factor (SUEF)	-	Gas backup	SUEF≥1.80

Reason: Original Proposal REPI-138-21 Proponent and AHRI have been working on this Proposal for months to gain consensus on a modification. After months of discussion both the Proponent and AHRI came back to the subcommittee with similar but still different modifications. After long discussion the subcommittee voted to Disapprove the modified version presented by the Proponent and Approve the version presented by AHRI. This created a committee Proposal listed and submitted separately. Proposal RECPI-10-21.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
code change proposal will neither increase nor decrease the cost of construction

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: provides better clarity of efficiency requirements based on equipment type and draw pattern.

Proposal # 605

RECPI-11-21

Proponents: Mike Stone, representing IECC Residential Electrical Subcommittee (ieccreelectrical@iccsafe.org)

2021 International Energy Conservation Code

Add new definition as follows:

ENERGY RATING INDEX (ERI). A numerical integer value that represents the relative energy performance of a Rated Home as compared with the energy performance of the *ERI Reference Design*, where an ERI value of 100 represents the energy performance of the *ERI Reference Design* and an ERI value of 0 represents a home with zero net energy performance.

Revise as follows:

APPENDIX RC
ZERO NET ENERGY RESIDENTIAL BUILDING PROVISIONS

SECTION RC101
COMPLIANCE

Add new text as follows:

SECTION RC202
GENERAL DEFINITIONS

Add new definition as follows:

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

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

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

Revise as follows:

RC4101.1 ~~Compliance~~ Scope. ~~Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RC102.~~ This appendix applies to new *residential buildings*.

Delete without substitution:

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

Add new text as follows:

RC401.2 Application. Residential buildings shall comply with Section R406.

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

RC401.3 Certificate. [no change, same as R401.3]

Revise as follows:

SECTION RC~~102~~ 406
ZERO NET ENERGY RESIDENTIAL BUILDINGS

Add new text as follows:

RC406.1 Scope. [no change, same as R406.1]

RC406.2 ERI compliance. Compliance based on the ERI requires that the rated design meets one of the following:

1. The requirements of the sections indicated within Table R406.2 and Sections R406.3 through R406.7, or

2. The requirements of ASHRAE/IES Standard 90.2, including:

2.1. The ERI requirements of ASHRAE/IES 90.2 Table 6-1 without the use of on-site power production (OPP),

2.2 The requirements of Sections R402.4.1.1, R402.4.1.2, R406. R406.3, R404.4 (Electric Readiness), R404.4 (Electric Vehicle Power Transfer Infrastructure), and

2.3 The maximum ERI including adjusted OPP of Table RC406.5 determined in accordance with RC406.4.

RC406.3 Building thermal envelope. [no change, same as R406.3]

Revise as follows:

RC~~102.2~~ 406.4 Energy Rating Index ~~zero energy score~~. The Energy Rating Index (ERI) not including renewable energy resources shall be determined in accordance with ANSI/RESNET/ICC 301.~~Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:~~

~~1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.~~

~~2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.~~

The Energy Rating Index (ERI) including renewable energy resources shall be determined in accordance with ANSI/RESNET/ICC 301, except where electrical energy is provided from a community renewable energy facility (CREF) or contracted from a physical or financial renewable energy power purchase agreement that meets requirements of RC406.4.1, on-site power production (OPP) shall be adjusted in accordance with Equation 4-2.

Adjusted OPP = OPP_{kWh} + $CREF_{kWh}$ + ~~REPC~~ $PPPA_{kWh}$ + $FPPA_{kWh}$ **(Equation ~~RC-1~~ 4-2)**

where:

OPP_{kWh} = Annual electrical energy from *on-site renewable energy*, in units of kilowatt-hours (kWh).

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

~~REPC~~ $PPPA_{kWh}$ =**~~Renewable Energy Purchase Contract power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.~~** Where not included as OPP, the annual electrical energy contracted from a *physical renewable energy power purchase agreement*, in units of kilowatt-hours (kWh).

$FPPA_{kWh}$ = Where not included as OPP, the annual electrical energy contracted from a *financial renewable energy power purchase agreement* (FPPA), in units of kilowatt-hours (kWh).

Add new text as follows:

RC406.4.1 Power purchase agreement contract. The renewable energy shall be delivered or credited to the building site under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.

RC406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the *rated proposed design* and confirmed built dwelling be shown to have an ERI less than or equal to both values indicated in Table RC406.5 when compared to the *ERI reference design*.

Revise as follows:

TABLE RC~~102.2~~ 406.5 MAXIMUM ENERGY RATING INDEX~~a~~

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING ~~OPP~~ RENEWABLE ENERGY	ENERGY RATING INDEX INCLUDING ADJUSTED OPP ~~(as proposed)~~
0	42	0
1	~~43~~ 42	0
2	~~45~~ 42	0
3	~~47~~ 42	0
4	~~47~~ 42	0
5	~~47~~ 42	0
6	~~46~~ 42	0
7	~~46~~ 42	0
8	~~46~~ 42	0

~~a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.~~

Add new text as follows:

RC406.6 Verification by approved agency. [no change, same as R406.6]

RC406.7 Documentation. [no change, same as R406.7]

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE/IES 90.2-2018	Energy-Efficient Design of Low-Rise Residential Buildings, Including approved addenda (Addenda A (approved Jan 2021), B (June 2021) and D (February 2022))

Reason: This member proposal combines approved proposals to Appendix RC for context, and then adds other beneficial edits to improve this Appendix and its adoptability by an AHJ by making it more similar to R406.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal simply clarifies requirements and thus will result in no additional cost for compliance with the Appendix where adopted.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: This proposal consolidates the zero-net sections which have been approved by the full consensus committee to date. It is located within the appendix. It has added additional code section references which are required which results in a more cohesive appendix.

Proposal # 606

REPI-4-21

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R102.1.1 (N1101.4) 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 to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the proposed total *building thermal envelope* UA, which is the sum of *U*-factor times assembly area, shall be less ~~is greater~~ 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 0 through 3 shall be 0.30.~~levels of efficiency and solar heat gain coefficients in Tables 402.1.1 and 402.1.3 of the 2009 *International Energy Conservation Code*.~~

$$UA_{Proposed\ design} \leq 1.15 \times UA_{Prescriptive\ reference\ design} \quad \textbf{(Equation 4-1)}$$

Reason: The purpose of this code change proposal is to improve the mandatory thermal envelope trade-off backstop applicable to the above code programs compliance alternative in Section R102.1.1. This proposal improves the efficiency and usability of the *IECC* by combining two successful concepts incorporated into the 2021 *IECC*. First, it adds flexibility for code users who are complying with the *IECC* through approved above-code programs by changing the thermal envelope backstop from being based on the 2009 *IECC* prescriptive tables to a calculation based on a percentage of the Total UA of the current code's envelope requirements. This would make the thermal envelope backstop that applies to above-code programs consistent with the backstop that applies to the ERI (which is often used in above-code programs). The ERI backstop, which was originally based on the 2009 *IECC* in the 2015 and 2018 editions of the *IECC*, was changed to a Total UA-based backstop in the 2021 *IECC* as a result of Proposal No. RE150-19 (as modified by the Committee). We believe that code users would benefit from both trade-off backstops working in the same way.

Second, this proposal will improve efficiency and streamline future code development by replacing a reference to an older code edition with a reference to the current code requirements. Basing the calculation on the current code helps ensure that improvements to the code baseline in 2024 and in future code editions will be reflected in the backstop without a need for additional code change proposals in the future. This will also simplify compliance and enforcement efforts by reducing the need to refer to other code books.
An effective thermal envelope backstop is crucial to ensure that the home retains reasonable envelope performance similar to the prescriptive path under alternative compliance paths such as above-code programs, the performance path, ERI, etc., and that the envelope is not unduly traded-off for other measures. Trading off envelope and associated occupant comfort can have direct impacts on energy usage. For example, if the occupant responds to discomfort from a "cold" or "hot" room due to an inadequate building envelope by adjusting the thermostat, the additional energy use from the adjusted thermostat can be substantial. Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R7 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	**Nat'l Avg**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
+1 Degree Heating	**4.1%**	**0.5%**	**3.0%**	**4.2%**	**4.4%**	**4.7%**	**4.5%**	**4.0%**	**2.9%**
-1 Degree Cooling	**3.2%**	**7.8%**	**5.3%**	**3.9%**	**2.6%**	**1.8%**	**1.4%**	**0.7%**	**0.4%**

An effective envelope trade-off backstop can help improve occupant comfort and can save significant energy and energy cost.

As the *IECC* and above-code programs play an increasingly important role in helping states and cities achieve energy efficiency and carbon reduction goals, it is more important than ever to put in place improved and streamlined trade-off backstops. These backstops are critical consumer protections that will maintain a minimum level of efficiency across all new homes, providing long-term comfort and energy savings for homeowners, and more broadly, reducing peak demand and greenhouse gas production at the state and national level.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal will neither increase nor decrease the cost of construction. This proposal does not increase the baseline stringency of the *IECC*, and whether the proposal results in increased or decreased costs ultimately depends on compliance choices made by the code user in each case. The added flexibility of moving to a UA-based backstop will allow builders to use what they conclude is the optimal combination of envelope measures to

meet the building thermal envelope UA under the code, which may reduce construction costs as compared with the current backstop in some cases.

COST-EFFECTIVNESS

This proposal does not increase or otherwise affect the stringency of the prescriptive code values or necessarily result in increased costs. Instead, the above-code-programs thermal envelope backstop only places limits on choices under an alternative compliance path (which is optional), so a cost-effectiveness analysis does not apply.

The ICC Board of Directors set the 2021 *IECC* as the baseline for future IECC development – and by extension made the 2021 *IECC* the basis for cost-effectiveness analyses. This means for purposes of analyzing code proposals, the existing provisions of the 2021 *IECC* are considered cost-effective and reasonable, since they are the starting point for analyses of code changes and no rollbacks are permitted. It should also be noted that US DOE found the entire 2021 *IECC* cost effective, including section R406. *See* Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC* (June 2021). Changes to trade-off backstops like this code change proposal, which utilizes U-factors and SHGCs less stringent than the prescriptive measures of the 2021 *IECC*, do not increase the stringency of that baseline or impose any additional costs to meet specific measures. In addition, if the prescriptive values are cost-effective, then the backstop values would be cost-effective. These backstops serve only as a consumer protection against excessive trade-offs, but do not require anything more than what would be required for base code compliance. Thus, a cost-effectiveness analysis would be difficult or impossible to apply and would not be informative.

Bibliography: Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC* (June 2021)

Attached Files

- **R7 table pix.PNG**
  https://energy.cdpaccess.com/proposal/318/1061/files/download/184/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Recommendation to support proposal since this will provide consistent backstop between all compliance paths when assessing alternative methods

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REPI-7-21

Proponents: Kim Cheslak, NBI, representing NBI (kim@newbuildings.org); Ben Rabe, representing Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, representing Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org); Howard Wiig, representing Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, representing Colorado Energy Office (kim.burke@state.co.us); Chris Castro, representing City of Orlando (chris.castro@orlando.gov); Brad Smith, representing City of Fort Collins (brsmith@fcgov.com); Amber Wood, representing ACEEE (awood@aceee.org)

2021 International Energy Conservation Code

Add new definition as follows:

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

Add new text as follows:

R103.2.2 Solar-ready system. The construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from *solar-ready zone* to electrical service panel or plumbing from *solar-ready zone* to *service water heating* system.

Revise as follows:

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

Add new text as follows:

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

Revise as follows:

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

R401.3 (N1101.14) Certificate. A permanent certificate shall be completed by the builder or other *approved* party and posted on a wall in the space where the furnace is located, a utility room or an *approved* location inside the *building*. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory *label*, service disconnect *label* or other required labels. The certificate shall indicate the following:

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces*.
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted and the compliance path used.
8. Where a *solar-ready zone* is provided, the certificate shall indicate the location, and dimensions.

Add new text as follows:

R404.4 (N1104.4) Renewable energy infrastructure. The building shall comply with the requirements of R404.4.1 or R404.4.2

R404.4.1 (N1104.4.1) One- and two- family dwellings and townhouses. *Dwelling units* one- and two-family dwellings and townhouses shall comply with Sections R404.4.1.1 through R404.4.1.4.

Exceptions:

1. A *dwelling unit* with a permanently installed on-site renewable energy system.
2. A *dwelling unit* with a solar-ready zone area that is less than 500 square feet (46 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
3. A *dwelling unit* with less than 500 square feet (46m^2) of roof area oriented between 110 degrees and 270 degrees of true north.
4. A *dwelling unit* with a *solar-ready zone* area that is shaded for more than 70 percent of daylight hours annually.
5. A *dwelling unit* that complies with Appendix RC.
6. A *dwelling unit* with a renewable energy power purchase agreement with a duration of not less than 15 years from a utility or a community renewable energy facility and for not less than 80 percent of the estimated whole-building electric use on an annual basis.

R404.4.1.1 (N1104.4.1.1) Solar-ready zone area. The total area of the *solar-ready zone* shall not be less than 250 square feet (23.2 m^2) and shall be composed of areas not less than 5.5 feet (1676 mm) in ibe direction and not less than 80 square feet (7.4 m^2) exclusive of access or set back areas as required by the *International Residential Code.*

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

R404.4.1.2 (N1104.4.1.2) Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R404.4.1.3 (N1104.4.1.3) Electrical service reserved space. The main electrical service panel shall have a reserved space for a dual pole circuit breaker and shall be labeled “For Future Solar Electric.” The reserved space shall be at the opposite (load) end of the busbar from the primary energy source.

R404.4.1.4 (N1104.4.1.4) Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the *solar ready zone* by a minimum 1 inch (25 mm) nonflexible metallic conduit or permanently installed wire as approved by the code official.
Where the interconnection terminates in the attic, location shall be no less than 12 inches (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled “For Future Solar Electric”.

R404.4.2 (N1104.4.2) Group R occupancies. Buildings in Group R-2, R-3 and R-4 shall comply with Section C405.13.

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Renewable energy infrastructure

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Renewable energy infrastructure
R406.3	Building thermal envelope

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

Reason: In 2020, renewable energy sources were responsible for 21% of U.S. electricity generation. In order to cost-effectively achieve a Biden's goal to create a carbon-free power sector by 2035, we must make sure our buildings are capable of cost effectively installing renewable energy now. According to a recent study entitled "A New Roadmap for the Lowest Cost Grid", the least expensive grid involves a large amount of centralized renewables and a large amount of distributed renewables located on the building site. More renewables placed on site enables more clean utility-scale renewables to be deployed efficiently. It is therefore crucial for new residential buildings to be solar-ready so that the U.S. can reach its 100% carbon-free electricity goal by 2035 in the most cost-effective manner. Installing renewables on-site will also allow homeowners to economically benefit from the transition towards a low-carbon economy and benefit from additional resiliency during disruptions in centrally supplied power.
In addition, this solar-ready requirement would help grow good paying jobs. According to the Bureau of Labor Statistics, the two fastest growing occupations in the US are solar PV and wind turbine service technician. The Interstate Renewable Energy Council estimates that to reach Biden's target of 100% renewable energy by 2035, the industry will need to employ three times the number of workers employed in 2020.

The proposed revisions and additions to the code have been moved from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code. The amendments would require all new homes to be solar ready by requiring a designated 300 square foot minimum "solar ready zone" on the roof. Conduit and wire from this zone must be installed and space in the electrical panel must be reserved for a future solar array. Homes where solar is not feasible due to shading or not enough solar exposure due to orientation are exempt. Information on compliance with this requirement must be placed on the construction documents to improve compliance and so that future homeowners know their home is solar-ready. Revisions to Table R405.2 and R406.2 make this a mandatory requirement in the energy code. This amendment points

multifamily buildings (Group R-2 and R-3 occupancies) to a similar amendment in the commercial energy code. If the residential committee chooses to accept this amendment but the commercial solar amendment is not accepted by the commercial committee, this amendment should be revised accordingly.

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

Bibliography: *Renewables Became the Second-Most Prevalent U.S. Electricity Source in 2020* , U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=48896.
Fact Sheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies, The White House, 22 Apr. 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

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

The National Solar Job Census 2020, Interstate Renewable Energy Council, May 2021, https://irecusa.org/wp-content/uploads/2021/07/National-Solar-Jobs-Census-2020-FINAL.pdf.Richardson, Jake. *Solar and Wind Tech Are the Fastest Growing Jobs in US*, Red, Green, and Blue, 28 Jan. 2019, http://redgreenandblue.org/2019/01/27/solar-wind-tech-fastest-growing-jobs-us/.

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

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: this proposal requires homes to be solar-ready ensuring that future homeowners can cost effectively install solar energy at a later date.

REPI-9-21

Proponents: Aaron Gary, representing Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Revise as follows:

R105.2 Required inspections. The *code official* or his or her designated agent, upon notification, shall make the inspections set forth in Sections R105.2.1 through R105.2.6 ~~R105.2.5~~.

R105.2.1 Footing and foundation inspection. Inspections associated with footings and foundations shall verify compliance with the code as to *R*-value, location, thickness, depth of burial and protection of insulation as required by the code and *approved* plans and specifications.

Revise as follows:

R105.2.2 Framing and air-barrier rough-in inspection. Air barrier inspections at framing and rough-in shall be made before application of air permeable insulation~~interior finish~~ and shall verify compliance with the code as to: ~~types of insulation and corresponding *R*-values and their correct location and proper installation; fenestration properties such as *U*-factor and SHGC and proper installation;~~ air leakage controls as required by the code; and *approved* plans and specifications. Exterior air barriers may be inspected after insulation is installed.

Add new text as follows:

R105.2.3 Insulation and fenestration rough-in inspection. Inspections at insulation and fenestration rough-in shall be made before application of interior finish and shall verify compliance with the code as to: types of insulation and corresponding R-values and their correct location and proper installation; fenestration properties such as U-factor and SHGC and proper installation.

Revise as follows:

R105.2.4 ~~R105.2.3~~ Plumbing rough-in inspection. Inspections at plumbing rough-in shall verify compliance as required by the code and *approved* plans and specifications as to types of insulation and corresponding *R*-values and protection, and required controls.

R105.2.5 ~~R105.2.4~~ Mechanical rough-in inspection. Inspections at mechanical rough-in shall verify compliance as required by the code and *approved* plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding *R*-value, system air leakage control, programmable thermostats, dampers, whole-house ventilation, and minimum fan efficiency.

Exception: Systems serving multiple dwelling units shall be inspected in accordance with Section C105.2.4.

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

Reason: In many cases the inspection of the air-sealing of the air-barrier is greatly obstructed by the presence of insulation in the thermal envelope at the time of inspection. As such, it has become common practice to separate the inspection of the framing and air-barrier from the insulation and fenestration during rough-in. Codifying this current best practice creates a more enforceable and verifiable code.

Cost Impact: The code change proposal will increase the cost of construction.
As the separation of the air barrier and insulation inspection is already common practice in many locations for practical reasons, codifying this inspection practice should not significantly increase the cost of construction, if at all.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Recommendation to approve with modification to add words “Air Permeable” after the word of and before the word insulation in section 105.2.2

REPI-11-21

Proponents: Amanda Hickman, representing Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Add new definition as follows:

ENCLOSED REFLECTIVE AIR SPACE. An unventilated cavity with a low-emittance surface bounded on all sides by building components.

REFLECTIVE INSULATION. A material with a surface emittance of 0.1 or less in an assembly consisting of one or more enclosed reflective air spaces.

Revise as follows:

R303.1.1 (N1101.10.1) Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and the *R*-value of the installed thickness shall be indicated on the certification. For reflective insulation, the number of reflective sheet(s), the number and thickness of the enclosed reflective air space(s) and the R-value for the installed assembly, shall be listed on the certification. For insulated siding, the *R*-value shall be on a label on the product's package and shall be indicated on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

Exception: For roof insulation installed above the deck, the *R*-value shall be labeled as required by the material standards specified in Table 1508.2 of the International Building Code or Table R906.2 of the International Residential Code, as applicable.

Reason: The section at present incorporates requirements that are specific to blown or sprayed fiberglass, cellulose insulation and sprayed polyurethane foam insulation together with general requirements for thermal envelope insulation materials. However, the code is silent on reflective insulations.

The proposal adds specific requirements similar to those for the other insulation materials (as well as appropriate definitions) for a type of material, (reflective insulation) that has been in the market place for over 35 years and has had nationwide distribution and installation. These products are well established and have two associated ASTM Standards, ASTM C727, Standard Practice for Installation and Use of Reflective Insulation in Building Constructions, and ASTM C1224,Standard Specification for Reflective Insulation for Building Applications.

The U.S. Department of Energy's website on weatherizing homes: https://www.energy.gov/energysaver/weatherize/insulation/types-insulation includes the advantages of reflective insulation systems. It states that reflective systems are most effective in preventing downward heat flow but that the effectiveness depends on spacing. This is the critical reason this code change is needed.
Many states and jurisdictional codes already include references on reflective insulation; the list follows:

IBC 2021

- Section 720 Thermal- and Sound-Insulating Materials
- Section 2614 Reflective Plastic Core Insulation

2020 Florida Building Code, Energy Conservation, 7th Edition

- R303.1.1 Building thermal envelope insulation
- Table R303.2.1 Insulation Installation Standards
- R303.2.1.2 Substantial contact

2020 Florida Building Code, Building, 7th Edition

- Section 720 Thermal- and Sound-Insulating Materials
- Section 2614 Reflective Plastic Core Insulation

2020 Minnesota Building Code

- Section 720 Thermal- and Sound-Insulating Materials
- Section 2614 Reflective Plastic Core Insulation
- Thermal Insulation Standards 2020, Section 7640.0130, Subpart 7

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal will not increase the cost of construction because only information regarding reflective insulation is being added.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: agree with need for definitions

Proposal # 101

REPI-13-21

Proponents: Amanda Hickman, representing Reflective Insulation Manufacturers Association (RIMA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Add new definition as follows:

RADIANT BARRIER. A material having a low emittance surface of 0.1 or less installed in building assemblies.

Add new text as follows:

R303.2.2 (N1101.11.2) Radiant barrier. Where installed, radiant barriers shall comply with the requirements of ASTM C1313/C1313M.

Add new standard(s) as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

C1313/C1313M-13(2019) Standard Specification for Sheet Radiant Barriers for Building Construction Applications

Reason: This proposal DOES NOT require the use of radiant barriers. But rather requires that WHEN radiant barriers are used, they comply with the appropriate ASTM standard. Furthermore this proposal provides important information to the code user and code enforcement community regarding radiant barriers.
The definition for Radiant Barrier is included in the 2021 IBC.

Radiant barriers are typically installed in attics to reduce summer heat gains through the roof. According to the DOE's website: https://www.energy.gov/energysaver/weatherize/insulation/radiant-barriers, Radiant barriers help to reduce cooling costs by reducing radiant heat gain. To be effective, radiant barriers are very dependent of their installationbecause their reflective surface must face an air space.

Radiant barriers follow two ASTM Standards – ASTM C1313/C1313M, "Standard Specification for Sheet Radiant Barriers for Building Construction Applications," and ASTM C1743, "Standard Practice for Installation and Use of Radiant BarrierSystems (RBS) in Residential Building Construction".

The proposed language is being included in this section specifically because the American Society for Testing andMaterials (ASTM) classifies radiant barriers as thermal insulation. The ASTM committee C16 on Thermal Insulation includespublished standards for this product. Subcommittee C16.21 deals specifically with reflective products, which include reflective insulation, radiant barrier and interior radiation control coatings. C16.21 develops standards and practices for these reflective building material thermal insulating products.

Radiant barrier products include a surface with an emittance of 0.1 or less that is installed in roof assemblies or attics with the low-emittance surface facing an open or ventilated air space. The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier. Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over one billion square feet of the product is being installed annually.

IBC 2021

- Section 1510, Radiant Barriers Installed Above Deck

Hawaii Title 3, Chapter 181.1 2015

- Section 407.2 Requirements
- Table 407.1 Points Option

Texas

- City of Austin Ordinance No. 20210603-055, City Code Chapter 12-25, Article 12, R402.6

2020 Florida Building Code, Energy Conservation, 7th Edition

- R405.7.1 Installation criteria for homes claiming the radiant barrier option
- Figure R405.7.1 Acceptable attic radiant barrier configurations
- Table 303.2.1 Insulation Installation Standards

2019 California Title 24, Part 6

- Section 100.1 Definitions
- Section 110.8 Mandatory requirements for insulation, roofing products and radiant barriers

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal will not increase the cost of construction because it only adds informational language regarding radiant barriers.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: radiant barriers help reduce heat transfer and installation standard is needed

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REPI-18-21

Proponents: Mark Lyles, representing New Buildings Institute (markl@newbuildings.org); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R401.2 Application . Residential buildings shall comply with ~~Section R401.2.5 and e~~ither Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

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

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

Delete without substitution:

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

1. ~~For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.~~
2. ~~For buildings complying under with Section R401.2.2 , the building shall meet one of the following:~~

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

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

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

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

Revise as follows:

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

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, *basement walls*, *crawl space walls* and floors and ducts outside *conditioned spaces*.
2. *U*-factors of fenestration and the *solar heat gain coefficient* (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted ~~and~~ the compliance path used , and where applicable, the additional efficiency measures selected for compliance with R408.

R405.2 Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.

2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.

3. An annual energy cost of the *proposed design* that is less than or equal to 90 percent of the annual energy cost of the *standard reference design* or the additional efficiency credits as required in Section R408.2 shall be installed without including without including such measures in the proposed design under Section R405. 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 Data System Prices and Expenditures reports. 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.

SECTION R408
ADDITIONAL EFFICIENCY REQUIREMENTS ~~PACKAGE OPTIONS~~

R408.1 Scope. This section establishes additional efficiency credits ~~package options~~ to achieve additional energy efficiency in accordance with Section R401.2.1.

R408.2 Additional energy efficiency credit requirements ~~package options.~~ Two of the a~~A~~dditional efficiency ~~package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.~~ measures shall be selected from Table R408.2 that meet or exceed a total of ten credits. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in Table R408.2 for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

Add new text as follows:

TABLE R408.2 CREDITS FOR ADDITIONAL ENERGY EFFICIENCY

Measure Number	Measure Description	Credit Value								
		CZ 0 &1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
R408.2.1.1(1)	≥2.5% Reduction in total UA	0	0	0	1	1	1	1	1	1
R408.2.1.1(2)	≥5% reduction in total UA	0	1	1	2	2	3	3	3	3
R408.2.1.1(3)	>7.5% reduction in total UA	0	1	2	2	2	3	3	4	4
R408.2.1.2(1)	0.22 U-factor windows	1	2	2	3	3	4	4	4	5
R408.2.1.2(2)	U-factor and SHGC for windows per Table R408.2.1	1	1	1	0	0	0	0	1	2
R408.2.3(1)	High performance cooling system option 1	7	6	5	3	3	3	1	1	1
R408.2.3(2)	High performance cooling system option 2	5	5	4	3	3	2	1	1	0
R408.2.3(3)	High performance gas furnace option 1	0	2	3	5	5	7	8	8	10
R408.2.3(4)	High performance gas furnace option 2	0	2	2	4	4	5	7	7	8
R408.2.3(5)	High performance heat pump system option 1	8	7	6	6	6	6	5	5	4
R408.2.3(6)	High performance heat pump system option 2	6	6	5	5	5	5	4	4	3
R408.2.3(7)	Ground source heat pump	0	2	4	6	6	8	7	6	5
R408.2.4(1)	Fossil fuel service water heating system	7	6	5	3	3	2	2	3	1
R408.2.4(2)	High performance heat pump water heating system option 1	12	11	11	8	8	6	5	5	3
R408.2.4(3)	High performance heat pump water heating system option 2	12	12	11	8	8	6	5	5	3
R408.2.4(4)	Solar hot water heating system	4	5	6	6	6	6	5	5	4
R408.2.4(5)	Compact hot water distribution	2	2	2	2	2	2	2	2	2
R408.2.5(1)	More efficient distribution system	4	6	7	10	10	12	13	15	16
R408.2.5(2)	100% of ducts in conditioned space	4	6	8	12	12	15	17	19	20
R408.2.5(3)	Reduced total duct leakage	1	1	1	1	1	1	2	2	2
R408.2.6(1)	2 ACH50 air leakage rate with ERV or HRV installed	1	4	5	10	10	13	15	8	8
R408.2.6(2)	2 ACH50 air leakage rate with balanced ventilation	2	3	2	4	4	5	6	6	6
R408.2.6(3)	1.5 ACH50 air leakage rated with ERV or HRV installed	2	4	6	12	12	15	18	11	11
R408.2.6(4)	1 ACH50 air leakage rate with ERV or HRV installed	2	5	6	14	14	17	21	14	14
R408.2.7	Energy efficient appliances	9	8	8	7	7	5	5	5	4
R408.2.8	Renewable energy measures	17	16	17	11	11	9	8	7	4

Revise as follows:

R408.2.1 Enhanced envelope ~~performance~~ option s. ~~The total *building thermal envelope* UA, the sum of *U*-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the *U*-factors in Table R402.1.2 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section R402.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table R402.1.2.~~ The building thermal envelope shall meet the requirements of Section R408.2.1.1 or R408.2.1.2.

Add new text as follows:

R408.2.1.1 Enhanced envelope performance UA. The proposed total *building thermal envelope* UA shall be calculated in accordance with Section R402.1.5 and shall meet one of the following:

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

R408.2.1.2 Improved fenestration. *Vertical fenestration* shall meet one of the following:

1. U-factor equal to or less than 0.22
2. U-factor and SHGC equal or less than that specified in Table R408.2.1.2

TABLE R408.2.1.2 IMPROVED FENESTRATION

Climate Zone	Fenestration U-factor	Fenestration SHGC
0	0.32	0.23
1	0.32	0.23
2	0.30	0.23
3	0.25	0.25
4	NA	NA
5	NA	NA
6	NA	NA
7 and 8	0.25	NR

Revise as follows:

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

1. Greater than or equal to ~~95 AFUE natural gas furnace and 16~~ 18 SEER and 14 EER air conditioner.
2. Greater than or equal to 16 SEER and 12 EER air conditioner.
3. Greater than or equal to 96 AFUE natural gas furnace.
4. Greater than or equal to 92 AFUE natural gas furnace.
5. Greater than or equal to 10 HSPF/~~16~~ 18 SEER air source heat pump.
6. Greater than or equal to 9 HSPF/16 SEE air source heat pump.
7. Greater than or equal to 3.5 COP ground source heat pump.

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

R408.2.~~3~~ 4 Reduced energy use in service water-heating option~~s~~. The hot water system shall meet one of the following efficiencies:

1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to 2.~~0~~ 9 UEF electric service water-heating system.
3. Greater than or equal to 3.2 UEF electric service water-heating system.
4. Greater than or equal to 0.4 solar fraction solar water-heating system.
5. Compact hot water distribution. For Compact Hot Water Distribution system credit, the volume shall store not more than 16 ounces of water in the nearest source of heated water and the termination of the fixture supply pipe when calculated using section R403.5.4.

To field or plan review verify that the system meets the prescribed limit, one of the following must be done:

1. At plan review, referencing ounces of water per foot of tube on plans as per Table R403.5.4.1.
2. At rough in (plumbing), referencing ounces of water per foot of tube installed as per Table R403.5.4.1.
3. At final inspection. In accordance with Department of Energy's Zero Energy Ready Home National Specification (Rev. 07 or higher) footnote on Hot water delivery systems.

R408.2.~~4~~ 5 More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

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

3. When ducts are located outside conditioned space, the total leakage of the ducts, measured in accordance with R403.3.5, shall be in accordance with one of the following:

   3.1. Where air handler is installed at the time of testing, 2.0 cubic feet per minute (0.94 L/s) per 100 square feet (9.29 m^2) of *conditioned floor area*.

   3.2 Where air handler is not installed at the time of testing, 1.75 cubic feet per minute (0.83 L/s) per 100 square feet (9.29 m^2) of *conditioned floor area*.

R408.2.~~5~~ 6 Improved air sealing and efficient ventilation system option. ~~The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/Moisture Transfer (LRMT).~~ The measured air leakage rate shall be one of the following:

1. Less than or equal to 32.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed.
2. Less than or equal to 2.0 ACH50, with balanced ventilation as defined in Section 202 of the 2021 *International Mechanical Code*.
3. Less than or equal to 1.5 ACH50, with either an ERV or HRV installed.
4. Less than equal to 1.0 ACH50, with either an ERV or HRV installed.

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

Add new text as follows:

R408.2.7 Energy efficient appliances. Appliances installed in a dwelling unit shall meet the product energy efficiency specifications listed in Table R408.2.7, or equivalent energy efficiency specifications. Not less than three appliance types from Table R408.2.7 shall be installed for compliance with this section.

TABLE R408.2.7 APPLICANCE SPECIFICATION REFERENCE DOCUMENT

Refrigerator	Energy Star Program Requirements, Product Specification for Consumer Refrigeration Products, Version 5.1 (08/05/2021)
Dishwasher	Energy Star Program Requirements for Residential Dishwashers, Version 6.0 (01/29/2016)
Clothes Dryer	Energy Star Program Requirements, Product Specification for Clothes Dryers, Version 1.1 (05/05/2017)
Clothes Washer	Energy Star Program Requirements, Product Specification for Clothes Washers, Version 8.1 (02/05/2018)

R408.2.8 Renewable energy. *Renewable energy resources* shall be permanently installed that have the rated capacity to produce a minimum of 1.0 watt of *on-site renewable energy* per square foot of conditioned floor area. To qualify for this option, *renewable energy cerftificate* (REC) documentation shall meet the requirements of R404.4.

Reason: This proposal builds on the additional efficiency options in the 2021 IECC by converting those package options into a points-based system similar to the "Additional Efficiency Credits" system in C406 of the commercial section of the energy code. The proposal requires projects to select additional efficiency "credits" equal to achieve a target of 10. There are several options provided, covering all aspects of building performance. The Northwest pioneered the use of the prescriptive residential options that are currently in place in Washington, and formally were used in Oregon, and found them to be an effective method of increasing efficiency for residential construction using the prescriptive approach. This option does not require performance energy modeling or HERS verification which will increase its usefulness. This type of flex points option can also be easily implemented in the U.S. DOE REScheck software. The purpose of this code change proposal is to improve overall residential building efficiency (heating, cooling and water heating energy) by roughly 10% and to create a scalable, flexible means of improving residential building efficiency for future IECC updates. Instead of requiring efficiency improvements to specific building components that are not equal, the new "credit" approach in Section R408 provides a multitude of options for builders that are calibrated to achieve the efficiency requirements of the IECC. This approach is also scalable according to a jurisdiction's needs – states or localities who need additional energy savings to meet energy or climate policy goals can adjust the number of required credits accordingly. Points-based approaches have been used for several years in Washington and Oregon. This proposal is similar to the Flex Points proposal for the 2021 IECC in overall structure, but the points table has been updated based on the updates included in the 2021 IECC and feedback received. Like the previous version, this proposal also includes alternative compliance pathways for builders who select the simulated performance alternative or the Energy Rating Index (ERI) and will bring roughly equivalent improvements to all three compliance paths.

This additional efficiency credit proposal is cost-effective, since it includes a number of options in every climate zone to achieve 10 points that are cost- effective and will provide three distinct benefits for jurisdictions adopting the 2024 IECC:

1. **This proposal meets a clear need for efficiency improvements in the model energy code now and in the future.** Although the 2021 IECC was determined to be roughly 9% more efficient than the 2018 IECC (PNNL 2021), major gains have plateaued. Buildings still consume an estimated 42% of the nation's energy, 54% of its natural gas, and 71% of its electricity. Governors, legislators, and mayors are increasingly turning to building energy codes to meet energy and climate goals, and those codes should continue to provide reasonable improvements going forward. The U.S. Conference of Mayors, in its fourth consecutive resolution on the subject, reiterated their "concerted support for putting future triennial IECC updates on a "glide path" of steady efficiency gains that will improve the efficiency performance of millions of U.S. residential, multi- family, and commercial buildings." *See* 2018 U.S.C.M. Resolution 86 (June 11, 2018). Several jurisdictions have already created or are in the process of creating package-based compliance paths or improved code provisions to meet their policy needs. The result is improved efficiency, but a lack of consistency in both format and requirements. Incorporating Flex Points into the 2024 IECC will not only provide a 10% boost in energy conservation but will also provide a realistic map for additional improvements going forward. And, by providing more uniform targets for the efficiency of building components, this proposal will contribute to economies of scale, potentially lowering prices for builders and ultimately consumers.
2. **This proposal will provide maximum flexibility for builders to achieve improved efficiency.** Additional efficiency credits trusts that builders and design professionals will select the most cost-effective and sensible efficiency improvements for a given project. There are several alternatives for compliance in each climate zone, along with options to comply in a performance- or rating-based path. There are alternatives related to more insulation, more efficient windows, reduced air and duct leakage and improved equipment. We believe that this approach provides the right incentives for builders to make long-lasting improvements in residential buildings that are in the best interests of homeowners. The credit values were calculated based on the present value of energy cost savings over the 2018 IECC (including relevant federal equipment efficiency standards) and would need to be updated, these values are provided here for reference and reflect the estimated useful life of each measure over an assumed 30-year life of the building. While a 30-year period is consistent with the typical life of a mortgage, it is a very conservative period given the likelihood that some measures will provide efficiency benefits for decades beyond the initial 30-year period. The analysis behind the 2021 IECC proposal , which used the methodology and assumptions included in the U.S. Department of Energy's Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes, including the economic equations to obtain the present value of energy costs within the calculation methodology. The energy consumption calculations take into consideration heating, cooling, and water heating energy, using DOE-2 energy simulation across 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. The analysis compares the annual energy savings between a home with and without an efficiency measure over the useful life of the efficiency measure using useful life data from NAHB and other sources. Energy costs were calculated using the most recent national EIA projections for natural gas and electricity.

3. **This proposal will encourage efficiency improvements in building components that are currently difficult to regulate.** Additional efficiency credits addresses two issues that have complicated model energy codes for many years. First, innovative building practices or emerging technologies can benefit from being listed in codes, but states (and national code developing organizations) are reluctant to require new technologies or practices before they are market-tested. As a result, there are high barriers to entry for new technologies, even when they could transform the marketplace and provide energy- or cost-saving benefits for homeowners. As an example, Heat Recovery Ventilators (HRVs) are cost-effective and reasonable for much of the country, but individual circumstances or climate conditions may favor another approach. Rather than require HRVs in every case, or most cases with exceptions, HRVs and Energy Recovery Ventilators are included as one of several options available to builders in every climate zone. Not only will credits create an opportunity for good technology to be used in more buildings, but it will open the door for market forces to make these technologies more widely available (and presumably less expensive). As new technologies or practices become available, these advances can be quickly and easily added into the credit table, fast-tracking technology that is good for consumers. Second, much of the heating, cooling, and water heating equipment installed in residential buildings is subject to federal preemption under the National Appliance Energy Conservation Act. As has been debated at length in ICC Code Development hearings over the last 15 years, including equipment efficiencies in performance trade-offs tends to weaken the efficiency of the energy code, since federal minimum efficiencies for nearly every covered product is well below the efficiency levels of commonly installed products. When these efficiency levels are used in trade-off baselines, builders use the improved efficiency of common heating, cooling, and water heating products as a means of trading away efficiency of more permanent building components and features, even though the equipment would have been installed anyway. This “free ridership” may provide short-term cost savings for homebuilders, but it saddles homeowners with unexpected high energy costs over the entire useful life of the building. Moreover, this equipment often carries a much shorter useful life, which is not typically captured in code compliance simulations. This credit structure creates a new incentive to improve the efficiency of covered products without resulting in efficiency rollbacks elsewhere in the code. Heating, cooling, and water heating improvements (among others) are included among the Flex Points options with points calculated according to climate-specific energy cost savings and the longevity of the equipment. Each of these upgrades will build upon the current IECC efficiency, rather than trading it away.

In sum, we believe that this proposal will improve efficiency by roughly 10% while unlocking the competitive market for new technologies or building components that are difficult to regulate and will provide a useful new tool for policymakers across the country – all without rolling back the effectiveness or efficiency of the IECC.

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

Requiring additional efficiency measures, such as more insulation, more efficient windows, reduced air leakage and duct leakage, and/or more efficient equipment, to save 10% energy will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home. Additionally, the flexibility of this approach allows for the most cost-effective

means of meeting the stated ICC energy reduction goals.

Bibliography: Salcido et al; *Energy Savings Analysis: 2021 IECC for Residential Buildings;* PNNL 2021; available at:https://www.energycodes.gov/sites/default/files/202107/2021_IECC_Final_Determination_AnalysisTSD.pdf

Uniting Cities to Accelerate Focus on the Economic and Climate Benefits of Boosting America's Building Energy Efficiency, 2019 U.S.C.M. Resolution 86 (June 11, 2018), *available at* https://www.usmayors.org/the-conference/resolutions/?category=c9211&meeting=86th%20Annual%20Meeting.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The proposal to expands the list of options for builders/developers and incorporates input from other proponents. Ensure alignment of action taken on REPI-138-21, REPI-77-21, REPI-73-21, and REPI-136-21.

REPI-20-21

Proponents: Dan Wildenhaus, representing Northwest Energy Efficiency Alliance (dwildenhaus@trccompanies.com); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R405.2 Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. An annual energy cost of the proposed design that is less than or equal to 90 percent of the annual energy cost of the standard reference design or the additional efficiency credits as required in Section R408.2 shall be installed without including such measures in the proposed design under Section R405. For *dwelling units* with greater than 5,000 square feet (465 m^2) of *conditioned floor area*, the annual energy cost of the proposed design shall be reduced by an additional 5 percent of 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 Data System Prices and Expenditures reports. 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.

R408.2 Additional energy efficiency ~~package options~~ credit requirements. Two of the a~~A~~dditional measures shall be selected from Table R408.2 that meet or exceed a total of ten credits. Five additional credits shall be selected for *dwelling units* with greater than 5,000 square feet (465 m^2) of *conditioned floor area*. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as indicated in the table for the specific climate zone. Interpolation of credits between measures shall not be permitted. ~~efficiency package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.~~

Reason: The average home size for new construction in North America is approximately 2,301 square feet for homes built in 2019, according to the Statistica Research Department[i]. The average number of people per household in the United States has stayed consistently between 2.53 and 5.54 from 2016 to 2020 according to the same research group[ii]. Energy codes have been basing savings on energy use index (kBtu/ft^2) for both site and source energy according to the U.S. Department of Energy. This metric, while useful for overall analysis of savings associated with code change, does not reflect operational cost for[i] homebuyers, or carbon footprint per individual.
Above code programs such as the ENERGY STAR Certified Homes Program and the Department of Energy's Zero Energy Ready Home[iii] have developed benchmarking schemes comparing house size to bedrooms with the formula or corresponding table:

(#BRs x 600 sq ft) + 400 sq ft = CFA Benchmark

Benchmark Home Size

Bedrooms in Home to be Built	0	1	2	3	4	5	6	7
Conditioned Floor Area Benchmark Home	1,000	1,000	1,600	2,200	2,800	3,400	4,000	4,600

RESNET, the body responsible for ANSI Standards 301, 310, and 380 developed a "house size adjustment" for modeled homes in 2019 to ensure that larger and smaller homes were not unfairly given too high or two low a HERS or ERI strictly based on size[iv].

Other adopted codes, such as the Washington State Residential Energy Code (WSEC-R)[v] has adopted for the previous two code cycles a tiered system for additional energy efficiency credits/options, requiring fewer credits for homes below 1,500 square feet and more credits for homes at or above 5,000 square feet.

i Median size of single family housing unit in the United States from 2000 to 2019; Statistica.

Median size of U.S. single family house 2000-2019 | Statista

ii Average number of people per household in the United States from 1960 to 2020; Statistica.

Average size of households in the U.S. 2020 | Statista

iii Benchmark Home Size: Determine Path by Bedrooms and Conditioned Floor Area; Building America Solution Center. https://basc.pnnl.gov/information/benchmark-home-size-determine-path-bedrooms-and-conditioned-floor-area

iv RESNET Adopts Home Size Adjustment Factor for HERS Index Scores – Transition Period to January 1, 2019

https://www.resnet.us/articles/resnet-adopts-home-size-adjustment-factor-for-hers-index-scores-transition-period-to-january-1-2019/

v Washington State Energy Code - Residential 2018 Edition. Washington State Building Codes Council. 2018 WSEC_R Final package.pdf (wa.gov)

vi 2021 IECC Residential Cost Effectiveness Analysis prepared for the National Association of Home Builders by the Home Innovation Research Labs https://www.nahb.org/-/media/NAHB/advocacy/docs/top-priorities/codes/code-adoption/2021-iecc-cost-effectiveness-analysis-hirl.pdf

Cost Impact: The code change proposal will increase the cost of construction.
The 2021 IECC Residential Cost Effectiveness Analysis[vi], as prepared for the National Association of Home Builders by the Home Innovation Research Labs has found that addition R408.2 that the incremental construction cost (weighted averages) between “Total without additional efficiency package options” and “Total with Option” ranges from $1,071 to $3,824, with the average cost being $2,875, with a lowest cost option of $1,071. The Simple Payback for homebuyers for additional costs, based on the 2018 Baseline Reference House ranged from 32 to 67 years, with an average of 44 years. By comparison, the average payback without an additional efficiency option is 48 years.

Adding a second measure for homes larger than 5,000 square feet could have a lowest cost option of $4,144, without taking into considerations new options added to the table for 2024. Considering that all but the Ventilation Option from the current R408.2 options that were assessed have resulted in a net reduction in simple payback for homebuyers, it is expected that having two measures added may result in Simple Payback average dropping from 44 years to 39 years, using an additive approach to payback years, but with a conservative estimate for the savings associated with adding a second measure (claiming on 66% of the likely savings due to the incremental reduction in proposed energy use as code advances).

Bibliography: i Median size of single family housing unit in the United States from 2000 to 2019; Statistica.
Median size of U.S. single family house 2000-2019 | Statista

ii Average number of people per household in the United States from 1960 to 2020; Statistica.

Average size of households in the U.S. 2020 | Statista

iii Benchmark Home Size: Determine Path by Bedrooms and Conditioned Floor Area; Building America Solution Center. https://basc.pnnl.gov/information/benchmark-home-size-determine-path-bedrooms-and-conditioned-floor-area

iv RESNET Adopts Home Size Adjustment Factor for HERS Index Scores – Transition Period to January 1, 2019

https://www.resnet.us/articles/resnet-adopts-home-size-adjustment-factor-for-hers-index-scores-transition-period-to-january-1-2019/

v Washington State Energy Code - Residential 2018 Edition. Washington State Building Codes Council. 2018 WSEC_R Final package.pdf (wa.gov)

vi 2021 IECC Residential Cost Effectiveness Analysis prepared for the National Association of Home Builders by the Home Innovation Research Labs https://www.nahb.org/-/media/NAHB/advocacy/docs/top-priorities/codes/code-adoption/2021-iecc-cost-effectiveness-analysis-hirl.pdf

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: This proposal was modified based on prior SC action on REPI-018 and REPI-126 to align with the points-based system in R408. The simplified proposal requires homes over 5,000 sf to achieve an additional 5% energy savings in R405 or 5 additional points in R408. Language edits were made by the SC to clarify the requirements and assist ICC staff in any needed reconciliation.

REPI-21-21

Proponents: Vladimir Kochkin, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R401.2.5 (N1101.13.5) Additional energy efficiency. This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.
2. For buildings complying under with Section R401.2.2 , the building shall meet one of the following:

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

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

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

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
~~R401.2.5~~	~~Additional efficiency packages~~
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: This proposal removes the unjustified penalty on the ERI compliance path. The 2018 ERI threshold values in Table R406.5 were developed based on energy modeling that included above-federal minimum equipment efficiencies. Therefore, the ERI path complies with the additional requirements of Sections R401.2.5 and R408 by default via meeting the minimum thresholds. The 2021 IECC further reduced the ERI targets through a separate proposal. Approval of both proposals was due to lack of coordination during the 2021 IECC development process. This change will not impact the DOE determination because DOE analysis does not include the ERI compliance path.
The 5% penalty in combination with the 2021 IECC revised ERI thresholds results in ERI values close to the zero-energy ready levels listed in Appendix RC ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS in the IECC. This level of performance has not been justified for minimum code provisions. According to RESNET, less than 7% of all rated dwelling units reached an ERI/HERS below 50 and only 1% of rated dwelling received an ERI/HERS below 45 in year 2020. Less than 25 percent of dwelling units constructed in the US obtain an ERI/HERS rating.

Cost Impact: The code change proposal will decrease the cost of construction.
This proposal removes an unjustified penalty on the ERI path.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: streamlines ERI path which is already a performance path by removing the additional 5% efficiency

requirement from R408streamlines ERI path which is already a performance path by removing the additional 5% efficiency requirement from R408

REPI-26-21

Proponents: Jeremy Williams, U.S. Department of Energy, representing U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Add new definition as follows:

***F*-Factor (Thermal Transmittance).** The perimeter heat loss factor for slab-on-grade floors (Btu/h·ft·°F) [W/(m·K)].

Revise as follows:

TABLE R402.1.2 (TABLE N1102.1.2) MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS
Portions of table not shown remain unchanged.

CLIMATE ZONE	BASEMENT WALL *U*-FACTOR	UNHEATED SLAB F-FACTOR	HEATED SLAB F-FACTOR	CRAWL SPACE WALL *U*-FACTOR
0	0.360	0.73	1.03	0.477
1	0.360	0.73	1.03	0.477
2	0.360	0.73	1.03	0.477
3	0.091[c]	0.54	0.77	0.136
4 except Marine	0.059	0.54	0.68	0.065
5 and Marine 4	0.050	0.54	0.68	0.055
6	0.050	0.48	0.68	0.055
7 and 8	0.050	0.48	0.68	0.055

For SI: 1 foot = 304.8 mm.

g. F-factors for heated slabs correspond to the configuration described by footnote (d) of Table R402.1.3

R402.2.9 (N1102.2.9) Slab-on-grade floors. Slab-on-grade floors, in contact with the ground, with a floor surface within 24~~less than 12~~ inches (600~~305~~ mm) above or below grade shall be insulated in accordance with Table R402.1.3.

Exception: Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

R402.1.2 (N1102.1.2) Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Table R402.1.2, based on the *climate zone* specified in Chapter 3. Assemblies shall have a *U*-factor or *F*-factor equal to or less than that specified in Table R402.1.2. Fenestration shall have a *U*-factor and glazed fenestration SHGC equal to or less than that specified in Table R402.1.2.

R402.1.3 (N1102.1.3) R-value alternative. Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U*-factor or *F*-factor in Table R402.1.2

R402.1.5 (N1102.1.5) ~~Total UA~~ Component performance alternative. Where the proposed total *building thermal envelope* thermal conductance ~~UA, the sum of *U*-factor times assembly area,~~ is less than or equal to the required total building thermal envelope conductance using ~~UA resulting from multiplying the *U*-~~factors in Table R402.1.2~~ by the same assembly area as in the proposed *building,*~~ the *building* shall be considered to be in compliance with Table R402.1.2. The ~~UA calculation~~ total thermal conductance shall be ~~performed~~ determined in accordance with Equation 4-1. Proposed *U*-factors and slab-on-grade *F*-factors shall be taken from ANSI/ASHRAE/IES Standard 90.1 Appendix A or determined using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to ~~UA~~ total thermal conductance compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration *U*-factors of Section R402.5 shall be met.

$(U_p A + F_p P) <= (U_r A + F_r P)$ **(Equation 4-1)**

where:

$U_p A$ = the sum of proposed *U*-factors times the assembly areas in the proposed building.
$F_p P$ = the sum of proposed *F*-factors times the slab-on-grade perimeter lengths in the proposed building.
$U_r A$ = the sum of *U*-factors in Table R402.1.2 times the same assembly areas as in the proposed building.
$F_r P$ = the sum of *F*-factors in Table R402.1.2 times the same slab-on-grade perimeter lengths as in the proposed building.

Reason: Residential building energy codes that are based on any version of the International Energy Conservation Code (IECC) typically allow compliance to be demonstrated in several ways, one of which is a component tradeoff approach whereby prescriptive requirements for some building components may be relaxed in trade for corresponding improvements in other components. Calculations for this component tradeoff are based on maintaining a maximum overall building UA value, which is the sum across all building envelope components of the product of each component's U-factor (conductance) and area. For slabs on grade, the component UA is based on an F-factor rather than a U-factor and is multiplied by the slab-edge perimeter length rather than slab area.

The IECC does not give explicit instruction on calculating slab F-factors, relying instead on external materials such as ASHRAE's Handbook of Fundamentals. Slab insulation is usually required only around the perimeter of the slab, but the 2018 IECC added a new requirement for full under-slab insulation of heated slabs. It is not clear, even using the ASHRAE reference, how to calculate F-factors for such slabs.
The recommended code-change text refers to Appendix A of ASHRAE Standard 90.1, where precomputed F-factors are tabulated for various combinations of slab insulation placement and R-value, but any F-factor source consistent with the ASHRAE Handbook of Fundamentals may be used.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The text presented here does not change the code's requirements in any way; it merely adds clarifying text showing one good source of slab F-factors as a function of insulation R-value and depth. There is no additional cost and no energy impact.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Provides more flexible methods of compliance.

REPI-28-21

Proponents: Thomas Culp, Birch Point Consulting LLC, representing the Glazing Industry Code Committee (culp@birchpointconsulting.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (TABLE N1102.1.2) MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

CLIMATE ZONE	FENESTRATION *U*-FACTOR[d]	SKYLIGHT[d] *U*-FACTOR	GLAZED FENESTRATION SHGC[d,e]
0	0.50	~~0.75~~ 0.60	0.25
1	0.50	~~0.75~~ 0.60	0.25
2	0.40	~~0.65~~ 0.60	0.25
3	0.30	~~0.55~~ 0.53	0.25
4 except Marine	0.30	~~0.55~~ 0.53	0.40
5 and Marine 4	~~0.30~~ 0.28[f,e,g]	~~0.55~~ 0.50	~~0.40~~ NR
6	~~0.30~~ 0.28[f,e,g]	~~0.55~~ 0.50	NR
7 and 8	~~0.30~~ 0.27[f,e,g]	~~0.55~~ 0.50	NR

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall r 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provid

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

~~f.~~ e. A maximum *U*-factor of ~~0.32~~ 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installe

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

TABLE R402.1.3 (TABLE N1102.1.3) INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Portions of table not shown remain unchanged.

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]
0	~~NR~~ 0.50	~~0.75~~ 0.60	0.25
1	~~NR~~ 0.50	~~0.75~~ 0.60	0.25
2	0.40	~~0.65~~ 0.60	0.25
3	0.30	~~0.55~~ 0.53	0.25
4 except Marine	0.30	~~0.55~~ 0.53	0.40
5 and Marine 4	~~0.30~~ 0.28~~[i, h]~~	~~0.55~~ 0.50	~~0.40~~ NR
6	~~0.30~~ 0.28~~[i, h]~~	~~0.55~~ 0.50	NR
7 and 8	~~0.30~~ 0.27~~[i, h]~~	~~0.55~~ 0.50	NR

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed ~~0.30~~ 0.28.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

~~g.~~ f. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13 & 5” means R-13 cavity insulation plus R-5 continuous insulation.

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

~~i.~~ h. A maximum *U*-factor of ~~0.32~~ 0.30 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

Reason: This proposal advances the residential fenestration criteria in a cost effective manner by aligning with the Energy Star version 6 requirements. EPA is advancing the Energy Star version 7 requirements for Windows, Doors, and Skylights with an implementation date in 2023, so aligning the 2024 IECC with the version 6 requirements allows the energy code to progress while also maintaining the philosophy that the Energy Star criteria be a notch beyond the base code.
In aligning and maintaining consistency with Energy Star, this proposal also corrects a rollback in energy efficiency which occurred last cycle when a maximum SHGC of 0.40 was added in zone 5 in the R-value table, in conflict with Energy Star. The EPA and DOE analyses conducted by Lawrence Berkeley National Laboratory both for version 6 in 2012 and for version 7 in 2021 clearly show that imposing a maximum SHGC in climate zone 5 actually harms energy efficiency and increases use of fossil fuels. Therefore, the Energy Star program has maintained a baseline SHGC of "Any" (or NR) for zones 5-8 in both version 6 and 7, as well as optional U-factor alternatives that include higher SHGC to allow increased flexibility and energy efficiency (footnote g). (Note that the Energy Star Most Efficient program for windows also imposes a minimum SHGC of > 0.20 in zones 5-8. That is not being proposed here, but also supports that a maximum SHGC in zone 4 was an energy rollback that needs to be

corrected.)

The current market share of Energy Star version 6 products is very high: 86% for windows, 80% for hinged entry doors, 84% for patio doors, and 72% for skylights. The high market share shows that fenestration meeting these proposed requirements are ubiquitous and cost effective.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
EPA estimates that the current market share of Energy Star version 6 products is very high: 86% for windows, 80% for hinged entry doors, 84% for patio doors, and 72% for skylights. This demonstrates that fenestration meeting the proposed requirements are ubiquitous and will not increase the cost of construction for the vast majority of homeowners. Nonetheless, for the minority of products that do not meet the Energy Star version 6 criteria, there will be a marginal increase in cost. EPA's analysis in 2012-14 of the change to the version 6 criteria "shows that average-cost products offer payback periods of less than 10 years in all but five cities and payback periods of less than seven years in half of the cities for which EPA performed energy savings analysis", and less for lower cost products. As the industry transitions to the Energy Star version 7 requirements, the cost and payback for these version 6 criteria will be even less. Additionally, there would be no increase in construction cost for locations meeting the altitude or windborne debris provisions in footnote f.

- Energy Star version 7 info including market share: https://www.energystar.gov/sites/default/files/asset/document/V7_Stakeholder%20Meeting_7-27-2021_final.pdf
- Energy Star version 6 cost effectiveness review: https://www.energystar.gov/sites/default/files/ESWDS-ReviewOfCost_EffectivenessAnalysis.pdf

Bibliography:

- Energy Star Version 6 final specification: https://www.energystar.gov/sites/default/files/ES_Final_V6_Residential_WDS_Spec.pdf
- Energy Star Version 6 draft 1 criteria analysis: https://www.energystar.gov/sites/default/files/specs//Draft6_V1_Criteria_Analysis_Report.pdf
- Energy Star Version 7 draft 1 criteria analysis: https://www.energystar.gov/sites/default/files/asset/document/ES_Residential_WDS_Draft%201_Criteria%20Analysis%20Report.pdf
- Energy Star Version 7 presentation: https://www.energystar.gov/sites/default/files/asset/document/V7_Stakeholder%20Meeting_7-27-2021_final.pdf

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: improvement in almost every climate zone and represents broad stakeholder consensus.

REPI-30-21

Proponents: John Woestman, representing Extruded Polystyrene Foam Association (XPSA) (jwoestman@kellencompany.com)

2021 International Energy Conservation Code

Delete and substitute as follows:

~~**TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS**~~

~~CLIMATE ZONE~~	~~FENESTRATION *U*-FACTOR[f]~~	~~SKYLIGHT *U*-FACTOR~~	~~GLAZED FENESTRATION SHGC[d,e]~~	~~CEILING *U*-FACTOR~~	~~WOOD FRAME WALL *U*-FACTOR~~	~~MASS WALL *U*-FACTOR[b]~~	~~FLOOR *U*-FACTOR~~	~~BASEMENT WALL *U*-FACTOR~~	~~CRAWL SPACE WALL *U*-FACTOR~~
~~0~~	~~0.50~~	~~0.75~~	~~0.25~~	~~0.035~~	~~0.084~~	~~0.197~~	~~0.064~~	~~0.360~~	~~0.477~~
~~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~~	~~0.026~~	~~0.084~~	~~0.165~~	~~0.064~~	~~0.360~~	~~0.477~~
~~3~~	~~0.30~~	~~0.55~~	~~0.25~~	~~0.026~~	~~0.060~~	~~0.098~~	~~0.047~~	~~0.091[c]~~	~~0.136~~
~~4 except Marine~~	~~0.30~~	~~0.55~~	~~0.40~~	~~0.024~~	~~0.045~~	~~0.098~~	~~0.047~~	~~0.059~~	~~0.065~~
~~5 and Marine 4~~	~~0.30~~	~~0.55~~	~~0.40~~	~~0.024~~	~~0.045~~	~~0.082~~	~~0.033~~	~~0.050~~	~~0.055~~
~~6~~	~~0.30~~	~~0.55~~	~~NR~~	~~0.024~~	~~0.045~~	~~0.060~~	~~0.033~~	~~0.050~~	~~0.055~~
~~7 and 8~~	~~0.30~~	~~0.55~~	~~NR~~	~~0.024~~	~~0.045~~	~~0.057~~	~~0.028~~	~~0.050~~	~~0.055~~

~~For SI: 1 foot = 304.8 mm.~~

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

~~b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.~~

~~c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.~~

~~d. The SHGC column applies to all glazed fenestration.~~

~~**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.~~

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

~~f. A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:~~

~~1. Above 4,000 feet in elevation above sea level, or~~

~~2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.~~

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
FENESTRATION U-FACTOR[f]	0.50	0.50	0.40	0.30	0.30	0.30	0.30	0.30
SKYLIGHT U-FACTOR	0.75	0.75	0.65	0.55	0.55	0.55	0.55	0.55
GLAZED FENESTRATION SHGC[d,e]	0.25	0.25	0.25	0.25	0.40	0.40	NR	NR
CEILING U-FACTOR	0.035	0.035	0.026	0.026	0.024	0.024	0.024	0.024
WOOD FRAME WALL U-FACTOR	0.084	0.084	0.084	0.060	0.045	0.045	0.045	0.045
MASS WALL U-FACTOR[b]	0.197	0.197	0.165	0.098	0.098	0.082	0.060	0.057
FLOOR U-FACTOR	0.064	0.064	0.064	0.047	0.047	0.033	0.033	0.028
BASEMENT WALL U-FACTOR	0.360	0.360	0.360	0.091[c]	0.059	0.050	0.050	0.050
CRAWL SPACE WALL U-FACTOR	0.477	0.477	0.477	0.136	0.065	0.055	0.055	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

d. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

f. A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

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

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

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b,i]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE[g]	MASS WALL *R*-VALUE[h]	FLOOR *R*-VALUE	BASEMENT[c,g] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c,g] WALL *R*-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	49	13 or 0 & 10ci	4/6	13	0	0	0
3	.30	0.55	0.25	49	20 or 13 & 5ci[h] or 0 & 15ci[h]	8/13	19	5ci or 13[f]	10ci, 2 ft	5ci or 13[f]
4 except Marine	.30	0.55	0.40	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
5 and Marine 4	0.30[i]	0.55	0.40	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	13/17	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
6	0.30[i]	0.55	NR	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
7 and 8	0.30[i]	0.55	NR	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

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

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

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

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

CLIMATE ZONE	0	1	2	3	4 except Marine	5 and Marine 4	6	7 and 8
FENESTRATION U-FACTOR[b,i]	NR	NR	0.40	0.30	0.30	0.30	0.30	0.30
SKYLIGHT U-FACTOR[b]	0.75	0.75	0.65	0.55	0.55	0.55	0.55	0.55
GLAZED FENESTRATION SHGC[b,e]	0.25	0.25	0.25	0.25	0.40	0.40	NR	NR
CEILING R-VALUE	30	30	49	49	60	60	60	60
WOOD FRAME WALL R-VALUE[g]	13 or 0&10ci	13 or 0&10ci	13 or 0&10ci	20 or 13&5ci[h] or 0&15ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]	30 or 20&5ci[h] or 13&10ci[h] or 0&20ci[h]
MASS WALL R-VALUE[h]	3/4	3/4	4/6	8/13	8/13	13/17	15/20	19/21
FLOOR R-VALUE	13	13	13	19	19	30	30	38
BASEMENT WALL R-VALUE[c,g]	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci
SLAB R-VALUE & DEPTH[d]	0	0	0	10ci, 2 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft
CRAWL SPACE WALL R-VALUE[c,g]	0	0	0	5ci or 13[f]	10ci, or 13	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

g. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13 & 5” means R-13 cavity insulation plus R-5 continuous insulation.

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

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation, or
   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

Reason: Proposed Revisions & Reasons - Swap X and Y axes of Table R402.1.2 and Table R402.1.3 for consistency with IECC-C format; no changes to technical requirements or footnotes. In addition to swapping the X and Y axes on these two tables, Table R402.1.3 may be improved by

noting in the table row headings that Fenestration and Skylight U-factors are "maximum", and the SHGC is "maximum". Alternatively, "Maximum" could be inserted in the title of Table R402.1.3: "Insulation Minimum R-Values and Fenestration Maximum Requirements by Component[a] ".
The proposal also includes editorial movement of a couple footnote indicators to improve Table R402.1.3 editorially.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is editorial, and intended to improve the usability of the code.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Recommendation to approve as amended as changes are editorial in nature and makes chart easier to read.

REPI-33-21

Proponents: Amanda Hickman, representing Leading Builders of America (LBA) (amanda@thehickmangroup.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (TABLE R1102.1.2) MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	FENESTRATION *U*-FACTOR[f]	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SHGC[d, e]	CEILING *U*-FACTOR	WOOD FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
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	0.0~~26~~ 30	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.0~~26~~ 30	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.30	0.55	0.40	0.0~~24~~ 26	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.0~~24~~ 26	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.0~~24~~ 26	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.0~~24~~ 26	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

d. The SHGC column applies to all glazed fenestration.

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

f. A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

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

TABLE R402.1.3 (TABLE N1102.1.3) INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b, i]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE[g]	MASS WALL *R*-VALUE[h]	FLOOR *R*-VALUE	BASEMENT[c,g] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c,g] WALL *R*-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	~~49~~ 38	13 or 0 & 10ci	4/6	13	0	0	0
3	.30	0.55	0.25	~~49~~ 38	20 or 13 & 5ci[h] or 0 & 15ci[h]	8/13	19	5ci or 13[f]	~~10ci, 2 ft~~ 0	5ci or 13[f]
4 except Marine	.30	0.55	0.40	~~60~~ 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	8/13	19	10ci or 13	10ci, ~~4~~ 2 ft	10ci or 13
5 and Marine 4	0.30[i]	0.55	0.40	~~60~~ 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	13/17	30	15ci or 19 or 13 & 5ci	10ci, 42 ft	15ci or 19 or 13 & 5ci
6	0.30[i]	0.55	NR	~~60~~ 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
7 and 8	0.30[i]	0.55	NR	~~60~~ 49	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

g. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13 & 5” means R-13 cavity insulation plus R-5 continuous insulation.

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

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation, or
   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

R408.2 (N1108.2) Additional efficiency credits ~~package options~~. Two a~~A~~dditional efficiency ~~package options for compliance with Section R401.2.1 are set forth in Sections Table R408.2.1 through R408.2.5.~~ measures shall be selected from Table R408.2 that are cumulatively equal to or greater than ten credits. Each measure selected shall meet the relevant subsections of Section R408 and receive credit as specified in the Table 408.2 for the specific Climate Zone. Interpolation of credits between measures shall not be permitted.

Add new text as follows:

R408.2.1 Opaque wall option. For *buildings* in climate zones 4 and 5, the maximum U-factor of 0.060 shall be permitted to be used for wood frame walls for compliance with Table R402.1.2 where complying with one or more of the following:

1. A heat pump is installed for space heating.
2. All installed water heaters have a UEF equal to or greater than 2.0 or a COP of greater than 1.0.
3. In addition to the number of credits required by Section R408.2, three additional credits are achieved.

Reason: This proposal increases the overall energy savings beyond the 2021 IECC but does so in a more balanced approach. In order to achieve the increased energy savings measures that we have proposed to R408, this code change adjusts prescriptive insulation levels to be more flexible and cost-effective.
Overwhelming data shows that energy savings gains are very dependent on climate zone. What saves energy in one area of the country may actually cost energy in another. A one size approach does not work from an energy savings point of view and it can also lead to egregious financial cost that can price many American families out of homeownership. Unfortunately, that it is exactly what the 2021 IECC did - and it is critical that is corrected.

Approving this proposal will ensure that the 2024 IECC does not only save more energy, but also preserves home affordability, and promotes code adoption.

Cost Impact: The code change proposal will decrease the cost of construction.
The 2021 edition of the IECC contains provisions that were egregious in cost - some well over a 100 year paybacks. This proposal adjusts the levels for prescriptive envelope requirements, freeing up more to be spent in better cost effective measures that save more energy.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Initially considered alongside REPI-018-21 – and other R408 measures, this proposal was modified to align with the REPI-018 points-based approach to R408. This proposal weakens the ceiling insulation requirements in R402 and compensates by offering either electrification options or 3 additional points in R408.

REPI-35-21

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

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.3 (TABLE N1102.1.3) INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Portions of table not shown remain unchanged.

CLIMATE ZONE	FLOOR *R*-VALUE i
0	13 or 7+5ci or 10ci
1	13 or 7+5ci or 10ci
2	13 or 7+5ci or 10ci
3	19 or 13+5ci or 15ci
4 except Marine	19 or 13+5ci or 15ci
5 and Marine 4	30 or 19+7.5ci or 20ci
6	30 or 19+7.5ci or 20ci
7 and 8	38 or 19+10ci or 25ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

i. "30 or 19+7.5ci or 20ci" means R30 *cavity insulation* alone or R19 *cavity insulation* with R7.5 *continuous insulation* or R20 *continuous insulation* alone.

R402.2.7 (N1102.2.7) Floors. Floor ~~*cavity*~~ *insulation* shall comply with one of the following:

1. Installation shall be installed to maintain permanent contact with the underside of the subfloor decking in accordance with manufacturer instructions to maintain required *R*-value or readily fill the available cavity space.
2. Floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.
3. A combination of cavity and continuous insulation shall be installed so that the cavity insulation is in contact with the top side of the continuous insulation that is installed on the underside of the floor framing separating the cavity and the unconditioned space below. The ~~combined~~ *R*-value s of the cavity and continuous insulation components or the R-value of continuous insulation only shall equal the required insulation component *R*-value s for floors. Cavity ~~+~~ insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

Reason: This proposal adds prescriptive R-value options to Table R402.1.3 for floors above unconditioned spaces (e.g., crawlspaces, floor overhangs, etc.) to align with the primary insulation options as done for above-grade walls. These options are cavity insulation only, cavity plus continuous insulation, and continuous insulation only. This proposal provides prescriptive solutions for a combination of cavity and continuous insulation as currently addressed in Item 3 of Section R402.2.7, but not implemented in Table R402.1.3. Thus, it addresses a gap in the current prescriptive R-value requirements in the code. Finally, it aligns Section R402.2.7 with changes to the table and corrects an error in indicating that cavity and insulation components can be simply summed to meet cavity insulation requirements (which conflicts with clear direction not to do this in Section R402.1.4).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposal provides options for floor insulation and, therefore, may actually reduce cost.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Consistent with how assemblies are handled in the code. Provides flexibility where so desired.

Proposal # 451

REPI-37-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

R402.2.10 (N1102.2.10) Crawl space walls. Crawl space walls shall be insulated in accordance with Table R402.1.3. **Exception:** Crawl space walls associated with a crawl space that is vented to the outdoors and the floor overhead is insulated in accordance with Table R402.1.3 and Section R402.2.7.

R402.2.10.1 (N1102.2.10.1) Crawl space wall insulation installations. ~~Where c~~ Crawl space wall insulation ~~is installed, it~~ shall ~~be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm).~~ comply with the following:

1. Where exterior crawl space wall insulation is installed, it shall be permanently attached to the wall and extend downward from the sill plate to not less than the base of the foundation wall.
2. Where interior crawl space wall insulation is installed, it shall be permanently attached to the foundation wall and extend downward from the sill plate at the top of the foundation wall to not less than the interior floor of the crawl space.

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. 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 stem walls and shall be attached to the stem walls.

Reason: Purpose: This proposal offers direction for installation of foundation insulation that performs, and which makes enforcement easier and more straight forward. The standing language does not address insulating from the outside and ambiguously speaks to insulating the rim joist or “the depth of the floor”.
Language that has been stricken is not enforced and is confusing creating situations where the crawl foundation wall may not be fully insulated especially at the top next to the sill plate connection and at the bottom connection with footings or soils. Performance and efficiency will be increased through consistent application which will benefit jurisdictions and the homeowner by ensuring continuous thermal envelopes that avoid thermal bridging.

There may be a perception that the removal of the requirement to insulate horizontally for 2’ over the dirt floor is a reduction in the stringency of the IECC, however, energy modeling has determined that the horizontal application of insulation inward for 2’ over the crawl dirt vapor retarder does not improve the energy performance of the home. This currently required detail is rarely enforced and or applied in the field. Proposals need to address cost of application and this proposal reduces cost by removing ineffective application.

The IECC has never specifically addressed the application of insulation on the exterior so this proposal clarifies that insulation shall extend above grade to the sill plate and below grade to the footing in this application. Frost protected shallow foundations that are constructed with horizontal insulation extending away from the foundation on the outside of the building are not prohibited by this change in language. As demonstrated in the Bibliography, this type of insulation technique takes the insulation horizontally from the bottom of the installed vertical installed insulation which in this case would be at the bottom of the foundation wall on the exterior.
Regardless of if the crawl space is vented or unvented, exposed earth needs to be covered with a class I vapor retarder. This proposal ensures that there is no confusion about this sound building durability and building science point.

Cost Impact: The code change proposal will decrease the cost of construction.
This proposal will not increase cost and should decrease cost as it is eliminating the requirement to install insulation 2’ horizontally on the interior of the foundation wall over the vapor retarder on the dirt floor.

Bibliography: Shallow frost foundation guide
https://www.huduser.gov/publications/pdf/fpsfguide.pdf

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: modification addressed concerns of subcommittee

REPI-39-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Add new definition as follows:

Knee wall. An *above-grade wall* assembly, or wall defined by vertical truss members, of any height that separate conditioned space from unconditioned buffer spaces, such as ventilated attics and entry porch roofs, rather than ambient outdoors.

Add new text as follows:

R402.2.3 (N1102.2.3) Attic knee wall. R402.2.3 Attic knee wall assemblies that separate conditioned space from unconditioned attic spaces shall meet the same insulation requirements as above-grade walls. Such knee walls shall have an air barrier between conditioned an unconditioned space.

R402.2.3.1 (N1102.2.3.1) Truss framing separating conditioned and unconditioned space. Where vertical roof truss framing members are used to separate conditioned space and unconditioned space, they shall meet the same insulation requirements as the above-grade walls.

Revise as follows:

TABLE R405.2 (TABLE N1105.2) REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3 ~~R402.2.3~~ R402.2. 4	Attic knee or pony wall Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

Reason: Attic knee walls, often named pony walls in the field, are a unique assembly that has been overlooked by the IECC. The assembly separates interior conditioned space from exterior unconditioned space, but it buffered from directly being connected to the ambient outdoors by a ventilated attic. The ventilated attic space often has harsher unconditioned side temperatures that normal above grade walls causing more significant heat loss or gain through the assembly than through normal insulated above grade walls. This being the case we see across the country in the field that attic knee or pony walls are often insulated to a lower R-value than the exterior walls associated with the same house. In addition, the IECC has not been clear about the need for attic side enclosed and sealed air barrier systems installation.
This proposal defines, describes how to address, and adds this unique assembly to the list of required assemblies that must be detailed in the requirements section of the IECC. It will ensure proper air barriers, insulation installation, air sealing of the assembly and will increase the performance of the home.

Cost Impact: The code change proposal will increase the cost of construction.
In theory, this assembly has been addressed as an above grade wall so this new section of code should not add cost to the construction of a home. In reality, this assembly has not been viewed in most of the country as a typical above grade wall so cost will be added to construction because of the realization of the significance of the assembly and the heat loss and gain that is driven through it because of it be adjacent to the ventilated attic.

The R-value of this part of the above grade wall assembly could traded off to a lower R-value, or the same R-value that is currently being installed when using the UA alternative, Total Building Performance, or ERI compliance pathways. This would lower the cost associated with this code proposal. However, as cost goes down implementation would still become better because the proposal would ensure that the installed insulation is

enclosed in a six-sided air sealed cavity which performs to better mitigate heat loss and gain through the assembly.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: assembly often overlooked and with low compliance rates. Language has issues but it's necessary.

Proposal # 374

REPI-40-21

Proponents: Jonathan Humble, representing American Iron and Steel Institute (Jhumble@steel.org)

2021 International Energy Conservation Code

Revise as follows:

R402.2.6 (N1102.2.6) Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall comply with the ~~insulation requirements of Table R402.2.6 or the~~ *U*-factor requirements of Table R402.1.2. The calculation of the *U*-factor for steel-frame d ceilings and walls in an envelope assembly shall ~~use a series-parallel path calculation method~~ be determined in accordance with AISI S250 as modified herein.

1. Where the steel-framed wall contains no cavity insulation, and uses continuous insulation to satisfy the *U*-factor maximum, the *steel-framed wall* member spacing is permitted to be installed at any on center spacing.
2. Where the steel-framed wall contains framing spaced at 24 inches (610 mm) on center with a 23% framing factor or framing spaced at 16 inches (400 mm) on center with a 25% framing factor, the next lower framing member spacing input values shall be used when calculating using AISI S250.
3. Where the steel-framed wall contains less than 23% framing factors the AISI S250 shall be used without any modifications.
4. Where the steel-framed wall contains other than standard C-shape framing members the AISI S250 calculation option for other than standard C-shape framing is permitted to be used.

Delete without substitution:

TABLE R402.2.6 STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL-FRAME EQUIVALENT *R*-VALUE[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-frame Wall, 16 inches on center	
R-13 + 4.2 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1	
R-13+5	R-0 + 15 or R-13 + 9 or R-15 + 8.5 or R-19 + 8 or R-21 + 7
R-13+10	R-0+20 or R-13 + 15 or R-15 + 14 or R-19 + 13 or R-21 + 13
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel-frame Wall, 24 inches on center	
R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4	
R-13+5	R-0 + 15 or R-13 + 7.5 or R-15 + 7 or R-19 + 6 or R-21 + 6
R-13+10	R-0 + 20 or R-13 + 13 or R-15 + 12 or R-19 + 11 or R-21 + 11
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20+5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

a. The first value is cavity insulation *R*-value; the second value is continuous insulation *R*-value. Therefore, for example, "R-30 + 3" means R-30 cavity insulation plus R-3 continuous insulation.

b. Insulation exceeding the height of the framing shall cover the framing.

Add new standard(s) as follows:

AISI

American Iron and Steel Institute
25 Massachusetts Avenue, NW, Suite 800
Washington, DC 20001

AISI . AISI S250 - 21 North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing

Reason: The purpose of this proposal is to address the issue of having to submit to the code official a request to use the alternative means and methods provisions for cold-formed steel framing designs that are not shown in the IECC. For example, Section C402.1.4.2 addresses only wall framing spacing for 16 and 24 inch on center spacing and is limited to cavity plus continuous insulation options only, whereas, in the market there are many more framing spacing and insulation options used.
This proposal recommends that the Section be modified to recognize the ANSI/AISI/COFS S250 standard. This standard covers cold-formed steel wall framing spacings from 6 inches to 24 inches on center, covers member sizes from 3.5 inches to 12 inches wide, and covers member thicknesses from 0.033 inches thick to 0.064 inches thick. This standard will provide greater latitude for the user of the IECC by mitigating the necessity of having to submit for approval under alternate means and methods provisions. Further, this standard also includes provisions for evaluation of wall assemblies where all the insulation is located outside the wall cavity, which is an option the IECC does not cover.

This standard also contains provisions for calculating ceiling assemblies constructed of cold-formed steel framing with either conventional c-shape framing members, or truss construction with insulation in the attic and with additional continuous insulation below the truss framing. Previous to this proposal we found users applying the 2003 IECC provisions, which contained the calculation procedures, as part of the alternative means and

methods submission process to demonstrate compliance. This proposal is intended to mitigate that additional step.

The ANSI/AISI/COFS S250 was approved and published in September 2021.

As part of AISI's effort to make this document user friendly, an excel spread sheet containing all the necessary equations and back-ground data was generated so that users would merely input the basic assembly materials data (e.g. R-values of insulations, sheathings, etc.) and allow the spread sheet to calculate within seconds the result. This excel spread sheet is available at no cost to any potential user (e.g. code official, design professional, building owner, etc.)

The proponent wishes to schedule time to present to the IECC Residential Committee this proposal, discuss, and to take questions from the Committee.

Cost Impact: The code change proposal will decrease the cost of construction.
This proposed change we expect will decease the cost of construction by eliminating the need to prepare an application to the alternative means and methods process. This is because of the standards wider range of envelope assembly options that the user is permitted to calculate in order to demonstrate compliance.

Bibliography: AISI, "Development of a U-factor Calculation Procedure for Cold-Formed Steel C-Shaped Clear Wall Assemblies," American Iron and Steel Institute, Washington, DC, Research Report RP20-2, April 2020.
AISI, "North American Standard for Thermal Transmittance of Building Envelopes with Cold-Formed Steel Framing," American Iron and Steel Institute, Washington, DC, AISI S250-21.

Attached Files

- **AISI_CFSD-Report-RP20-2-Final.pdf**
  https://energy.cdpaccess.com/proposal/106/1189/files/download/23/
- **AISI S250-21&S250-21-C_s.pdf**
  https://energy.cdpaccess.com/proposal/106/1189/files/download/22/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides clear and accurate way of determining wall and ceiling assemblies for closed form steel.

REPI-42-21

Proponents: Wesley Hall, representing The Reflective Insulation Manufacturers Association - International (wes.hall@reflectixinc.com)

2021 International Energy Conservation Code

Add new definition as follows:

RADIANT BARRIER. A material having a low emittance surface of 0.1 or less installed in building assemblies.

Add new text as follows:

R402.3 (N1102.3) Radiant barriers. Where installed to reduce thermal radiation, radiant barriers shall be installed in accordance with ASTM C1743.

Add new standard(s) as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

C1743-2019	Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Residential Building Construction

Reason: This proposal DOES NOT require the use of radiant barriers. But rather requires that WHEN radiant barriers are used, they comply with the appropriate ASTM standard. Furthermore this proposal provides important information to the code user and code enforcement community regarding radiant barriers.
The definition for Radiant Barrier is included in the 2021 IBC.

Radiant barriers are typically installed in attics to reduce summer heat gains through the roof. According to the DOE's website: https://www.energy.gov/energysaver/weatherize/insulation/radiant-barriers, Radiant barriers help to reduce cooling costs by reducing radiant heat gain. To be effective, radiant barriers are very dependent of their installationbecause their reflective surface must face an air space.

Radiant barriers follow two ASTM Standards – ASTM C1313/C1313M, "Standard Specification for Sheet Radiant Barriers for Building Construction Applications," and ASTM C1743, "Standard Practice for Installation and Use of Radiant BarrierSystems (RBS) in Residential Building Construction".

The proposed language is being included in this section specifically because the American Society for Testing andMaterials (ASTM) classifies radiant barriers as thermal insulation. The ASTM committee C16 on Thermal Insulation includespublished standards for this product. Subcommittee C16.21 deals specifically with reflective products, which include reflective insulation, radiant barrier and interior radiation control coatings. C16.21 develops standards and practices for these reflective building material thermal insulating products.

Radiant barrier products include a surface with an emittance of 0.1 or less that is installed in roof assemblies or attics with the low-emittance surface facing an open or ventilated air space. The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier. Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over one billion square feet of the product is being installed annually.

IBC 2021

- Section 1510, Radiant Barriers Installed Above Deck

Hawaii Title 3, Chapter 181.1 2015

- Section 407.2 Requirements
- Table 407.1 Points Option

Texas

- City of Austin Ordinance No. 20210603-055, City Code Chapter 12-25, Article 12, R402.6

2020 Florida Building Code, Energy Conservation, 7th Edition

- R405.7.1 Installation criteria for homes claiming the radiant barrier option
- Figure R405.7.1 Acceptable attic radiant barrier configurations
- Table 303.2.1 Insulation Installation Standards

2019 California Title 24, Part 6

- Section 100.1 Definitions
- Section 110.8 Mandatory requirements for insulation, roofing products and radiant barriers

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal will not increase the cost of construction because it only adds informational language regarding radiant barriers.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: provides useful definition on reflective insulation and emittance

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REPI-43-21

Proponents: Theresa A Weston, The Holt Weston Consultancy, representing The Air Barrier Association of America (ABAA) (holtweston88@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

R402.4 Air leakage. The *building thermal envelope* shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through ~~R402.4.5~~ R402.4.6.

R402.4.1.2 Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 ~~or~~ ASTM E1827 or ASTM E3158 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* have been sealed.

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

During testing:

1. Exterior windows and doors, 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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 ~~or~~ ASTM E1827 or E3158 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single-family and multiple-family building *dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

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

Add new standard(s) as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

E3158-18 Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building

Reason: This proposal adds an additional reference test method, ASTM E3158. This test method has already been included in the list of acceptable test methods for whole building air leakage testing in the IECC-C but was not added to the parallel section of the IECC-R.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does increase code requirements or introduce new code requirements. It only add an additional test protocol option to the current list of test protocol standards.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: this method for air leakage testing should be allowed in the code.

REPI-47-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	~~The~~ A sealed air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. ~~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 air sealed with gasketing materials that allow for repeated entrance over time.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with Section R402.2.4 Eave Baffles shall be installed in accordance with Section R402.2.3
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing	All bathtubs, showers, and plumbing walls on exterior walls	Insulation shall be installed to fill the available space and surround wiring,

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	plumbing, or other obstructions, installation requirements can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air barrier Criteria:

- This section of the code proposal removes insulation requirements that were placed on the wrong side of the table. They are also redundant to insulation requirements that are already in place on the insulation side of the table for this component.
- Driving home the concept of air barriers separating conditioned space from unconditioned space is important to continue here to clarify the requirement to bring drop ceilings into the conditioned space.
- In the field we are continuing to see hatches that are caulked shut and must be cut open. The requirement for air sealing hatches and doors now is clarified that a gasketing air sealing material must be installed that allows for repeated entrance without damaging the air seal.

Insulation Installation Criteria:

- There are many precedents in code language to point to sections for additional clarification, especially for installation guidance that is already in the code but are important to the section of code where the reference has been made. The specific referenced sections in this proposal describe the installation of measures in the requirement section of the code.
- These sections of code are important to reiterate in Table R402.4.1.1 due to the many compliance options that are available. In addition, traditionally Section R402.2.3 and R402.2.4 have been in the prescriptive section of the code. They are currently right after the discussion of prescriptive compliance. As jurisdiction adopt newer code it is important to ensure that although the word mandatory has been removed in the IECC that there are still installation requirements in this table that are explained in other sections of the code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed language changes do not increase the cost of construction but rather removes redundancy and offers greater clarity of existing requirements.
Accessibility to attic spaces is new language but is not a new requirements so it should not increase cost but rather increase clarity.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Proposal clarifies that dropped ceilings are inside the thermal envelope. Addresses gasketing of access hatches and doors. The subcommittee agreed it was a needed update.

REPI-50-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
~~Electrical/phone~~ box on exterior walls	~~shower or tub.~~ ~~The air barrier shall be installed behind electrical and~~ communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots ~~that penetrate building thermal envelope~~ shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	HVAC supply and return register boots located in the building's thermal envelope shall be buried and surrounded by insulation.
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: This proposal requires that all supply and return registers be sealed to the surface they are penetrating. The origin of this air sealing requirement comes from ENERGY STAR, who has demonstrated that energy loss is associated with duct boot installation in three ways: 1) if the boot directly penetrates the thermal envelope, such as a duct boot coming from a ventilated attic into the house; 2) when air that should be delivered to the conditioned space is redirected into building cavities when it hits the register cover; 3) when Venturi pressure, sometimes called the Coanda effect, is created and pulls air into the building cavity as it is being delivered into the room. See Bibliography for more)
By not being able to deliver the HVAC designed volume of air to the rooms of the house, the occupant is often left with no other choice than to raise the thermostat set point temperature in the winter and to lower it in the summer. This causes energy inefficiencies while not correcting their comfort issue. In addition, building cavities are often connected to unconditioned space which increases duct leakage to the outside, as well as other inefficiencies. Therefore, I also believe that it is an important energy and building durability issue. This needs to be addressed at this time because many builders and contractors have experience implementing this in part, if not in whole and this proposal finished what the code has been intending when it barrowed this requirement from the Energy Star program.There have not been insulation requirements associated with duct boots in the past which continues to make this a significant code change proposal. Ensuring that our building cavities are insulated properly is imperative when duct boots are placed in them, and this proposal directly addresses that issue at the termination of the duct boot and the substrate it passes through. Lastly, this proposal aligns with

ENERGY STAR requirements that are the basis of the creation of this table that has been adopted by the IECC.

6. Duct Quality Installation: See Bibliography from more information

6.4.1 In addition, all duct boots sealed to the finished surface, Rater-verified at final. 39

Cost Impact: The code change proposal will increase the cost of construction.
As noted during the 2021 IECC development hearings, this proposal changes the scope of the requirement and therefore should slightly increase the cost of execution by the application of additional caulk, but the benefits to the energy performance of the system far out way the small incremental cost. In reality, this proposal, offers better clarity and expansion of existing requirements and for Energy Star builders there would be no increase in cost.

Bibliography: Read more here, **https://www.achrnews.com/articles/128615-why-dirt-streaking-occurs-around-vents**

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provide clarification to how insulation is to be installed around HVAC supply and return register boots

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REPI-51-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
~~shower or tub.~~		
~~Electrical/phone~~ box on exterior walls	~~The air barrier shall be installed behind electrical and~~ communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—
Common walls or double walls	Air sealing materials recognized in a *listed* fire-resistance rated common wall or double wall design and installed in accordance with the listing, or air sealing materials recognized in an *approved* design, shall be used. Common walls or double walls shall be considered an exterior wall for the purposes of air barrier and air sealing application of this Table (R402.4.1.1).	Insulation materials recognized in the listed common wall or double-wall design and installed in accordance with the listing, or insulation materials recognized in the approved design, shall be used.

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air Sealing Criteria:

- Area separation walls have extreme air leakage. The BXUV guide has been updated to allow air sealing and this should be reflected in the IECC and specifically in Table R402.4.1.1. Below is an example of the new language that has been added to the following Shaft Liner assemblies: U336, U347, U366, U373, U375

  8. **Caulk/Sealant —** (Optional, Not Shown, Intended for use as an air barrier - Not intended to be used as fireblocking) — ASTM C834, Type OP, Grade 0° C or -18° C Latex Sealant at the Shaftliner and C-Track (Item 1) and H-Stud (Item 2) framing locations.

  8A. **Caulking and Sealants* —** (Optional - Intended for use as an air barrier - Not intended to be used as fireblocking) - A bead of sealant applied around the partition perimeter in the 3/4 in. air space between wood framing (Item 4) and shaftliner panels (Item 3) to create an air barrier.

  DUPONT DE NEMOURS, INC. — Great Stuff Gaps & Cracks, Great Stuff Pro Gaps & Cracks, Great Stuff Pro Window & Door

- Area Separation wall assemblies need to be treated like any other exterior wall that has a drop ceiling, tub or other air barrier issue associated with this table within it or adjacent to it. The 1" to ¾" gap between the framed portion of the assembly and the gypsum area separation portion of the assembly allows significant air flow between conditioned and unconditioned spaces which the requirements of Table R402.4.1.1 is designed to mitigate. If these issues are not addressed with area separation wall construction, it is even more difficult to achieve the air leakage requirements of the IECC.

Insulation Criteria:

- Insulation in area separations walls have traditionally been ignored as they are assumed to be an adiabatic wall with no heat loss or gain. In reality, a significant amount of air moves behind the interior drywall in these assemblies and therefore insulation installation makes a significant difference in their energy performance.

Cost Impact: The code change proposal will increase the cost of construction.
Construction is expected to be impacted by this proposal because air sealing has not been allowed in most jurisdiction because of interpretations (right or wrong) or how area separation walls must be built. It is unclear how these assemblies used in town house and duplex construction, are complying with the air leakage requirements of the code. In the Colorado market most jurisdictions are allowing some level of air sealing and we are seeing compliance with air leakage requirements. So in Colorado, and other similar markets, cost of construction will remain the same, and in other markets construction cost will go up, but air leakage compliance will also go.

Bibliography: See attached BXUV Guides for more information regarding air sealing of area separation walls

Attached Files

- **BXUV.U375 _ UL Product iQ.pdf**
  https://energy.cdpaccess.com/proposal/409/1204/files/download/111/
- **BXUV.U373 _ UL Product iQ.pdf**
  https://energy.cdpaccess.com/proposal/409/1204/files/download/110/
- **BXUV.U366 _ UL Product iQ.pdf**
  https://energy.cdpaccess.com/proposal/409/1204/files/download/109/
- **BXUV.U347 _ UL Product iQ.pdf**
  https://energy.cdpaccess.com/proposal/409/1204/files/download/108/
- **BXUV.U336 _ UL Product iQ.pdf**
  https://energy.cdpaccess.com/proposal/409/1204/files/download/107/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Clarifies the air sealing and insulating in insulation requirements for shared wall assemblies

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REPI-52-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Showers, tub s, and fireplaces adjacent to the	~~The~~ An air barrier ~~installed at exterior walls adjacent to showers and tubs~~ shall separate insulation in the	Exterior framed walls adjacent to showers and tubs, and fireplaces shall

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
adjacent to the building thermal envelope. ~~on exterior wall~~	*building thermal envelope* ~~wall~~ from the shower, ~~or~~ tub, and fireplace assemblies.	Exterior framed walls adjacent to showers, and tubs and fireplaces shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Component column:

- The 2012 IECC Air barrier and Insulation table was the last table that specifically referenced the void space behind fireplaces that are located on exterior walls. Just like behind tubs and shower pans a supplemental air barrier is needed on the interior side to enclose the insulation as the drywall plane has been moved to the front of the fireplace in a framed wall. The term Framed wall is intentional to ensure that there is no misinterpretation that masonry fireplaces have this detail and or requirement.

Air barrier criteria section:

- This first revision continues to require the installation of a supplemental air barrier in areas were drywall, tile backer, or other air impermeable material is not installed as the finished surface and is not in alignment with the insulation installed in the building's thermal envelope. The only addition, other than clarification, is the addition of the area behind framed fireplaces boxes on exterior walls.
- Air sealing the tub and shower drain trap penetration eliminates a significant leakage source especially when located in floor systems over unconditioned spaces. This air leakage often creates condensation on the back side of tubs and shower pans which leads to mold and other building durability issues.
- Fireplace door air sealing is outlined in the prescriptive section R402.4.2 and clearly describes that this component shall be air sealed. The instruction should not be limited to fireplaces that are installed using the prescriptive compliance options. Therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

Insulation Installation Criteria:

- Again, the term Framed wall is intentional to ensure that there is no misinterpretation that masonry fireplaces have this detail and or requirement.
- Fireplaces was added to this section for consistency.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed language does not increase the cost of construction, but rather offers clarity of existing requirements for better implementation and enforcement.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Proposal clarifies that fireplaces need to be insulated like exterior walls.

REPI-53-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
	shower or tub. The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed. Boxes, housing, and enclosures that penetrate the air barrier shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All concealed openings into the box, housing, or enclosure shall be sealed. The continuity of the air barrier shall be maintained around boxes, housings, and enclosures that penetrate the air barrier. Alternatively, air-sealed boxes shall be installed in accordance with R402.4.6.	
Electrical/phone box on exterior walls ,communication, and other equipment boxes, housings, and enclosures		Boxes, housing, and enclosures shall be burried in or surrounded by insulation.
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Component column:

- Although technically speaking, low voltage, speaker, or computer wire boxes are a form of electrical box many builders and trade partners only view true 20- or 15-amp power outlet or switch gang boxes as electrical boxes. By simply broadening the definition to utility box we can ensure that any such box that is installed in an exterior wall or ceiling is insulated, airtight, or air sealed properly.

Air barrier and air sealing criteria section:

- In this section the two requirements have been broken apart for greater clarity. First an airtight box of some sort must be installed and second the box must be and air tight box or air sealed, and must be sealed to the surface that it penetrates.

Insulation Installation Criteria:

- Currently there is not guidance in this table regarding insulating behind electrical boxes in any insulated assembly. This added language rectifies this.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
§ The proposed language does not increase the cost of construction, but rather offers clarity of existing requirements.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Revised by proponent to meet suggestions from SC. Latest version was well received, meeting initial intention. With confusion alleviated

REPI-54-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be air sealed.	Framing cavities around windows, skylights and doors shall be completely filled with insulation or insulated per window manufacturer's instructions.
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1. Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
	shower or tub.	
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air barrier and air sealing criteria section:

- A simple adjective creates better clarity

Insulation installation criteria section:

- Often the framing around windows creates spaces that are odd sizes and shapes. I think of a recent house that I inspected that had several octangle widows fit into a square opening. The cavities that were created would not be defined as narrow cavities section of this table but would be addressed by the proposed language.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
§ The proposed language does not increase the cost of construction but rather offers clarity of requirements.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: addressed concerns of subcommittee through modification.

REPI-55-21

Proponents: Vladimir Kochkin, NAHB, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.1 (N1102.4.1.1) Installation. The components of the *building thermal envelope* as indicated in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria indicated in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official,* an *approved* third party shall inspect all components and verify compliance.

TABLE R402.4.1.1 (TABLE N1102.4.1.1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

Portions of table not shown remain unchanged.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
Rim joists	Rim joists shall include an ~~exterior~~ air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

b. ~~Air barrier and~~ Iinsulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: This proposal clarifies and simplifies this provision. The revised language allows the building designer the choice of selecting an air barrier based on the specific wall assembly design. Having the additional word “exterior” can lead to misinterpretation that the air barrier always must be outboard of the rim joist’s exterior face. That was never the intent of this provision. Footnote b is revised to coordinate with the change in the table and to clarify that rim joist is not exempt from the air barrier requirements. The footnote is correct in stating that full enclosure of insulation at the rim is not required.

The first row in Table R402.4.1.1 clearly states "breaks and joints in the air barrier shall be sealed." Having the sentence requiring additional sealing of rim to the sill and subfloor can be interpreted that a secondary air barrier is required at those locations in addition to the primary air barrier method.

It is noted that a whole-building tightness test is required to verify the overall air tightness of the house. Exterior WRB is always required for frame construction.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change primarily is a clarification of intent. The goal is to avoid misinterpretations of the provisions in the field.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides clarity to the section

Proposal # 252

REPI-57-21

Proponents: Lisa Rosenow, representing Self (lrosenow@evergreen-tech.net); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. The *building* or *dwelling unit* thermal envelope shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cfm/ft^2 (1.4 L/s × m^2) ~~cubic feet per minute (CFM) per square foot [0.0079 m^3/(s × m^2)]~~ of building or *dwelling unit enclosure area*. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure differential of 0.2 inch ~~w.g.~~ water gauge (50 Pa~~scals~~). 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* have been sealed.

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

During testing:

1. Exterior windows and doors, 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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units*, an air leakage rate not exceeding ~~0.30 cubic feet per minute per square foot [0.008 m^3/(s × m^2)]~~ 0.30 cfm/ft^2 (1.5 L/s × m^2) of the *dwelling unit enclosure area*, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 ~~and reported~~ at a pressure differential of 0.2 inch ~~w.g~~ water gauge (50 Pa), shall be permitted in all climate zones for:

1. Attached ~~single-family and multiple-family building~~ *dwelling units*.
2. ~~Buildings or d~~ *Dwelling units* that are ~~1,500~~ 1,500 square feet (139.4 m^2) or smaller.

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

Reason: Purpose of proposed changes is to clarify code intent and align terminology with the commercial air barrier testing provisions.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The intent of this proposal is to improve code language clarity only.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The proposal was intended to align residential with commercial air leakage testing standards.

REPI-58-21

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

~~**Exception**~~ **Exceptions:**

1. When testing individual *dwelling units*, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:
   1.1. Attached single and multiple family building *dwelling units*.
   1.2. Buildings or *dwelling units* that are 1,500 square feet (139.4 m^2) or smaller.
2. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, 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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

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

1. ~~Attached single-family and multiple-family building *dwelling units*.~~
2. ~~Buildings or *dwelling units* that are 1,500 square feet (139.4 m^2) or smaller.~~

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

Reason: The purpose of this code change proposal is to make an editorial change. Specifically, this proposal moves the air leakage testing exception for small dwelling units to be directly following Section R402.4.1.2, which outlines the air leakage testing requirements for all residential buildings. The exception is currently located at the end of a list of instructions for carrying out an air leakage test, and code users may not understand that the exception allows an alternative to the metric used to measure air leakage under Section R402.4.1.2. This proposal is not intended to change any code requirements, but rather to make the *IECC* more user-friendly.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Because the proposal is only an editorial improvement, there is no cost impact.

COST-EFFECTIVENESS

Because this proposal does not impact code stringency or cost, a cost-effectiveness analysis is not applicable.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: increases legibility of this code.

Proposal # 304

REPI-60-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing Colorado Chapter of the ICC (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed ~~5.0~~ **4.0** air changes per hour or ~~0.28~~ **0.22** cubic feet per minute (CFM) per square foot [0.00632 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

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

During testing:

1. Exterior windows and doors, 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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units*, an air leakage rate not exceeding ~~0.30~~ 0.27 cubic feet per minute per square foot [0.00~~8~~ 7 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single-family and multiple-family building *dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

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

Reason: This proposal is intended to make sense of what occurred during the 2021 code development process. Three proposals passed and the correlation of the proposals created confusing language that left the impression that the three and five air leakage rates depending on climate zone has been relaxed to 5 ACH50 across the country.
Because of that confusion it became apparent that this code change proposes should propose a single air leak rate for all climate zones. Building science research and application has determined that tight building envelopes are beneficial to all homes not just homes located in heating dominated climates. Homes in cooling dominated climates also gain efficiency and durability benefits from tight building envelopes. 3 ACH50 is a nationally achievable air leakage rate, and this proposal continues the 2021 IECC leeway by offering leakage concession to two housing types, attached and small dwelling units, that have at times struggled to achieve the leakage target. That being said, there is also a new allowance to use a CFM per square foot of shell area air leakage compliance metric that better assesses the leakage of a home as it is not based on volume but rather actual holes in the building envelope.

This proposal makes sense as demonstrated by the quick brand recognition and dominance of YETI coolers. As with houses, airtight and well insulated coolers keep their contents cold in the summer. If needed they would also keep their contents warm in the winter. The code recognizes this reality in heating dominated climates and it is time it is also recognized in cooling dominated climates. Lastly, with recent extreme weather events we will see a better ability to shelter in place during excessive cold and hot periods when homes are built tighter.

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

This proposal will increase code of construction in some cooling dominated climate projects that have not already incorporated sound building science-based construction practices that are not only being incorporated into the code but also being advanced by industry.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Presented by air leakage working group considered CEPI-60, 63 and 64 together.

Proposal # 419

REPI-61-21

Proponents: Aaron Gary, representing Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Add new text as follows:

R402.4.1.4 Sampling for R2 multifamily dwelling units. For buildings with eight or more testing units complying with R402.1.2 or R402.1.3, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit, a middle floor unit, and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional three units shall be tested, including a mixture of testing unit types and locations. Where buildings have fewer than eight testing units, each testing unit shall be tested.

Revise as follows:

R402.4.1.2 Testing. The *building* or each *dwelling unit* in the *building* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

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

1. For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved* third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, *conditioned spaces* in accordance with Sections R402.2.12 and R402.3.5, as applicable.
2. Where tested in accordance with R402.4.1.4, testing of each *dwelling unit* is not required.

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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

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

1. Attached single-family and multiple-family building *dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

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

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

Add new text as follows:

R402.4.1.4 Dwelling unit sampling. For *buildings* with eight or more dwelling units, the greater of seven or 20 percent of the *dwelling units* in the building shall be tested. Tested units shall include a top floor unit, a ground floor unit, a middle floor unit, and the *dwelling unit* with the largest *dwelling unit enclosure area*. Where the air leakage rate of a tested unit is greater than the maximum permitted air leakage rate, corrective actions shall be made to the unit and the unit re-tested. For each tested unit that has a greater air leakage rate than the maximum permitted air leakage rate, an additional three units, including the corrected unit, shall be tested. Where buildings have fewer than eight *dwelling units*, each *dwelling unit* shall be tested.

Reason: Aligns with the commercial provisions of the 2021 IECC and RESNET sampling guidelines so that envelope leakage testing requirements for a multi-family (R2 classification) project that is 3 stories or lower in height (and that falls under the Residential provisions of the IECC) will be tested at the same rate as apartment building that is 4 stories or taller in height (and falls under the Commercial provisions of the IECC). Sampling provisions were approved as part of the 2021 IECC for Commercial multifamily (R2 classifications) projects because it is very costly and time consuming to test each dwelling unit for projects where there may be dozens of dwelling units in each building. Considering that the same tradesman generally constructs a building, it is reasonable to deem that construction practices are consistent and that if a reasonable sampling of units tested pass, then all units would pass.

Cost Impact: The code change proposal will decrease the cost of construction.
For multifamily projects that are built and test well, sampling provisions such as those approved in the Commercial provisions of the 2021 IECC will reduce the cost and time required for testing and verification. Projects that do not meet their testing thresholds will understandably be tested as a higher rate, potentially test each, until they too are meeting the required standards consistently and as such will may not see a reduction in testing and verification costs or timelines.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: sampling increase efficiencies

Proposal # 516

REPI-63-21

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing and maximum air leakage rate. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

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

During testing:

1. Exterior windows and doors, 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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

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

1. Attached single-family and multiple-family building *dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

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

R402.4.1.3 (N1102.4.1.3) Prescriptive air ~~l~~Leakage rate. When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 4.0~~5.0~~ air changes per hour in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 4.0~~5.0~~ air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	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, °C = (°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 that is 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 shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall 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 having 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 having 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 having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having 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 for 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 × 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.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. 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.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multifamily buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

Reason: The purpose of this code change proposal is to improve the efficiency and resiliency of homes in climate zones 0 through 2 through improved building air tightness. Specifically, the proposal modifies the prescriptive air tightness requirement and the performance path baseline from ≤5.0 ACH50 to ≤4.0 ACH50. The proposal still retains the trade-off flexibility of the 2021 *IECC* for these climate zones, which will allow code users to trade back up to ≤5.0 ACH50 in the performance path, as long as efficiency losses are accounted for elsewhere in the building.
The envelope air tightness requirement for the southernmost climate zones has not changed since the air leakage test requirement was first incorporated into the 2012 *IECC*. In the meantime, air leakage testing has become a far more common step in new construction, and the techniques and products used to achieve tight envelopes have become more commonplace in all climate zones, including zones 0-2. According to a recent DOE Residential Field Study in Texas, nearly 1/3 of the homes in climate zone 2 sampled for air leakage testing already achieved 4.0 or lower air leakage, even though the local code requirements ranged from ≤5.0 to ≤7.0 ACH50. *See* https://www.energycodes.gov/residential-energy-code-field-studies . These homes would already be compliant with the air tightness requirement proposed above at no additional cost or effort, and the remainder of the homes would not have to undergo radical changes to achieve it.

Although a tighter envelope will have a more pronounced effect on energy conservation in climate zones with a larger difference between indoor and outdoor temperatures, reasonable envelope air tightness is still extremely important in moderate climates.

- Improving air tightness from ≤5.0 to ≤4.0 ACH50 will not substantially increase the cost of construction, but it will save homeowners money over the home’s useful life;
- A significant number of counties in climate zones 0-2 are classified as warm/humid, and a tighter envelope will help cooling systems operate efficiently and manage indoor humidity, improving the long-term durability of buildings;
- A tighter building envelope, along with adequate fresh air through dedicated mechanical ventilation, will help maintain healthier indoor air quality for the home’s occupants;
- More efficient building envelopes will generally help maintain occupant comfort and passive survivability in the event of extreme weather events or extended power outages, such as the recent power outage in Texas.

As building practices and materials improve, it is important to set code requirements that help optimize building operation and efficiency. Air tightness levels in homes in climate zones 0-2 have already been improved as a result of market transformation: More builders have learned how to improve air tightness as a part of quality construction, and manufacturers have tuned products to meet the growing national demand for tighter homes.

Beyond the direct energy and cost savings associated with reduced air leakage, we expect that occupants will experience improved comfort, and as a result, will be less likely to adjust the thermostat to counteract a "drafty home." Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R4 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	**Nat'l Avg**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
+1 Degree Heating	**4.1%**	**0.5%**	**3.0%**	**4.2%**	**4.4%**	**4.7%**	**4.5%**	**4.0%**	**2.9%**
-1 Degree Cooling	**3.2%**	**7.8%**	**5.3%**	**3.9%**	**2.6%**	**1.8%**	**1.4%**	**0.7%**	**0.4%**

We believe the envelope air tightness requirement in these climate zones could be improved with little additional effort, and that homeowners will benefit from these improvements for many years.

Cost Impact: The code change proposal will increase the cost of construction.
This proposal will increase the cost of construction in some cases. As noted above, many buildings that achieve ≤5.0 ACH50 already achieve ≤4.0 ACH50 as well, or would not require substantial additional cost to achieve this improvement. We believe it is reasonable to assume an average increase in construction costs of $108 per dwelling unit based on cost data from NREL's BEopt modeling software. For many builders, any incremental costs to achieve these gains will be reduced or eliminated over time as new techniques and quality assurance are adopted into standard practices. But for purposes of this code change proposal, a $108 incremental cost per dwelling unit is a reasonable and conservative estimate.

COST-EFFECTIVENESS

This proposal is clearly cost-effective to the homeowner. Based on modeling using NREL's BEopt software and following the residential building cost-effectiveness methodology developed by the U.S. DOE (*see* www.energycodes.gov/methodology), the analysis conducted by EECC found that this proposal will save homeowners significant energy cost and will result in clear life-cycle cost effectiveness for homeowners. The analysis estimated that this proposal will produce a positive net life cycle benefit of $225-836 over the first 30 years of the building's useful life (using the average $108 incremental cost from BEopt referenced above), depending on climate zone. A summary table of this cost-effectiveness analysis is below.

[R4 table pix_cost.png]

Climate Zone	ACH50	Incremental Cost Upgrade	Annual Energy Savings	Present Value Costs	Present Value Benefits	Life Cycle Net Benefit
1	4.0	$108	$8	$245	$469	$225
2	4.0	$108	$20	$245	$1080	$836

Bibliography: (1) www.energycodes.gov/residential-energy-code-field-studies; (2) www.energycodes.gov/methodology

Attached Files

- **R4 table pix_cost.PNG**
  https://energy.cdpaccess.com/proposal/312/931/files/download/178/
- **R4 table pix.PNG**
  https://energy.cdpaccess.com/proposal/312/931/files/download/177/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: controlling air leakage is important in warm climates as well.

Proposal # 312

REPI-64-21

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (N1102.4.1.2) Testing and maximum air leakage rate. The *building* or *dwelling unit* shall be tested for air leakage. The maximum air leakage rate for any *building* or *dwelling unit* under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area in climate zones 0, 1, and 2, and 4.0 air changes per hour or 0.22 cubic feet per minute (CFM) per square foot [0.0063 $m^3/(s \times m^2)$] of dwelling unit enclosure area in climate zones 3 through 8. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope* have been sealed.

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

During testing:

1. Exterior windows and doors, 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, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual *dwelling units*, an air leakage rate not exceeding 0.24~~0.30~~ cubic feet per minute per square foot [0.0064 ~~0.008~~ $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single-family and multiple-family building *dwelling units*.
2. Buildings or *dwelling units* that are 1.500 square feet (139.4 m^2) or smaller.

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

R402.4.1.3 (N1102.4.1.3) Prescriptive air leakage ~~Leakage~~ rate. When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, and 2.0 ~~3.0~~ air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 2.0 ~~3.0~~ air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	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, °C = (°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 that is 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 shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall 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 having 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 having 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 having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having 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 for 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 × 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.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. 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.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the "hot water rectangle") divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multifamily buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

R408.2.5 (N1108.2.5) Improved air sealing and efficient ventilation system option. The measured air leakage rate shall be less than or equal to 2.0 ~~3.0~~ ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/Moisture Transfer (LRMT).

Reason: The purpose of this code change proposal is to improve the energy efficiency and resiliency of homes in climate zones 3-8 through improved building envelope air tightness. Specifically, the proposal improves the prescriptive envelope air tightness requirement and performance path baseline from ≤3.0 ACH50 to ≤2.0 ACH50 for climate zones 3-8. It will also make a corresponding change to the Additional Efficiency Package Option that awards credit for reduced air leakage and the installation of an HRV/ERV. In order to maintain the level of trade-off flexibility allowed under the 2021 *IECC*, the proposal allows code users in climate zones 3-8 to trade up to ≤4.0 ACH50 in the performance path, as long as the efficiency losses are accounted for elsewhere in the home. The proposal also makes a corresponding improvement to the alternative air tightness requirement for smaller dwelling units.

The prescriptive envelope air tightness requirement of ≤3.0 ACH50 for climate zones 3-8 has not changed since the mandatory air leakage test requirement was first incorporated into the 2012 *IECC*. In the meantime, air leakage testing has become a far more common step in new construction, and the techniques and products used to achieve tight envelopes have become more commonplace in all climate zones. Tighter building envelopes provide a range of benefits to homeowners at relatively low cost:

- Improving air tightness from ≤3.0 to ≤2.0 ACH50 will not substantially increase the cost of construction, but it will save homeowners money over the home's useful life;
- A tighter envelope will help both heating and cooling systems operate more efficiently and manage indoor humidity, improving the long-term durability of buildings;
- A tighter building envelope, along with adequate fresh air through dedicated mechanical ventilation, will help maintain healthier indoor air quality for the home's occupants;

- More efficient building envelopes will generally help maintain occupant comfort and passive survivability in the event of extreme weather events or extended power outages.

Across the country, the envelope tightness in new buildings has improved in recent years as a result of market transformation. More builders have learned how to improve air tightness as a part of quality construction, and manufacturers have tuned products to meet the growing national demand for tighter homes. Above-code programs such as Energy Star require blower door testing, and it is a core element of energy ratings. Now that builders have had experience achieving the code requirement of ≤3.0 ACH50 under the *IECC* for nearly a decade, we believe the envelope air tightness requirement could be moderately improved with little additional effort.

Beyond the direct energy and cost savings associated with reduced air leakage, we expect that occupants will experience improved comfort, and as a result, will be less likely to adjust the thermostat to counteract a "drafty home." Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R2 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	**Nat'l Avg**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
+1 Degree Heating	**4.1%**	**0.5%**	**3.0%**	**4.2%**	**4.4%**	**4.7%**	**4.5%**	**4.0%**	**2.9%**
-1 Degree Cooling	**3.2%**	**7.8%**	**5.3%**	**3.9%**	**2.6%**	**1.8%**	**1.4%**	**0.7%**	**0.4%**

There is no question that homeowners will benefit from a tighter building envelope for many years, and we urge the adoption of this straightforward efficiency improvement.

Cost Impact: The code change proposal will increase the cost of construction.
This proposal will increase the cost of construction in some cases. Some builders who achieve 3.0 ACH50 may already achieve 2.0 ACH50 with no additional cost. Those buildings that do not currently achieve 2.0 ACH50 should not require major additional cost to achieve this improvement. We believe it is reasonable to assume an average increase in construction costs of $198 per dwelling unit based on cost data from NREL's BEopt modeling software. For many builders, any incremental costs to achieve these gains will be reduced or eliminated over time as new techniques and quality assurance are adopted into standard practices. But for purposes of this code change proposal, a $198 average incremental cost per dwelling unit is a reasonable and conservative estimate.

COST-EFFECTIVENESS

This proposal is clearly cost-effective to the homeowner. Based on modeling using NREL's BEopt software and following the residential building cost-effectiveness methodology developed by the U.S. DOE (*see* www.energycodes.gov/methodology), the analysis conducted for EECC found that this proposal will save homeowners substantial energy cost and will result in clear life-cycle cost effectiveness. The analysis estimated that this proposal will produce a positive net life cycle benefit of $378-$5,044 over the first 30 years of the building's useful life, using the average incremental cost of $198 identified above and depending on climate zone. A summary table of this cost-effectiveness analysis is below.

[R2 table pix_cost.png]

Climate Zone	ACH50	Incremental Cost Upgrade	Annual Energy Savings	Present Value Costs	Present Value Benefits	Life Cycle Net Benefit
3	2.0	$198	$15	$448	$845	$397
4	2.0	$198	$37	$448	$827	$378
5	2.0	$198	$27	$448	$1,468	$1,020
6	2.0	$198	$34	$448	$1,831	$1,383
7	2.0	$198	$57	$448	$3,077	$2,629
8	2.0	$198	$103	$448	$5,492	$5,044

Bibliography: www.energycodes.gov/methodology

Attached Files

- **R2 table pix_cost.PNG**

https://energy.cdpaccess.com/proposal/299/1142/files/download/175/

- **R2 table pix.PNG**
  https://energy.cdpaccess.com/proposal/299/1142/files/download/174/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: air leakage tightness is essential to energy efficiency, lasts the life of the building, and is the largest contributor to errors in HVAC equipment.

REPI-65-21

Proponents: Nicholas O'Neil, representing NEEA (noneil@energy350.com); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

R402.4.2.1 (N1102.4.2.1) Gas fireplace efficiency. All gas fireplace heaters rated to ANSI Z21.88 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to ANSI Z21.50 shall be listed and labeled, including their FE ratings, in accordance with CSA P.4.1.

Add new standard(s) as follows:

ANSI

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

Z21-50-2019/CSA 2.22-19	Vented Decorative Gas Appliances
Z21.88-2019/CSA 2.23-19	Vented Gas Fireplace Heaters

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

P.4.1-2021	Testing method for measuring fireplace efficiency

Reason: The IECC does not currently address gas fireplace efficiency (though section 402.4.2 does reference safety standards for wood-burning fireplaces). Gas-burning fireplaces have a wide range of efficiency levels, from 28% to 90% and greater. Gas-fireplaces are most commonly used as secondary heating sources but may still be used for a significant number of hours per heating season.

This proposal establishes a minimum efficiency performance threshold for fireplaces based on the Canadian FE Standard. (https://www.nrcan.gc.ca/energy/products/energuide/label/reading/13718).

We suggest using the FE metric in lieu of AFUE because it more accurately reflects annual heating consumption of the fireplace (taking into account cycling losses, heating and non-heating season efficiency, pilot light contribution, etc.). Additionally the FE rating serves as the basis for efficiency for several utility programs throughout the US offering incentives for fireplaces with high FE ratings.The minimum performance threshold of 50% FE aligns with the BC Ministry of Energy, Mines, and Petroleum Resources regulations that mandates all vented gas fireplace heaters be listed and labeled with a minimum FE score of 50%. Decorative fireplaces, which comprise the bulk of fireplace sales, do not have an FE threshold but are required to be listed and labeled with an FE score. This proposal language is available in WA, NV, BC and in WA, NV, BC, and forthcoming legislation in CAGas Fireplace Efficiency
https://energy.cdpaccess.com/proposal/82/872/files/download/192/
https://energy.cdpaccess.com/proposal/82/872/files/download/122/

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Market analysis has shown that the minimum efficiency level for vented gas heaters is above 50% FE currently, and this proposal would set a minimum threshold to remove the worst performers from the market. Additionally, vented gas heaters make up a smaller portion of the market compared to decorative gas fireplaces which are exempt from this efficiency requirement, even though they need to have an FE rating (which aligns with BC standards, and legislation in NV, WA and forthcoming in CA.)

Bibliography: Z21-50-2016/CSA 2.22-16 -Vented Decorative Gas Appliances R402.4.2.1

Z21.88-2017/CSA 2.23-17 - Vented Gas Fireplace Heaters R402.4.2.1

Attached Files

- **Gas Fireplace Efficiency Proposal Support.docx**
  https://energy.cdpaccess.com/proposal/82/872/files/download/192/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: The proposal has been approved as the IECC does not currently address gas fireplace efficiency which may still be used for a significant number of hours per heating season.

REPI-66-21

Proponents: Megan Hayes, representing NEMA (Megan.Hayes@nema.org)

2021 International Energy Conservation Code

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

Revise as follows:

R402.4.6 (N1102.4.6) Air-Sealed Electrical and communication boxes ~~(air-sealed boxes).~~ Air-sealed ~~E~~ electrical and communication boxes ~~installed in~~ that penetrate the *air barrier* of the *building thermal envelope* shall be caulked, taped, gasketed, or otherwise sealed to ~~limit air leakage between conditioned and unconditioned spaces~~ the *air barrier* element being penetrated. Air-sealed ~~Electrical and communication outlet~~ boxes shall be buried in or surrounded by insulation. Air-sealed boxes shall be tested and marked in accordance with NEMA OS 4 ~~, *Requirements for Air-Sealed Boxes for Electrical and Communication Applications*, and shall have an air leakage rate of not greater than 2.0 cubic feet per minute (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Electrical and communication outlet Air-sealed boxes shall be marked "NEMA OS 4" or "OS 4" in accordance with NEMA OS 4. Electrical and communication outlet~~ Air-sealed boxes shall be installed ~~per the~~ in accordance with the manufacturer's instructions ~~and with any supplied components required to achieve compliance with NEMA OS 4.~~

Reason: This editorial revision better aligns the language being used in Table R402.1.1 by clarifying the requirements only apply where air-sealed boxes are selected as permitted by the table and applies to those boxes that penetrate the thermal envelope thus necessitating the need for an air barrier or air-sealed box.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
There is no increase or decrease cost in construction as this proposal simply adds clarify to the original intent of R402.4.6.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The proponent presented a modified version coordinated with REPI 53 that expands the terminology for electrical boxes and simplifies the language pertaining to the use of the referenced standard.

REPI-68-21

Proponents: Elizabeth McCollum, representing on behalf of the California Statewide Utility Codes and Standards Team (iecc-cool-roof@2050partners.com); Mark Lyles, representing New Buildings Institute (markl@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

LOW-SLOPED ROOF. A roof slope less than 2 units vertical in 12 units horizontal (17 percent slope).

STEEP-SLOPED ROOF. A roof slope 2 units vertical in 12 units horizontal (17 percent slope) or greater.

Add new text as follows:

R402.6 Roof reflectance. Roofs in Climate Zones 0 through 3 shall comply with one or more of the options in Table R402.6.

Exceptions:

1. Roofs with a radiant barrier with an emittance of 0.05 or less.
2. Portions of the roof that include or are covered by one or more of the following:
   - 2.1 *On-site renewable energy* systems or components
   - 2.2 Solar air or water heating systems or components
   - 2.3 Vegetative roofs or landscaped roofs
   - 2.4 Above roof decks or walkways
   - 2.5 Skylights
   - 2.6 HVAC systems and components, and other opaque objects mounted above the roof
3. Portions of roof shaded during the peak sun angle of the summer soltice by permanent features of the building or by permanent features of adjacent buildings.
4. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot (74 kg/m^2) or 23 psf (117 kg/m^2) pavers.
5. Roofs where portions exempted by exceptions 2, 3, and 4 make up not less than 75 percent of the total roof area.

TABLE R402.6 (TABLE N1102.6) MINIMUM ROOF REFLECTANCE[a]

Roof Slope	Three-year aged solar reflectance index[b]
Low-slope	75[b,c]
Steep-slope	16

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for solar reflectance shall be assigned a 3-year-aged solar reflectance in accordance with Section R402.6.1

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft 2 × °F (12 W/m 2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

R402.6.1 (N1102.6.1) Aged solar reflectance . Where an aged solar reflectance required by Section R402.6 is not available, it shall be determined in accordance with Equation 4-1.

$R_{aged}=[0.2+0.7(R_{initial}-0.2)]$ **(Equation 4-1)**

where:

R_{aged}=The aged solar reflectance

$R_{initial}$=The initial solar reflectance determined in accordance with CRRC-S100

Revise as follows:

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Roofs	Type: ~~composition shingle on wood sheathing.~~ *Low-sloped*: modified bitumen *Steep-sloped*: asphalt shingles	As proposed
	Gross area: same as proposed.	As proposed
	Low-sloped: (Aged) Solar ~~absorptance~~ reflectance = 0.63~~0.75~~. *Steep-sloped*: (Aged) Solar reflectance = 0.2	As proposed
	Thermal Emittance = ~~0.90~~ 0.75.	As proposed

R407.2 (N1107.2) Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned.
2. The *occupied* space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in *conditioned spaces* has a *solar heat gain coefficient* (SHGC) of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior roof surface complies with one of the options in Table R402.6~~C402.3 of the *International Energy Conservation Code* Commercial Provisions~~ or the roof or ceiling has insulation with an *R-value* of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a slope of not less than $^1/_4$ unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with *exterior walls* facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

R503.1.1 (N1111.1.1) Building envelope. Building envelope assemblies that are part of the *alteration* shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.3, R 402.6 and R402.4.5.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof recover where the new roofing meets the reflectance requirements under R402.6.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.

Add new standard(s) as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

ASTM C1549-2016	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
ASTM E903-2012	Standard Test Method for Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres (Withdrawn 2005)
ASTM E1918-06(2016)	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-sloped Surfaces in the Field
ASTM E1980- 11	Standard Practice for Calculating Solar Reflectance of Horizontal and Low-sloped Opaque Surfaces

CRRC

Cool Roof Rating Council
2435 North Lombard Street
Portland, OR 97217

ANSI/CRRC-S100-2020	Standard Test Methods for Determining Radiative Properties of Materials

Revise as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.6	Roof Reflectance
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: A cool roof is a relatively inexpensive energy conservation measure to passively reduce cooling load in warmer regions. Cool roofs strongly reflect sunlight and efficiently radiate heat away from the roof surface. Cool roofs are generally light colors like white or grey, but also are available in a variety of traditional colors by using cool-colored pigments. Installing a cool roof reduces the conduction of heat into the building, thus reducing the need for air-conditioning in conditioned spaces. Minimizing the need for air conditioning saves energy and money, and the decreased load helps to moderate peak grid demand during heat waves and very hot summer afternoons, thereby reducing the risk of power outages. Decreasing the convection of heat into the building also offers increased occupant comfort in unconditioned buildings.
The reflectance and TE values degrade over time, hence 3-year aged values are used for the performance benchmark referred to as aged solar reflectance (ASR) and TE. For the current IECC Cool Roof proposal, the proposal team defined the code requirements above in terms of SRI, which is a combination of ASR and TE. SRI provides more flexibility in terms of product selection than specifying minimum ASR and TE. The proposed 75 SRI value excludes product selections with unacceptably low ASR or TE. In addition to energy benefits, cool roofs also help reduce air temperature, lowering urban heat island effects and peak electricity demand, reducing the potential for rotational load shedding in extreme weather.

Cool roof is required in IECC 2021 commercial new construction requirements for climate zones 0 to 3 per Section C402.3. The proposed change aligns residential requirements in R402.6 with the commercial new construction requirements in Section C402.3, and extends the requirement to Climate Zones 4 and 5. The proposed cool roof requirements are based on California's 2022 Title 24 residential new construction cool roof requirements. Cool roofs were shown to be cost effective in select warmer California climate zones that are a subset of IECC climate zones 2 and 3. 2022 Title 24, Part 6 requires an aged solar reflectance index (SRI) of 75 in low sloped roof buildings and a SRI of 16 in steep sloped roof buildings. The 2022 Title 24 code expanded the applicability of cool roof requirements in single family alterations to a broader set of CEC climate zones (as compared to 2019 Title 24, Part 6 requirements) based on the 2022 CASE Report (Frontier Energy et. al., 2020).

A wide range of cool roof products are available in the market for both low-sloped and steep-sloped roof applications. There are approximately 3000 roofing products listed with Cool Roof Rating Council (CRRC) and a majority of those are appropriate for both low-sloped and steep-sloped installations. These products include single-ply, fluid applied membrane, asphaltic membrane, and metal coating products and modified bitumen-based products that are commonly used for cool roof installations and are available in a range of colors. The proposal team based the material selection and associated costs on the 2022 Title 24 California Statewide Codes and Standards Enhancement (CASE) Report (Frontier Energy et. al., 2020) conducted in 2020 for single family alterations. The CASE report is the latest reference on cool roof cost available that refers to other external studies (Freedonia group, 2019) (TRC, 2016a) (TRC, 2016b) for both material selection and cost estimates.

Cost Impact: The code change proposal will increase the cost of construction.
Cool roofs reflect higher amounts of incident solar radiation and radiate a higher amount of absorbed heat. This reduces the cooling load and consequently the energy consumed by cooling energy systems, resulting in cooling energy savings. This translates to net building energy savings for buildings in warmer, cooling dominant regions.

The proposal team estimates energy cost savings over the estimated useful life of the roof product that offset incremental measure costs based on analysis conducted by the California Statewide CASE team for the 2022 Title 24, Part 6 update cycle (Frontier Energy et. al., 2020). The analysis estimated 4-66 kWh/yr savings per dwelling unit for existing buildings with steep slope roofs and 25-700 kWh/yr savings per dwelling unit in existing buildings with low sloped roofs. Given the milder climate zones analyzed in California, this estimate is conservative for IECC Climate Zones 0 through 3. The proposal team will provide supporting documentation that includes savings analysis for the proposed IECC climate zones for presentation in IECC committee meetings.The Residential Energy Savings and Process Improvements for Additions and Alterations CASE Report (Frontier Energy et. al., 2020) includes estimated incremental costs for cool roof products meeting the proposed SRI through ASR and TE as shown in Table 1.

Table 1: Incremental Cool Roof Costs from Residential Energy Savings and Process Improvements for Additions and Alterations CASE Report

Roof slope	Baseline	Proposed	Estimated Incremental Cost (per square foot)
Low-sloped	0.1 ASR, 0.85 TE (equivalent SRI 4)	0.63 ASR, 0.75 TE (equivalent SRI 72)	$0.17-$0.84
Steep-sloped	0.1 ASR, 0.85 TE (equivalent SRI 4)	0.2 ASR, 0.75 TE (equivalent SRI 11)	$0.00-$0.55

All CRRC-rated products that meet the minimum aged SRI of 72 have an aged SRI of 75 or greater, so we expect a similar incremental cost for the proposed requirement as listed in Table 1 above. The proposal team will provide supporting documentation that includes evidence of simple payback within the estimated useful life of the roof in advance of IECC committee meetings.

Bibliography: Freedonia group. (2019). *Low Slope Roofing.* Retrieved from https://www.freedoniagroup.com/industry-study/low-slope-roofing-3762.htm
Frontier Energy et. al. (2020). *2022 CASE Report: Residential Energy Savings and Process Improvements for Additions and Alterations.* Retrieved from https://title24stakeholders.com/wp-content/uploads/2020/08/SF-Additions-and-Alterations_Final_-CASE-Report_Statewide-CASE-Team.pdf

TRC. (2016a). *Title 24 Codes and Standards Local Ordinances: Cost-Effectiveness Study for Cool Roof, Final Report for All Climate Zones.*

TRC. (2016b). *City of Palo Alto 2016 Building Energy Efficiency Reach Code Cost Effectiveness Study.*

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: it will increase efficiency and reduce heat island effect in climate zones: 0-3.

REPI-69-21

Proponents: Kimberly Newcomer, representing NBI (kim@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

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

Add new text as follows:

R403.1 (N1103.1) General. Systems serving individual *dwelling units* shall comply with Section R403. Systems serving *common areas or* two or more *dwelling units* shall comply with Sections C403 and C404 of the International Energy Conservation Code – Commercial Provisions instead of Section R403.

Revise as follows:

~~**R403.1**~~ **R403.2 (N1103.2) Controls.** Not less than one thermostat shall be provided for each separate heating and cooling system.

R403.6.1 (N1103.6.1) Heat or energy recovery ventilation. *Dwelling units* shall be provided with a heat recovery or energy recovery ventilation system ~~in Climate Zones 7 and 8~~. The system shall be balanced with a minimum sensible heat recovery efficiency of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.

Exceptions:

1. Dwelling units in single and two-family buildings in Climate Zones 0-6.
2. Dwelling units in Group-R occupancies that comply with Section C403.7.4.1.

Delete without substitution:

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

Add new text as follows:

R404.2 (N1104.2) Interior lighting controls.. Lighting serving individual *dwelling units* shall comply with Section R404.2.1. Lighting serving *common areas* shall comply with Sections C405.2 of the International Energy Conservation Code – Commercial Provisions instead of Section R404.2.1.

Revise as follows:

~~**R404.2**~~ **R404.2.1 (N1104.2.1)** ~~**Interior lighting controls**~~ **Controls for individual dwelling units.** Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture. **Exception:** Lighting controls shall not be required for the following:

1. Bathrooms.
2. Hallways.
3. ~~Exterior lighting fixtures.~~
4. Lighting designed for safety or security.

Add new text as follows:

R404.3 (N1104.3) Exterior lighting controls. Exterior lighting controlled from within individual *dwelling units* shall comply with Section R404.3.1. Controls for all other exterior lighting shall comply with Sections C405.2.7 of the International Energy Conservation Code – Commercial Provisions instead of Section R404.3.1.

Revise as follows:

~~**R404.3**~~ **R404.3.1 (N1104.3.1)** ~~**Exterior lighting controls**~~ **Controls for individual dwelling units.** Where the total permanently installed exterior lighting power is greater than 30 watts, the permanently installed exterior lighting shall comply with the following:

1. Lighting shall be controlled by a manual on and off switch which permits automatic shut-off actions.

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

2. Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs.

3. Controls that override automatic shut-off actions shall not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours.

Add new text as follows:

R404.4 (N1104.4) Electrical Power Systems. Group R occupancies shall comply with Sections C405.6 through C405.12.

Reason: This combination of proposals seeks to align the requirements of multifamily dwelling units across the two sides of the code. Currently there are large discrepancies in terms of system design, control and stringency between a 3-story MF building and a 4-story MF building. This leads to market confusion, enforcement inconsistencies, and large potential untapped energy savings. This revision and its companion seek to close these gaps and create a common set of requirements for multifamily buildings.
The 2022 version of Title 24 has created a new section to regulate MF buildings - similar to a more "omnibus" proposal submitted by NBI previously. Based on feedback from that submission to not create a new section, this proposal instead works to align the sections that currently exist.

Cost Impact: The code change proposal will increase the cost of construction.
Low-rise multifamily buildings will see an increase in first cost. Since these same provisions have been deemed to be acceptable for cost effectiveness for 4 story MF buildings, the same should apply to 3 story buildings.

Bibliography: https://newbuildings.org/resource/multifamily-building-guide/
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: per proponents reason statement

Proposal # 290

REPI-70-21

Proponents: Jeremy Williams, representing U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Add new definition as follows:

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

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

Revise as follows:

R403.1 Controls. Not less than one thermostat shall be provided for each separate heating and cooling system. The primary heating or cooling system serving the *dwelling unit* shall comply with Sections R403.1.1 and R403.1.2.

R403.1.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system of the *dwelling unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day and different days of the week. This thermostat shall include the capability to set back or temporarily operate the system to maintain *zone* temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

Add new text as follows:

R403.1.2 Demand responsive thermostat. The thermostat shall be provided with a *demand responsive control* capable of communicating with the Virtual End Node (VEN) using a wired or wireless bi-directional communication pathway that provides the homeowner the ability to voluntarily participate in utility demand response programs, where available. The thermostat shall be capable of executing the following actions in response to a *demand response signal*:

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

Thermostats controlling single stage HVAC systems shall comply with Section R403.1.2.1. Thermostats controlling variable capacity systems shall comply with Section R403.1.2.2. Thermostats controlling multi-stage HVAC systems shall comply with either Section R403.1.2.1 or R403.1.2.2. Where a *demand response signal* is not available the thermostat shall be capable of performing all other functions.

Exception: Assisted living facilities.

R403.1.2.1 Single stage HVAC system controls. Thermostats controlling single stage HVAC systems shall be provided with a *demand responsive control* that complies with one of the following:

1. Certified OpenADR 2.0a VEN, as specified under Clause 11, Conformance
2. Certified OpenADR 2.0b VEN, as specified under Clause 11, Conformance
3. Certified by the manufacturer as being capable of responding to a *demand response signal* from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls
4. IEC 62746-10-1
5. The communication protocol required by a controlling entity, such as a utility or service provider, to participate in an automated demand response program
6. The physical configuration and communication protocol of CTA 2045-A or CTA-2045-B

R403.1.2.2 Variable capacity and two stage HVAC system controls. Thermostats controlling variable capacity and two stage HVAC systems shall be provided with a *demand responsive control* that complies with the communication and performance requirements of AHRI 1380.

Revise as follows:

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

1. Not more than one-half of the *occupied* space is air conditioned and is controlled by a thermostat in accordance with Sections R403.1.1 and R403.1.2.
2. The *occupied* space is not heated.

3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in *conditioned spaces* has a *solar heat gain coefficient* (SHGC) of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior roof surface complies with one of the options in Table C402.3 of the *International Energy Conservation Code*–Commercial Provisionsor the roof or ceiling has insulation with an *R-value* of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a slope of not less than $^1/_4$ unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with *exterior walls* facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

Add new standard(s) as follows:

CTA

Consumer Technology Association Technology & Standards Department
1919 S Eads Street
Arlington
, VA 22202

CTA Consumer Technology Association Technology & Standards Department. ANSI/CTA-2045-B – 2018: Modular Communications Interface for Energy Management

IEC

IEC Regional Centre for North America
446 Main Street 16th Floor
Worcester, MA 01608

IEC IEC Regional Centre for North America. IEC 62746-10-1 - 2018: Systems interface between customer energy management system and the power management system - Part 10-1: Open automated demand response

OpenADR

OpenADR Alliance
111 Deerwood Road, Suite 200
San Ramon, CA 94583

OpenADR OpenADR Alliance. OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

AHRI 1380-2019	Demand Response through Variable Capacity HVAC Systems in Residential and Small Commercial Applications

Add new text as follows:

CTA Consumer Technology Association Technology & Standards Department ANSI/CTA-2045-A – 2018:. Modular Communications Interface for Energy Management

Reason: As buildings account for over 70% of U.S. electricity use, effectively managing their loads can greatly facilitate the transition towards a clean, reliable grid. Grid-interactive efficient buildings (GEBs) combine efficiency and demand flexibility with smart technologies and communication to provide occupant comfort and productivity while serving the grid as a distributed energy resource (DER). In turn, GEBs can play a key role in ensuring access to an affordable, reliable, sustainable and modern U.S. electric power system. Their national adoption could provide $100-200 billion in U.S. electric power system cost savings over the next two decades. The associated reduction in CO_2 emissions is estimated at 6% per year by 2030.[1]
Building codes represent standard design practice in the construction industry and continually evolve to include advanced technologies and innovative practices. Historically, national model energy codes establish minimum efficiency requirements for new construction.[2] Expanding codes to support GEB capabilities is a pivotal step towards realizing demand flexibility in support of a clean grid by addressing capabilities to improve interoperability between smart building systems, the grid, and renewable energy resources. Realizing GEBs requires buildings with automated demand response (DR) capabilities that enable standardized control, subject to explicit consumer consent, of energy smart appliances on an electricity network. This is achieved through communication between appliances and a controlling entity that is in communication with the consumer

participants.

Energy codes can support DR communication standardization and advance the deployment of flexible load technologies such as smart home energy management systems, energy storage, behind-the-meter generation, and electric vehicles (EVs). Incorporating automated demand response capabilities in energy codes provides many benefits to consumers and society. Specifically, it matches intermittent renewable energy sources to building electric loads, decreases peak load on the electric grid, allows buildings to respond to utility price signals, supports electrical n etwork reliability and market growth of products and processes aligned with clean economic growth.

The incorporation of DR into the model residential energy codes was considered for the 2021 International Energy Conservation Code (IECC) code development cycle. The scope of this proposal includes two strategies for DR in residential buildings: 1) smart thermostats with demand-responsive control and 2) electric water heating incorporating demand-responsive controls and communication.

[1] DOE (U.S. Department of Energy). 2021. *A National Roadmap for Grid-Interactive Efficient Buildings*. Washington DC. Accessed on June 9, 2021 at https://gebroadmap.lbl.gov/

[2] While advanced codes can be considered model codes, in this document, the term "model energy code" refers to the current published version of the International Energy Conservation Code-Residential and ASHRAE Standard 90.1, as those documents are referenced by Energy Conservation and Production Act as modified by the Energy Policy Act of 1992 as the minimum requirements for states adopting energy codes. https://www.govinfo.gov/content/pkg/USCODE-2011-title42/pdf/USCODE-2011-title42-chap81-subchapII.pdf.

[3] https://www.iccsafe.org/building-safety-journal/bsj-technical/code-development-a-process-of-evolution-and-improvement/

Cost Impact: The code change proposal will increase the cost of construction.
The costs associated with installing residential DR control strategies highlighted in this technical brief are discussed below. The installed costs for smart thermostats and electric water heaters with DR control are modest and depend on the design of the home.

The cost of a standard programmable thermostat required in the 2021 IECC ranges from $20 to $100 based on costs at local home improvement stores. A smart thermostat can range from $120 to $400 based on brand, model, and level of sophistication. The cost to install a programmable or smart thermostat ranges from $112 to $255, with the national average cost of $175. Thus, the incremental cost of upgrading from a standard programmable thermostat to a smart thermostat with DR controls is anywhere between $100 and $300.

Electric resistance water heaters supplied with CTA-2045 communication have been manufactured but are not widely available. HPWHs have taken over the energy efficiency segment of the water heater market, and brands at local home improvement stores include the CTA-2045 communication ports. The average cost for a 50-gallon electric resistance heater is $400, while the average cost for a 50-gallon HPWH is $1,300 at local home improvement stores (Salcido et al. 2021). The incremental cost of $900 plus additional condensate removal equipment of $75 results in a total cost differential of $975. Therefore, for buildings already including HPWHs in the original design, the incremental increase in cost is $0. If the building specified an electric resistance water heater, the most straightforward way to implement the CTA-2045 communication for DR control is to switch to an HPWH with an incremental cost of $975.

While DR control functionality will reduce costs to utilities as well as electric costs to consumers, it is difficult to estimate or calculate the actual cost savings. DR will present cost-saving opportunities for buildings as more homeowners take advantage of time-of-use or real-time pricing controls as they become more widely available. Adding DR controls in model energy codes can help homeowners have the capability of participating in DR programs with alternative utility pricing structures whether they exist now or in the future. When DR requirements are part of the model energy code, it will not require homeowners or buildings to participate in any DR programs but will guarantee that residential buildings are capable of participating in DR programs

Bibliography: Salcido V, Y Chen, B Taube, E Franconi, and M Rosenberg. 2021. *Demand Response in Residential Energy Code.* Pacific Northwest National Laboratory, Richland, Washington. PNNL-31994

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Requiring thermostats to be demand response control capable enables homeowners to opt into utility demand response program, which can help save the homeowner money and improve grid resilience.

REPI-73-21

Proponents: Ryohei Hinokuma, Daikin U.S. Corporation, representing Daikin U.S. Corporation (ryohei.hinokuma@daikinus.com)

2021 International Energy Conservation Code

Revise as follows:

R403.1.2 Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric-resistance heat shall have controls that~~,~~ ~~except during defrost,~~ are configured to prevent supplemental heat operation when the capacity of the heat pump compressor can meet the heating load. Limit supplemental heat operation to only those times when one of the following applies:

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

Reason: The use of electric resistance heaters as backup heating devices can significantly increase winter energy consumption, and air source heat pumps can effectively provide heating without such devices including the cold climate regions in the United States. Also, Daikin has observed that it's common for heat pumps to be installed with electric resistance heaters configured to operate in conditions where sufficient heating capacity is available from the heat pump alone. This results in reducing the operation hours of heat pumps and increasing the operation hours of electric-resistance heaters. Such setting of heat pump systems will fail to yield expected reduction of GHG emissions and result in higher energy consumption and longer peak demand events. Therefore, Daikin proposes to revise R403.1.2, which defines the use of electric resistance heaters as supplementary heat for heat pumps, to prevent such practice.
See attached letter for more background information justifying this modification.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Requiring the use of the switchover temperature controls will not increase nor decrease the cost of construction - however, it will result in energy savings and lower utilities costs for the end -user.

Attached Files

- **2021.10.12_Daikin Comments - 2024 IECC_Final.pdf**
  https://energy.cdpaccess.com/proposal/530/1202/files/download/206/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Proposal defines the use of electric resistance heaters as supplementary heat for heat pumps.

REPI-74-21

Proponents: Nicholas O'Neil, representing NEEA (noneil@energy350.com); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

PILOT LIGHT, CONTINUOUSLY BURNING. A small gas flame used to ignite gas at a larger burner. Once lit, a continuously pilot light remains in operation until manually interrupted. Pilot light ignition systems with the ability to switch between intermittent and continuous mode are considered continuous.

PILOT LIGHT, INTERMITTENT. A pilot which is automatically ignited when an appliance is called on to operate and which remains continuously ignited during each period of main burner operation. The pilot is automatically extinguished when each main burner operating cycle is completed.

PILOT LIGHT, INTERRUPTED. A pilot which is automatically ignited prior to the admission of fuel to the main burner and which is automatically extinguished after the main flame is established.

PILOT LIGHT, ON-DEMAND. A pilot which, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve.

Add new text as follows:

R403.1.3 Continuously Burning Pilot Light. Gas fireplace systems are not permitted to be equipped with a *continuously burning pilot light.*

Exception: Any fireplace equipped with an *on-demand*, *intermittent* or *interrupted ignition pilot light* (as defined in ASNI Z21.20) is not considered to have a *continuously burning pilot light.*

Add new standard(s) as follows:

ANSI

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

ANSI Z21.20-2005 (R2016)	Automatic Gas Ignition Systems And Components	R403.1.3

Reason: Standing pilot lights are no longer necessary with many gas-fired appliances offering alternative ignition methods. Some models rely completely on intermittent ignition, while others allow standing pilots to operate for a few hours after shutdown and then use electronic ignition to re-start. This proposal saves energy by eliminating the wasted energy of a pilot light during the numerous hours per year when the appliance is non-operational.
With an average heat output of 946 btu/h for a continuously burning pilot light, analysis has shown an energy savings of 28 therms/yr if switching from a continuous pilot light to an intermittent pilot light. This is based on studies that looked at average fireplace use over the course of the year of 3,700 hours. Meaning, homeowners who use their fireplace less than this can stand to save more as the pilot light wastes energy as it sits idle.

Furthermore, the The Hearth, Patio & Barbecue Association (HPBA), based just outside of Washington, DC, is the North American industry association for manufacturers, retailers, distributors, representatives, service firms, and allied associates for all types of fireplace, stove, heater, barbecue, and outdoor living appliances and accessories. They also agree the continuous pilot lights are not necessary as the technology has moved on to intermittent or on-demand pilot lights that can accommodate various climates and user preferences. The HPBA shares the same position to discontinue the use of continuous pilots as demonstrated by their policy statement available on their website, as follows:Position Statement: New technologies now exist that can more adequately replace continuous pilots, which provided an important safety feature, but have required consumers to manually extinguish the pilot on their gas appliances. A phasing out of continuous pilots saves homeowners money and achieves energy conservation when appliances are not in frequent use.

https://energy.cdpaccess.com/proposal/81/871/files/download/188/

Cost Impact: The code change proposal will increase the cost of construction.
This prohibition is not expected to add significant cost to any gas-fired appliance listed in the proposal. Past efficiency studies have shown $100 increase in price for fireplaces in particular to move from a standard continuously lit pilot light to an intermittent ignition system.

Attached Files

- **Pilot light prohibition proposal support.docx**
  https://energy.cdpaccess.com/proposal/81/871/files/download/188/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: This proposal saves energy by eliminating the wasted energy of a pilot light during the numerous hours per year when the appliance is non-operational.

Proposal # 81

REPI-78-21

Proponents: David Springer, representing on behalf of the California Statewide Utility Codes and Standards Team (iecc-ducts2@2050partners.com); Mark Lyles, representing New Buildings Institute (markl@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

THERMAL DISTRIBUTION EFFICIENCY (TDE). The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct.

Add new definition as follows:

DISTRIBUTION SYSTEM EFFICIENCY (DSE). A system efficiency factor that adjusts for the energy losses associated with delivery of energy from the equipment to the source of the load.

Revise as follows:

R403.3.1 Ducts located outside conditioned space. Supply and return ducts located outside *conditioned space* shall be insulated to an *R*-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Ducts buried beneath a building shall be insulated as required per this section or have an equivalent *thermal distribution efficiency*. Underground ducts utilizing the *thermal distribution efficiency* method shall be listed and *labeled* to indicate the *R*-value equivalency.

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermal distribution systems	Duct insulation: in accordance with Section R403.3.1. A 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. Duct location: same as proposed design. **Exception:** For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floorarea* at a pressure of differential of 0.1 inch w.g. (25 Pa).	Duct location: as proposed. Duct insulation: as proposed. As tested or, where not tested, as specified in Table R405.4.2(2).

Reason: Thermal Distribution System Efficiency (TDSE) defined in Section R202 is inconsistent with the term (DSE) used in Table R405.4.2(1). The change to Distribution System Efficiency (DSE) is to provide consistency. This definition is from the ASHRAE Standard 152, a consensus standard titled “Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems.”

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not increase the cost of construction.

Bibliography: *ANSI/ASHRAE Standard 152-2014: Method Of Test For Determining The Design And Seasonal Efficiencies Of Residential Thermal Distribution Systems*, ASHRAE, https://webstore.ansi.org/standards/ashrae/ansiashraestandard1522014.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The original proponents of having TDE in the IECC reached out to the WG to explain the reason why the term was added to the code. Underground ducts are tested in accordance with NSF P374. The term, thermal distribution efficiency (TDE), comes from this testing protocol. Underground ducts are listed in accordance with ICC ES LC1014, which also refers to NSF P374. While neither of these are ANSI standards, they are the only methods currently available for testing, listing and labeling underground ducts. There are several manufacturers of underground ducts that certify to these methods. To be consistent and to facilitate enforcement, thermal distribution efficiency (TDE) needs to remain in the IECC. Separately, the WG learned that ANSI/RESNET/IECC Standard 301 has a different, but similar definition for DSE. Since Standard 301 is already referenced in the IECC, it makes sense to use this definition. DSE is used in Table R405.4.2(1).

REPI-79-21

Proponents: Craig Conner, representing self (craig.conner@mac.com); Joseph Lstiburek, representing Building Science Corporation (joe@buildingscience.com)

2021 International Energy Conservation Code

Revise as follows:

R403.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space,* it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in ventilated attic spaces or unvented attic with vapor diffusion port shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall 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 R403.3.6, 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.

3. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:

    3.1. A *continuous air barrier* installed between unconditioned space and the duct.

    3.2. Insulation installed in accordance with Section R402.2.7.

    3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.

4. Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following:

    4.1. A *continuous air barrier* installed between unconditioned space and the duct.

    4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.

    4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

Reason: Research done by the Department of Energy through the Building America Program shows that sealed attics with vapor diffusion ports significantly reduce the risk of condensation on ductwork. The existing IRC language allows sealed attics with vapor diffusion ports. This language makes it clear that the buried duct language for vented attics also applies to sealed attics with vapor diffusion ports.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This allows another option. It does not add costs.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: improved language with modification to replace the term sealed with unvented to correlate with I codes

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REPI-80-21

Proponents: Vladimir Kochkin, NAHB, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3.2 Ducts located in conditioned space. For ductwork to be considered inside a *conditioned space,* it shall comply with one of the following:

1. The duct system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in ventilated attic spaces shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall 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 R403.3.6, 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.

3. ~~Ductwork in floor cavities located over unconditioned space shall comply with all of the following:~~ Ductwork located in wall or floor building assemblies separating unconditioned from conditioned space shall comply with the following:

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

   3.2. ~~Insulation installed in accordance with Section R402.2.7.~~ Ducts shall be installed in accordance with Section R403.3.1.

      Exception: Where the building assembly cavities containing *ducts* have been air sealed in accordance with Section R402.4.1, *duct* insulation is not required.

   3.3. ~~A minimum R-19R-10 insulation installed in the cavity width separating the duct from unconditioned space.~~ Not less than R-10 insulation, and not less than 50 percent of the required R-value specified in Table R402.1.3, shall be located between the *duct* and the *unconditioned space*.

   3.4 For *ducts* in these building assemblies to be considered within *conditioned space*, the air handling equipment shall be installed within *conditioned space*.

4. ~~Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following:~~

   ~~4.1. A *continuous air barrier* installed between unconditioned space and the duct.~~

   ~~4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.~~

   ~~4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.~~

Reason: The provision for R19 insulation was added in the 2021 IECC without justification. Apparently, the requirement was copied from a drawing intended for CZ 3 applications where R-19 floor insulation is a requirement. There is no basis for having a separate requirement for insulation at duct locations in floor cavities that is more restrictive than the floor insulation R-value requirement (CZ 0, 1, 2 require R13 floor insulation). Furthermore, duct insulation requirement for ducts in unconditioned space is R6 or R8 depending on the duct diameter. The proposed modification aligns the requirement for ducts in floors with a similar requirement for ducts in exterior walls where ducts must be separated by R-10 (see R403.3.2(4) of 2021 IECC). It is noted that floor insulation installation is always required to be in compliance with Section R402.2.7 and the floor is required to include an air barrier between unconditioned space and the duct.

There are no energy use implications associated with this change. The R19 requirement can add cost for constructing a bulkhead to accommodate the added insulation in the floor.

Cost Impact: The code change proposal will decrease the cost of construction.
In certain floor assembly configurations in Climate Zones 0, 1, and 2, this change will reduce costs by avoiding the need for bulkhead construction.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The original proposal to revise the minimum insulation value for 3.3 was accepted, and further modified to combine Items 3 and 4 as a single Item 3.

Proposal # 238

REPI-82-21

Proponents: Craig Conner, representing self (craig.conner@mac.com); Joseph Lstiburek, representing Building Science Corporation (joe@buildingscience.com)

2021 International Energy Conservation Code

Revise as follows:

R403.3.3 (N1103.3.3) 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 shall have an insulation *R*-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the *R*-value of the duct insulation.
3. In Climate Zones 0A, 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable.

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

4. In Climate Zones 0A, 1A, 2A and 3A when installed in an unvented attic with vapor diffusion port, the supply ducts shall be completely buried within ceiling insulation, insulated to an R-value of not less than R-8 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable..

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

   4.1. Air permeable insulation installed in unvented attics shall be in compliance with the requirements of Section R806.5.2 of the International Residential Code.

Reason: Additional research done by the Department of Energy through the Building America Program has shown that Climate Zone 3A should not have been included in this section. Some condensation has been noted in some instances in Climate Zone 3A. However, with a sealed attic with vapor diffusion ports the issue of condensation is resolved. The additional language in 4. Makes it clear that this also applies to Climate Zones 0A, 1A, 2A and 3A.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is a correction to the code. It will not increase costs.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Proposal modified to Restore 3A in item 3 and add item 4 also provide further modification to replace the term sealed with unvented to align with I codes. Discussion on removing partially or completely will be done under separate proposal.

REPI-83-21

Proponents: Craig Conner, representing self (craig.conner@mac.com); Joseph Lstiburek, representing Building Science Corporation (joe@buildingscience.com)

2021 International Energy Conservation Code

Revise as follows:

R403.3.3.1 (N1103.3.3.1) Effective R-value of deeply buried ducts. Where using the Total Building Performance Compliance Option in accordance with Section R401.2.2 , sections of ducts that are installed in accordance with Section R403.3.3~~, located directly on or within 5.5 inches (140 mm) of the ceiling,~~ surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

Reason: There are many cases with stick framed attics where 2x10 and 2x12 framing is used and ducts may be laying over framing that is higher than 5.5 inches of the ceiling. The remaining language is sufficient as it addresses R403.3.3 language for installation, states the ducts must be surrounded with insulation and can't have less than 3.5" of insulation above the duct. If that duct is higher than 5.5" from the ceiling, there will be no negative temperature or condensation impact.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This clarifies the effective R-value of deeply buried ducts. It does not add costs.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: provides clarification for requirements

Proposal # 553

REPI-85-21

Proponents: Aaron Gary, representing Seft (aaron.gary@texenergy.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3.5 Duct testing. Each ~~D~~ duct~~s~~ system shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. 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.

A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*.

Exceptions: ~~A duct air-leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.~~

1. A duct air-leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.
2. Where tested in accordance with R403.3.7 testing of each duct system is not required.

R403.3.6 Duct leakage . The total leakage of the ducts, where measured in accordance with Section R403.3.5, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area* where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3.0 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 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.
3. Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the *building thermal envelope*, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.

Add new text as follows:

R403.3.7 Dwelling unit sampling. For buildings with eight or more *dwelling units* the *duct systems* in the greater of seven, or 20 percent of the *dwelling units* in the building shall be tested, including a top floor unit, a ground floor unit, a middle floor unit, and the unit with the largest *conditioned floor area*. Where buildings have fewer than eight *dwelling units*, the *duct systems*-in each unit-shall be tested. Where the leakage rate of a *duct system* is greater than the maximum permitted leakage rate, corrective actions shall be made to the system and the system retested until it passes. For each tested *dwelling unit* that has a greater duct leakage rate than the maximum permitted leakage rate, an additional three *dwelling units*, including the corrected unit, shall be test.

Revise as follows:

R403.3.8 ~~R303.3.7~~ Building cavities. *Building* framing cavities shall not be used as ducts or plenums.

Reason: The concept of using a sample of tested apartment units to demonstrate compliance for the whole of the multifamily apartment building was approved as part of the Commercial provisions of the 2021 IECC. This proposals applies that previously approved concept to multifamily apartment buildings that fall under the Residential provisions of the IECC. It also slightly updates the sampling method specified in the Commercial provisions of the 2021 IECC to better align with the updated RESNET multifamily sampling guidelines.

Cost Impact: The code change proposal will decrease the cost of construction.
For multifamily projects that are built and test well, sampling provisions such as those approved in the Commercial provisions of the 2021 IECC will reduce the cost and time required for testing and verification. Projects that do not meet their testing thresholds will understandably be tested as a higher rate, potentially test each, until they too are meeting the required standards consistently and as such will may not see a reduction in testing and verification costs or timelines.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: to provide guidance on sampling for testing.

Proposal # 521

REPI-86-21

Proponents: David Springer, representing on behalf of the California Statewide Utility Codes and Standards Team (iecc-ducts2@2050partners.com); Mark Lyles, representing New Buildings Institute (markl@newbuildings.org); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R403.3.6 Duct system leakage. ~~The total leakage of the ducts, where measured in accordance with Section R403.3.5, shall be as follows:~~ The total measured duct sytem leakage shall not be greater than the values in Table R403.3.6. For buildings complying with Section R405 or R406, where duct system leakage to outside is tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554, the leakage to outside value shall not be used for compliance with this section, but shall be permitted to be used in the calculation procedures of Section R405 and R406.

1. ~~Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 85 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 3.0 2.0 cubic feet per minute (85 57 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 4.03.0 cubic feet per minute (113.3 85 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.~~
3. ~~Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the *building thermal envelope*, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of *conditioned floor area*.~~

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3~~, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6~~	Duct~~s~~ Systems
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

R403.3 Duct~~s~~ systems. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7.

R403.3.5 Duct system testing. Each d~~D~~uct~~s~~ system shall be ~~pressure~~ tested for air leakage in accordance with ANSI/RESNET/ICC 380 or ASTM E1554~~ to determine air leakage by one of the following methods:~~ . Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system. Registers shall be sealed during the test. A written report of the test results shall be signed by the party conducting the test and provided to the *code official. Duct system* leakage testing at either rough-in or post-construction shall be permitted.

~~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. 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.~~

~~A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official.*~~

Exception:

~~A duct air leakage t~~ Test ing shall not be required for *duct~~s~~ sytems* serving ventilation systems that are not integrated with *duct~~s~~ systems* servi

Add new text as follows:

TABLE R403.3.6 MAXIMUM TOTAL DUCT SYSTEM LEAKAGE

-	Rough In	Post Construction
Duct systems serving more than 1,000ft2 of conditioned floor area	cfm/100 ft^2 (LPM/9.29 m^2)	cfm/100 ft^2 (LPM/9.29 m^2)
Air handler is not installed	3 (85)	NA
Air handler is installed	4 (113.3)	4 (113.3)
Duct systems located in conditioned space, with air handler installed	8 (226.6)	8 (226.6)
Duct systems serving less than or equal to 1,000 ft^2 of conditioned floor area	**cfm (LPM)**	**cfm (LPM)**
Air handler is not installed	30 (849.5)	NA
Air handler is installed	40 (1132.7)	40 (1132.7)
Duct systems located in conditioned space, with air handler installed	80 (2265.4)	80 (2265.4)

Revise as follows:

TABLE R405.4.2(1) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass where the proposed wall is a mass wall; otherwise wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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: as specified in Table R402.1.2 , with the insulation layer on the interior side of the walls.	As proposed
Above-grade floors	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	As proposed
Ceilings	Type: wood frame.	As proposed
	Gross area: same as proposed.	As proposed
	U-factor: as specified in Table R402.1.2.	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 an aperture of 1 ft^2 per 300 ft^2 of 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 as specified in Table R402.1.2 .	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 R402.1.2.	As proposed
	SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.	As proposed
	Interior shade fraction: 0.92 – (0.21 × SHGC for the standard reference design).	Interior shade fraction: 0.92 – (0.21 × SHGC as proposed)
	External shading: none	As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than 0.01 × *CFA* + 7.5 × (N_{br} + 1)	

<table>
<tr><td>rate</td><td>+ 1)
where:</td><td>The mechanical ventilation rate[b] shall be in addition to the air leakage rate and shall be as proposed.</td></tr>
<tr><td>BUILDING COMPONENT</td><td>STANDARD REFERENCE DESIGN</td><td>PROPOSED DESIGN</td></tr>
<tr><td></td><td>CFA = conditioned floor area, ft^2.
N_{br} = number of bedrooms.
The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.</td><td></td></tr>
<tr><td>Mechanical ventilation</td><td>Where mechanical ventilation is not specified in the proposed design: None
Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal $(1/e_f) \times [0.0876 \times CFA + 65.7 \times (N_{br}+1)]$
where:
e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of $0.01 \times CFA + 7.5 \times (N_{br}+1)$
CFA = conditioned floor area, ft^2.
N_{br} = number of bedrooms.</td><td>As proposed</td></tr>
<tr><td>Internal gains</td><td>IGain, in units of Btu/day per dwelling unit, shall equal $17{,}900 + 23.8 \times CFA + 4{,}104 \times N_{br}$
where:
CFA = conditioned floor area, ft^2.
N_{br} = number of bedrooms.</td><td>Same as standard reference design.</td></tr>
<tr><td>Internal mass</td><td>Internal mass for furniture and contents: 8 pounds per square foot of floor area.</td><td>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.</td></tr>
<tr><td rowspan="3">Structural mass</td><td>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.</td><td>As proposed</td></tr>
<tr><td>For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.3, located on the interior side of the walls.</td><td>As proposed</td></tr>
<tr><td>For other walls, ceilings, floors, and interior walls: wood frame construction.</td><td>As proposed</td></tr>
<tr><td>Heating systems[d, e]</td><td>For other than electric heating without a heat pump: as proposed.
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.</td><td>As proposed</td></tr>
<tr><td>Cooling systems[d, f]</td><td>As proposed.
Capacity: sized in accordance with Section R403.7.</td><td>As proposed</td></tr>
<tr><td>Service water heating[d, g]</td><td>As proposed.
Use, in units of gal/day = $25.5 + (8.5 \times N_{br})$
where: N_{br} = number of bedrooms.</td><td>As proposed
Use, in units of gal/day = $25.5 + (8.5 \times N_{br}) \times (1 - HWDS)$
where:
N_{br} = number of bedrooms.
$HWDS$ = factor for the compactness of the hot water distribution system.
<table><tr><th colspan="2">Compactness ratio[i] factor</th><th>HWDS</th></tr><tr><td>1 story</td><td>2 or more stories</td><td></td></tr><tr><td>> 60%</td><td>> 30%</td><td>0</td></tr><tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr><tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr><tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr></table></td></tr>
<tr><td rowspan="3"></td><td>Duct insulation: in accordance with Section R403.3.1.</td><td>Duct insulation: as proposed.</td></tr>
<tr><td><u>Duct location: same as proposed</u></td><td>Duct location: as proposed.</td></tr>
<tr><td><u>Duct system leakage to outside: For duct systems serving≤ 1,000 ft^2 of conditioned floor area, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).</u></td><td><u>Duct system leakage to outside: The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.</u>

<u>Exceptions:</u></td></tr>
</table>

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Thermal distribution systems	For *duct systems* serving ~~1,000 ft² of conditioned floor area~~, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100ft2 (9.29 m^2) of *conditioned floor area*. Distribution System Efficiency (DSE): For hydronic systems and ductless sytems, a ~~A~~ 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~~. ~~Duct location: same as proposed design.~~ ~~**Exception:** For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floorarea* at a pressure of differential of 0.1 inch w.g. (25 Pa).~~	1. Where duct system leakage to outside is tested in accordance ANSI/ RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. Where total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area. Distribution System Efficiency (DSE): For hydronic systems and ductless systems as specified in Table R405.4.2(2). ~~Duct location: as proposed.~~ ~~Duct insulation: as proposed.~~ ~~As tested or, where not tested, as specified in Table R405.4.2(2).~~
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F.	Same as standard reference design.
Dehumidistat	Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None. Where the proposed design utilizes a mechanical ventilation system with latent heat recovery: Dehumidistat type: manual, setpoint = 60% relative humidity. Dehumidifier: whole-dwelling with integrated energy factor = 1.77 liters/kWh.	Same as standard reference design.

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, °C = (°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 that is 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 shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall 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 having 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 having 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 having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having 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 for 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 × 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.

. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

. 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.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multifamily buildings with central water heating systems, circulation loops or electric heat traced pipes.
2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.
3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.
4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the compactness ratio.
5. The basement or attic shall be counted as a story when it contains the water heater.
6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and *HWDS* factor.

TABLE R405.4.2(2) DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	~~—~~ NA	0.95
~~Untested d~~ Distribution system~~s~~ components entirely located in conditioned space[c]	~~0.88~~ NA	1
"Ductless"~~ systems~~[d]	1	~~—~~ NA

a. Default values in this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in conditioned space shall mean that no component of the distribution system~~, including the air-handler unit,~~ is located outside of the conditioned space.

d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air-handler enclosure.

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3~~ except Sections R403.3.2, R403.3.3 and R403.3.6~~	Duct~~s~~ systems
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: IECC Section R403.3.6 limits total leakage to 4.0 cfm per 100 ft^2 of conditioned space for ducts outside the thermal envelope and 8.0 cfm per 100 ft^2 for ducts inside the thermal envelope. The proposed change would reduce allowable duct leakage from 4 to 3 cfm per 100 square feet of conditioned floor area if an air handler is installed, and from 3 to 2 cfm per 100 square feet if no air handler is installed at the time of testing. IECC Table R405.2 is poorly written making it unclear whether Section R403.3.6 is excluded from Total Building Performance requirements. This amendment clarifies this requirement.

When ducts are located in unconditioned space, return duct leakage effectively draws air from attic spaces or outdoors, increasing heating and cooling load. Supply duct leakage creates a pressure deficit which increases infiltration and heating and cooling load, and reduces system capacity, resulting in longer run times.

Proper practices of duct sealing include use of UL 181, UL 181A, and UL 181B approved pressure sensitive tapes and mastic to seal sheet metal seams and joints and flex duct connections to collars and boots in accordance with ANSI/SMACNA-006-2006. In addition to sealing, drawbands or clamps should be used to secure flexible duct connections.

The proposed leakage rate is readily achievable and has been demonstrated by California Title 24 compliance experience. Since the 2005 version of Title 24 was implemented, residential ducts have been required to be verified by HERS raters to have leakage rates at 25 Pa pressurization of no greater than 6 percent of total fan flow (as measured or using a 400 cfm per ton default). Test results are required to be recorded in HERS registries. The 2019 Title 24 standards reduced the maximum leakage rate to 5 percent of fan flow. Relating Title 24 leakage requirements to the IECC requirements, for an 1800 square foot home with a two-ton air conditioner, the maximum leakage rate at 5 percent is 40 cfm, or 2.2 cfm per 100 square feet, which is 27% more stringent than this proposal.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Based on field studies and computer simulations completed in a hot-dry climate, the proposed code change would result in annual site energy savings of approximately 2% depending on fuel source. Savings are highly dependent on heating and cooling system operating hours, climates, and duct leakage impacts on infiltration.

If industry standard practices for duct installation are followed there should be no additional cost for duct sealing to achieve the proposed leakage rate.

Bibliography: 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. California Title 24, Part 6. https://www.energy.ca.gov/publications/2008/2019-building-energy-efficiency-standards-residential-and-nonresidential
Hoeschele, M., R. Chitwood, et al. 2015. “High Performance Ducts in Hot-Dry Climates”. Department of Energy Building America report. https://www.nrel.gov/docs/fy15osti/64366.pdf

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides clarity to existing language and removes redundant language. Also provides a table to better identify requirements.

REPI-87-21

Proponents: Howard Ahern, representing Airex Manufacturing (howard.ahern@airexmfg.com)

2021 International Energy Conservation Code

Revise as follows:

R403.4.1 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, ~~equipment maintenance~~ physical damage, and wind. The protection shall provide shielding from solar radiation that can cause degradation of the material and shall be removable no less than 6 feet (1828 mm) from the equipment for maintenance. Adhesive tape shall be prohibited

Reason: Reason:
Purpose of code change:

This proposal will clarify the intent of Section R403.4.1 The intent of these sections is not only protection of pipe insulation from weather but to insure the insulations thermal conductivity energy savings integrity lasts the life of the mechanical system as

per the intent of the code. To remove the opportunity for misunderstanding so that the code has will have its intended result, the term “equipment maintenance” must be clarified that it is for physical damage. The 2012,2015, & 2018 IECC Code and Commentary both state that Equipment maintenance is to protect from physical damage to the pipe insulation.

“The piping insulation should be protected from sunlight, moisture, wind and solar

radiation but also from personal who may step on it, run in to it with equipment, etc. and cause it to be damaged. “

Protective covering must also protect from physical damage so if the protection covering does get

damaged from stepping on it, dropping tools on it, birds, lawn trimmers etc.it can be repaired or replaced.

Keeping the insulations thermal conductivity integrity and insuring the insulation system last the

life of the mechanical system and avoiding the costly replacement of the insulation. Repairing pipe insulation is

done with adhesives and then adhesive seams are left to weather exposure leading to degradation. The seams

open sun and moisture damage the insulation system.

Removable protection is vital to ensure insulation can retard heat and condensation to provide energy savings and safety.

Some insulation manufactures are now stating that gel coated or plastic coated insulation while it may be UV resistance , it will only protect for about a year without additional protection, or stating for protection longevity the coated insulation must have additional protection. Cracks in the protection , seams splitting or unprotected ends allow moisture to damage the insulation and It only takes a 1% moisture gain to equal to a 7.5 % loss in thermal efficiency.

Pipe insulation is sold in minimum 6 foot sections at Contractor supply Distributors

This proposal states that protection be removable no less than 6 feet from the equipment to allow equipment maintenance without having to destroy the insulation or purchase additional pipe insulation to replace.

Removable protection comes in many forms and from many manufactures it can be as simple as bent sheet metal, piping covers, jackets, pre fit channel systems & gutter systems, preformed covers, cladding, pipe , etc.

The intent is in the original 2012 IECC code proposal, the proponent's reason statement of this requirement EC207-09/10 stated this was to Harmonize the IECC with ASHRAE 90.1 the 2012 code the reason statement also stated -"All AC

units require periodic maintenance. The frequency varies with how hard the unit operates, exterior temperature,

preventive maintenance program, and many others. On every occasion, every maintenance provides an excuse for the

Freon line insulation to be touched and removed." The intent is clear that the protection be removable and independent

of the pipe insulation for maintenance without damaging the pipe insulation.

Removing protection without damaging the insulation is stated in EC207-09/10 "Adhesives Tape is not

permitted as it will limit maintenance and damage insulations permeability characteristics. Removal

of tape damages the integrity of the original insulation into pieces, specially, if the insulation

has reached thermo set state.

The main reason for pitting and corrosion of the piping in refrigerant lines is moisture intrusion into the pipe insulationfrom the termination point that are not protected. The gap between the piping and insulation creates a pathway formoisture to run the length and damage the system. "The most likely area of intrusion is at the insulation system penetration Points,gauges, attachments etc. If the integrity or exterior of the insulation system is not

installed correctly and moisture sources are present, moisture will more than likely penetrate the

insulation system. Moisture intrusion can negatively affect all aspects of the insulation system such as

thermal values, which can have a direct impact on process control, energy cost, condensation,

control, safety, the potential of mold development etc. Not to mention the potential of corrosion

under the insulation (CUI)." Insulation, the Forgotten Technology for Energy Conservation 2007 ACEE

https://energy.cdpaccess.com/proposal/36/624/files/download/210/

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This change will not increase the cost of construction as removable protection has been used before and snice the IECC2012 when protection was required. In fact this will decrease the cost of construction on future equipment replacement and maintenance by not having to replace pipe insulation.

Bibliography: Howard Ahern
Airex Manufacturing

760-250-1625

howard.ahern@airexmfg.com

Attached Files

- **Impact and Advantages of proper insulation cover Saum Nour.pdf**
  https://energy.cdpaccess.com/proposal/36/1107/files/download/210/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The proposal indicates that protection be removable without having to destroy the insulation or purchase additional pipe insulation to replace.

REPI-89-21

Proponents: Gary Klein, representing on behalf of the California Statewide Utility Codes and Standards Team (iecc-pipe-insulation@2050partners.com); Mark Lyles, representing New Buildings Institute (markl@newbuildings.org); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Revise as follows:

R403.5.2 Hot water pipe insulation. Insulation for service hot water piping ~~with a thermal resistance, *R*-value, of not less than R-3~~ shall comply with Table R403.5.1 and be applied to the following:

1. Piping $^{3}/_{4}$ inch (19.1 mm) and larger in nominal diameter located inside the *conditioned space*.
2. ~~Piping serving more than one dwelling unit.~~
2.3. Piping located outside the *conditioned space*.
3.4. Piping from the water heater to a distribution manifold.
4.5. Piping located under a floor slab.
5.6. Buried piping.
6.7. Supply and return piping in ~~circulation and recirculation systems~~ *circulating hot water systems.* ~~other than cold water pipe return demand recirculation systems.~~

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

TABLE R403.5.2 MINIMUM PIPE INSULATION THICKNESS

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		MINIMUM PIPE INSULATION THICKNESS (in inches)
	Conductivity Btu × in./(h × ft^2 × °F)[a]	Mean Rating Temperature, °F	
141–200	0.25–0.29	125	1.0
105–140	0.21–0.28	100	1.0

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

a For insulation outside the stated conductivity range listed in Table R403.5.2, the minimum thickness (T) listed in Table R403.5.2, shall be determined as follows:

$$T = r\left[(1 + t/r)^{K/k} - 1\right]$$

where:

T = Minimum insulation thickness.

r = Actual outside radius of pipe.

t = Insulation thickness listed in the table for applicable fluid temperature and pipe size; 1-inch.

K = Conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × ft^2 × °F).

k = The upper value of the conductivity range listed in Table R403.5.2 for the applicable fluid temperature.

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
Mechanical	
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.2	Hot water pipe insulation
R403.5.3	Drain water heat recovery units

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
Mechanical	
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.2	Hot water pipe insulation
R403.5.3	Drain water heat recovery units

Reason: The proposal will update the requirements for the hot water pipe insulation from insulation level R-3 to a thickness of 1 inch. The proposal will apply to service hot water pipes of all diameter sizes, though most distribution pipes are unlikely to exceed 1 ½ inch in diameter. At service hot water temperatures, a 1-inch insulation thickness on a 1-inch diameter pipe translates to an R-value level of R-7.7. The proposed 1-inch insulation thickness is consistent with pipe insulation requirements in Table C403.12.3 *Minimum Pipe Insulation Thickness (in inches)*, applicable to systems serving multiple dwelling units. This is the case for the 105 and 140°F temperature and the "<1" and "1 to < 1½" nominal pipe size (inch) ranges.

Both the IECC commercial section and ASHRAE standards specify pipe insulation requirements in terms of pipe insulation thickness. California's Title 24, Part 6 specifies both the insulation R-value and thickness, allowing buildings to show compliance using either requirement. The proposal team recommends changing the requirement to insulation thickness, to be consistent with the IECC commercial section, ASHRAE, and California's requirements. Table 1 summarizes pipe insulation requirement formats across energy standards. The team further recommends defining how insulation thickness shall be determined for alternative materials, the same method as described under C403.12.3 and for Table C403.12.3.
Table 1: Pipe Insulation Requirement Formats across Energy Standards

Energy Standards	IECC Residential	IECC Commercial	ASHRAE	CA Title 24 Part 6
Specifies Insulation R-value	Current	No	No	Yes
Specifies Insulation Thickness	As Proposed	Yes	Yes	Yes

Currently text in both IEEC sections R403.5.2 and R403.8 imply applicability for piping serving "more than one dwelling unit" (or "multiple dwelling units"). The proposal team recommends clarifying language such that service hot water systems serving anything other than a one single-family home or one dwelling unit would follow R403.8 and comply with commercial sections C403 and C404. This raises concerns that two-dwelling unit buildings covered by the IRC will now be directed to commercial sections.

Cost Impact: The code change proposal will increase the cost of construction.
The pipe insulation prices shown in Table 2 were collected in support of the 2022 Title 24, Part 6 update to pipe insulation requirements and do not include pricing for 1/2 inch insulation, but demonstrate a cost trend across increasing insulation thickness (Statewide CASE Initative, 2020).

Table 2: Insulation Cost per Linear Foot at Different Pipe Sizes and Insulation Thicknesses

Pipe Size (inch)	Insulation Thickness (inches)			
	1/2	1	1 1/2	2
3/4	TBD	$14	NA	NA
1	TBD	$14.75	$15.75	NA
1 1/2	TBD	NA	$18	$21.75

The proposal team will perform detailed cost analyses on the insulation thickness proposal based on the typical pipe length found in single-family homes and multifamily dwelling units in advance of IECC committee meetings.

Bibliography: Statewide CASE Initative. (2020, September). *2022 Title 24 Final CASE Report - Multifamily Domestic Hot Water Distribution.* Retrieved from Title24Stakeholders: https://title24stakeholders.com/wp-content/uploads/2020/09/2022_T24_Final-CASE-Report-MF-DHW-Dist.pdf
Statewide CASE Initiative. (2011, October). *Water and Space Heating ACM Improvement.* Retrieved from Title24Stakeholders: http://title24stakeholders.com/wp-content/uploads/2017/10/2013_CASE-Report_Water-and-Space-Heating-ACM-Improvement.pdf

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: based on the proponent's reason statement.

Proposal # 404

REPI-90-21

Proponents: Kim Cheslak, NBI, representing NBI (kim@newbuildings.org); Josh Keeling, representing Cadeo Group (jkeeling@cadeogroup.com); Ben Rabe, representing Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, representing Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org); Howard Wiig, representing Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, representing Colorado Energy Office (kim.burke@state.co.us); Matt Tidwell, representing Portland General Electric (matthew.tidwell@pgn.com); Chris Castro, representing City of Orlando (chris.castro@orlando.gov); Amber Wood, representing ACEEE (awood@aceee.org); Brad Smith, representing City of Fort Collins (brsmith@fcgov.com)

2021 International Energy Conservation Code

Add new definition as follows:

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

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

Add new text as follows:

R403.5.4 Demand responsive water heating. Electric storage water heaters with a rated water storage volume of 40 gallons (150L) to 120 gallons (450L) and a nameplate input rating equal to or less than 12kW shall be provided with *demand responsive controls* in accordance with Table R403.5.4 or another equivalent *approved* standard.

Exceptions:

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

TABLE R403.5.4 DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls	
	Manufactured Before 7/1/2025	Manufactured On or After 7/1/2025
Electric stoarge water heaters	ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a *demand response signal.*	ANSI/CTA-2045-B Level 2, except “Price Stream Communication” functionality as defined in the standard.

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water circulation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water calculation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Add new standard(s) as follows:

ANSI

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

ANSI/CTA 2045-B February 2021 Modular Communications Interface for Energy Management

ASME

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

BPVC *Boiler and Pressure Vessel Code*

Reason: With increasing penetrations of intermittent renewable energy, volatile wholesale power prices, and subsequent growth in dynamic rates/demand response programs, grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services. In their assessment of the National Potential for Load Flexibility, Brattle estimated that across all measures these services could provide as much as $15 billion per year in value to the electric system.
As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid

operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend. Water heaters offer an unparalleled opportunity for load shifting: tanks full of hot water are inherently energy storage devices. Including the controls necessary to take advantage of this opportunity is relatively simple and affordable in new construction. Compared to other energy storage technologies such as batteries, smart, grid-integrated water heater controls can deliver substantial dispatchable (that is, reliable to the grid operator) energy flexibility. The controls specified by ANSI/CTA-2045-B ensure negligible risk of occupant disruption (that is, the hot water will not run out). Water heaters provide a particularly attractive option as they have inherent thermal storage that allows energy consumption to be shifted with little to no impact to the end user. This capability has been demonstrated in several contexts, most recently through regional demonstrations conducted by EPRI and BPA.

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

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

Versions of this standard are included in codes or other requirements in California, Oregon, and Washington and are referenced explicitly by ENERGY STAR.

Cost Impact: The code change proposal will increase the cost of construction.
To enable grid-interactive controls, there are two sources of costs: the incremental cost to ensure that equipment is interoperable with CTA-2045-B and the cost of the control module installed in that device. The incremental manufacturing cost is in the range of a few dollars, and negligible at higher volumes. The current incremental cost to include a CTA-2045-B compliant control module ranges from about $60 (direct current, hard-wired connection) to $160 (alternating current, wireless cellular connection); this is expected to decline as manufacturing lines are brought up to larger scale (source: Advanced Water Heating Initiative). The major determinant of cost if the chosen radio pathway as chipset costs vary considerably between different frequencies/standards.

In the BPA report, manufacturers stated a range of $2-$30 for regional deployment, but noted that there would be economies of scale for a national rollout. The main cost was development of firmware/hardware to accommodate the standard, but these costs have already been incurred to meet codes/standards in OR, WA, and CA.

Bibliography: [1] Brattle, The National Potential for Load Flexibility (2019)
https://brattlefiles.blob.core.windows.net/files/16639_national_potential_for_load_flexibility_-_final.pdf
[2] BPA, CTA-2045 Water Heater Demonstration Report (2018) https://www.bpa.gov/EE/Technology/demand-response/Documents/Demand%20Response%20-%20FINAL%20REPORT%20110918.pdf

EPRI, CEA-2045 Field Demonstrations Project Description (2014) https://www.epri.com/research/products/000000003002004009

[3] USDOE, A National Roadmap for Grid-Interactive Efficient Buildings (2021)
https://gebroadmap.lbl.gov/A%20National%20Roadmap%20for%20GEBs%20-%20Final.pdf

[4] Washington State Revised Code of Washington, Title 19, Chapter 19.260, Section 19.260.080, available at
https://app.leg.wa.gov/RCW/default.aspx?cite=19.260.080

Oregon Department of Energy, Energy Efficiency Standards Rulemaking https://www.oregon.gov/energy/Get-Involved/Pages/EE-Standards-Rulemaking.aspx

U.S. EPA Energy Star Program, Connected Criteria for ENERGY STAR Products,
https://www.energystar.gov/products/spec/connected_criteria_energy_star_products_pd

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: This proposal adds Demand Response controls for tanked water heaters only. The proposal is for specific tanked water heaters with 3 exceptions listed in the proposal. The reason for the revision replaces a definition for “grid integrated controls”.

Proposal # 183

REPI-91-21

Proponents: Dan Wildenhaus, representing Northwest Energy Efficiency Alliance (dwildenhaus@trccompanies.com); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

R403.5.4 Water volume determination. The water volume in the piping shall be calculated in accordance with this section. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered to be sources of heated water. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from Table R403.5.4. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

TABLE R403.5.4 INTERNAL VOLUME OF VARIOUS WATER DISTRIBUTION TUBING

OUNCES OF WATER PER FOOT OF TUBE									
NOMINAL SIZE (inches)	COPPER TYPE M	COPPER TYPE L	COPPER TYPE K	CPVC CTS SDR 11	CPVC SCH 40	CPVC SCH 80	PE-RT SDR 9	COMPOSITE ASTM F1281	PEX CTS SDR 9
3/8	1.06	0.97	0.84	N/A	1.17	-	0.64	0.63	0.64
1/2	1.69	1.55	1.45	1.25	1.89	1.46	1.18	1.31	1.18
3/4	3.43	3.22	2.90	2.67	3.38	2.74	2.35	3.39	2.35
1	5.81	5.49	5.19	4.43	5.53	4.57	3.91	5.56	3.91
1 1/4	8.70	8.36	8.09	6.61	9.66	8.24	5.81	8.49	5.81
1 1/2	12.18	11.83	11.45	9.22	13.20	11.38	8.09	13.88	8.09
2	21.08	20.58	20.04	15.79	21.88	19.11	13.86	21.48	13.86

For SI: 1 foot = 304.8 mm, 1 inch = 25.4 mm, 1 liquid ounce = 0.030L, 1 oz/ft^2 = 305.15 g/m^2.

N/A = Not available.

Reason: *Language needs to be introduced into the prescriptive portion of the code's Systems section in order to be referenced in new R408 Additional Efficiency Package Options.*
Inefficient hot water distribution systems have been recognized as a problem for many years as they result in energy and water waste, and result in long hot water delay times that are the cause of a significant number of complaints by new home buyers. Recirculation systems are a solution to two of the three problems (water and wait time), but the thermal energy impact of different recirculation system options has already been addressed in section **R403.5.1.1 Circulation system**.[1]

In all non-recirculation distribution options, water heater energy consumption and hot water waste are correlated. A decrease in water heater energy consumption follows a reduction in wasted water; therefore, improving insulation and reducing the piping length and/or pipe diameter have equal benefits for energy and water waste. In recirculation systems, water heater energy consumption and wasted hot water are independent, and often have an inverse effect (when recirculation is not demand based).[2]

This distribution system problem exists for a variety of factors including:

- An outdated pipe sizing methodology in the plumbing code that results in oversized hot water distribution systems since the assumed fixture flow rates are much higher than current requirements.
- Municipalities with design recommendations that force plumbers and designers to assume low supply water pressure, resulting in larger distribution piping, which waste more water and energy.
- Increasing efforts to conserve water has resulted in the realization of water savings due to improvements in showerhead and lavatory maximum flow rates; however, reduced flow rates often result in increased wait times if the hot water distribution system is not designed to accommodate lower flows.
- Increasing popularity of gas instantaneous water heaters, which offer improved operating efficiency, but can result in increased water waste when starting from a “cold start up” situation.
- Inefficient plumbing installations that are not focused on minimizing pipe length or pipe diameters.

The IECC has already addressed pipe insulation and Circulation systems in the 2021 IECC Residential provisions.

1

Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility Farhad Farahmand, TRC Companies Yanda Zhang, ZYD Energy

2*Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models* E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation

https://energy.cdpaccess.com/proposal/445/976/files/download/134/
https://energy.cdpaccess.com/proposal/445/976/files/download/133/
https://energy.cdpaccess.com/proposal/445/976/files/download/132/
https://energy.cdpaccess.com/proposal/445/976/files/download/131/
https://energy.cdpaccess.com/proposal/445/976/files/download/130/

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Incremental first costs to builders, designers, and plumbers are design based and each builder will need to determine potential cost impacts based on existing designs and measures in use. Depending on current practices and paths taken for IECC compliance this measure may result in small incremental cost increases or decreases. These potential cost differences relative to standard practices are likely to be:

· Reduced cost of PEX or copper tubing due to less material installed.

· Reduced cost to pipe insulation due to smaller plumbing layout.

· Reduced or neutral cost in labor hours for plumber.

· Increased water heating venting costs, if a gas water heater or electric heat pump water heater is centrally located.

· Increased venting labor costs, if a gas water heater or electric heat pump water heater is located is centrally located and not on a garage wall.

This measure should not have maintenance costs associated with it compared to standard practices.

Bibliography: · *Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility* Farhad Farahmand, TRC Companie;Yanda Zhang, ZYD Energy
· *Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models* E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation

· California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing

· Home Innovation Research Labs Annual Builder Practices Survey, 2021

· Department of Energy Zero Energy Ready Home National Program Requirements (Rev. 07) [footnote 15]

· Efficient hot water distribution system – USBGC LEED BD+C: Homes v4 – LEED v4

· Residential Hot Water Distribution Systems: Roundtable Session; JD Lutz, Lawrence Berkely National Laboratory; G Klein, California Energy Commission; D Springer, Davis Energy Group; BD Howard, Building Environmental Science & Technology

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: based on the proponent's reason statement.

REPI-93-21

Proponents: Marian Goebes, representing n behalf of the California Statewide Utility Codes and Standards Team (iecc-sf-hrv-erv@2050partners.com); Mark Lyles, representing New Buildings Institute (markl@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

R403.6.1 Heat or energy recovery ventilation. *Dwelling units* shall be provided with a heat recovery or energy recovery ventilation system ~~in Climate Zones 7 and 8~~. The system shall be balanced with a minimum sensible heat recovery efficiency of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.

Exceptions:

1. Dwelling units in single- and two-family dwellings and townhouses in Climate Zones 0-4.
2. Dwelling units in Group R occupancies the comply with Section C403.7.4.1.

Reason: The current residential requirement is to provide dwelling units with HRVs or ERVs only in Climate Zones 7 and 8. This proposed change will expand the requirement for HRVs and ERVs to Climate Zones 5 through 8 for single- and two-family dwelling units and all Climate Zones except 3C for multifamily dwelling units.
The proposed requirement for single-family homes builds on the current requirement that is based on the PNNL (2018) analysis, and expands the requirements by

1. Assuming a “better case” cost estimate for an ERV or HRV than was assumed in the PNNL (2018) report,
2. Assuming a higher sensible recovery efficiency for the HRV: 67% instead of 65%,
3. Accounting for the cost of carbon, and
4. under one scenario) including savings when accounting for increased tightness (in a separate proposal led by another stakeholder to move from 3 ACH50 to 2 ACH50 in climate zones 3 through 8).

The proposed analysis will include scenarios with and without a tighter envelope requirement (#4) in case that proposal does not move forward.

In short, the proposal team anticipates finding increased cost-effectiveness in single-family homes compared to PNNL (2018) because of lower costs (#1) and higher savings (#2 through #4).

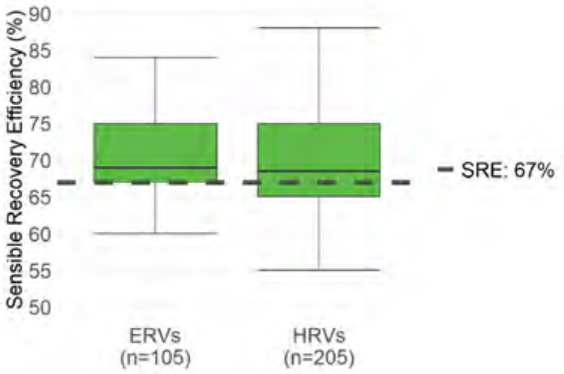
For the proposed multifamily (MF) requirement, the proposal seeks to align the requirements of multifamily dwelling units across the two sides of the code. Currently there are large discrepancies in terms of system design, control and stringency between a 3-story MF building and a 4-story MF building. This leads to market confusion, enforcement inconsistencies, and untapped energy savings. This proposed revision seeks to close these gaps and create a common set of requirements for multifamily buildings. The ERV/HRV measure is an example where there is inconsistencies, since ASHRAE 90.1-2019 requires heat or energy recovery for high-rise multifamily dwelling units except in Climate Zone 3C.

The 2022 version of Title 24 has created a new section to regulate MF buildings - similar to a more "omnibus" proposal submitted by NBI previously. Based on feedback on NBI’s submission suggesting that future proposals not create a new section, this proposal instead works to align the sections that currently exist.

Cost Impact: The code change proposal will increase the cost of construction.
The proposal team will identify additional savings compared to the PNNL (2018) analysis by including a higher sensible recovery efficiency (SRE), including the abated cost of greenhouse gas emissions, and (under one scenario) assuming a tighter building envelope than the current IECC-R requirements.

The proposed analysis will assume a higher sensible recovery efficiency (SRE) for the HRV: 67% instead of 65% at 32F (assumed in PNNL 2018). This new assumption is based on typical values for HRVs and ERVs in the Home Ventilating Institute (HVI) database shown in Figure 1, which show that most ERVs and HRVs meet or exceed an SRE of 67%.

Figure 1: Boxplot of SRE of ERVs and HRVs (30-100cfm) from the HVI Certified Products database (Source: TRC 2020 pdf p. 86)



The proposed analysis will include the abated cost of greenhouse gas emissions from reduced energy use. The analysis may use the Integrated Energy Policy Report (IEPR) emissions price forecast, which estimates the current cost of cap-and-trade carbon as $29 and the societal cost of $106, or the estimate of $51 assumed by the U.S. Government Interagency Working Group (2021). The proposal team will follow the latest guidance from the IECC on incorporating the cost of carbon, or the U.S. Government Interagency Working Group (2021) estimate if the IECC is still deliberating on this issue. In addition, the proposal team will assume an increase in the cost of carbon, as demonstrated in Figure 2.

Figure 2: Current and Predicted Price of the Avoided Cost of Carbon (Source: E3 2020)

Finally, the proposed analysis will investigate the impacts of tightening the building envelope to 2 ACH50, since another stakeholder may propose this requirement. This analysis will be considered separately, in case the 2 ACH50 proposal does not move forward.

In advance of IECC committee meetings, the proposal team will conduct single-family simulations to investigate the energy savings from an HRV.

The proposal team anticipates findings lower costs than what PNNL (2018) assumed, based on new market research.

The PNNL (2018) report found lifecycle cost savings of $824 and $3,111 in Climate zones 7 and 8, respectively, as shown in Table 1, assuming a first cost of $1,500 for an HRV and a sensible recovery effectiveness of 65%. PNNL did not find the HRV to be cost effective in climate zone 6 or lower under these assumptions. Assuming a “best-case” cost assumption of $500 for the HRV, PNNL found the HRV to be cost effective in climate zones 5 through 8. As stated in PNNL (2018), “The cost of HRV equipment ranges from about $500 to a few thousand dollars, depending on the manufacturer, capacity, configuration, and the base design of the home.”

While PNNL (2018) assumed a total measure cost of $1,500, several studies have used a lower estimate, including two studies that cited $1,300:

NREL (2018) and TRC (2017), and one study that cited $1050 (Oregon Department of Consumer and Business Services - Building Codes Division 2021). These costs include equipment and labor costs for both the HRV appliance itself as well as related ductwork.

In advance of IECC committee meetings, the proposal team will revisit costs for an HRV (including ducting and the appliance) for a “better case” scenario that is between what PNNL assumed ($1,500), and the best case that PNNL found ($500).

Bibliography: PNNL, *Residential Heat Recovery Ventilation*, 2018. https://www.osti.gov/servlets/purl/1488935
E3, *Time Dependent Valuation of Energy for Developing Building Efficiency Standards*, 2020. https://efiling.energy.ca.gov/GetDocument.aspx?tn=74439

Oregon Department of Consumer and Business Services - Building Codes Division, *memo of cost estimates*, 2021. https://www.oregon.gov/bcd/codes-stand/code-adoption/Documents/20210316-res-reach-bcd-costs.pdf

TRC, *2016 Title 24 Residential Reach Code Recommendations*, 2017.

TRC, *Multifamily Indoor Air Quality Codes and Standard Enhancement Report,* 2020. https://efiling.energy.ca.gov/GetDocument.aspx?tn=235290&DocumentContentId=68182

U.S. Government Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990, 2021 https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Committee discussed the updated cost-effectiveness calculations provided by the Proponent. While the Committee debated the design and costs used in the analysis, the Committee ultimately voted to support expanding the current requirement for HRV/ERVs in CZ 7 & 8 to include CZ 5 & 6 given the cost-effective energy savings demonstrated by the Proponent.

REPI-94-21

Proponents: Mike Moore, Stator LLC, representing Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R403.6.1 Heat or energy recovery ventilation . *Dwelling units* shall be provided with a heat recovery or energy recovery ventilation system in Climate Zones 7 and 8. The system shall be a balanced ventilation system with a ~~minimum~~ sensible ~~heat~~ recovery efficiency (SRE) of no less than 65 percent at 32°F (0°C) at ~~a~~ an airflow ~~flow~~ greater than or equal to the design airflow. The SRE shall be determined from a listed value or from interpolation of listed values.

Reason: This proposal is intended to clarify the existing requirements in this section. "Balanced ventilation system" is a term that is now defined in the 2024 IRC and IMC. The industry term for sensible heat recovery efficiency is "sensible recovery efficiency" (SRE). For any given heat or energy recovery ventilator, the SRE generally improves as airflow is reduced. By interpolating, a specifier can obtain a closer estimate of the unit's performance at the design airflow. As a point of reference, interpolation of the SRE was recently vetted by the California Energy Commission and approved for inclusion in Part 6 of Title 24-2022.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal clarifies the application of existing requirements and does not affect construction cost.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: clarifies the existing language

Proposal # 410

REPI-95-21

Proponents: Mike Moore, Stator LLC, representing Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-dwelling mechanical ventilation shall meet the efficacy requirements of Table R403.6.2 at one or more rating points. Fans shall be tested in accordance with ~~HVI 916~~ the test procedure referenced by Table R403.6 and listed. The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ~~ERC~~ ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.85 Pa). Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa).

TABLE R403.6.2 WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY[a]

~~FAN LOCATION~~ SYSTEM TYPE	AIRFLOW RATE ~~MINIMUM~~ (CFM)	MINIMUM EFFICACY (CFM/WATT)	TEST PROCEDURE
HRV, ~~or~~ERV, or balanced	Any	1.2 ~~cfm/watt~~	HRV or ERV: CAN/CSA 439 Balanced without heat or energy recovery; ASHRAE Standard 51 (ANSI/AMCA Standard 210)
Range hood	Any	2.8	ASHRAE 51 (ANSI/AMCA Standard 210)
In-line supply or exhaust fan	Any	3.8 ~~cfm/watt~~	
Other exhaust fan	< 90	2.8 ~~cfm/watt~~	
	≥ 90 and < 200	3.5 ~~cfm/watt~~	
	≥ 200	4.0	
Air-handler that is integrated to tested and *listed* HVAC equipment	Any	1.2 ~~cfm/watt~~	Outdoor airflow as specified. Air-handler fan power determined in accordance with the HVAC appliance's test method referenced by Section C403.3.2 of the IECC-Commercial Provisions.

For SI: 1 cubic foot per minute = ~~28.3 L/min.~~ 0.47 L/s.

a. Design outdoor airflow rate/watts of fan used.

Add new standard(s) as follows:

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

CAN/CSA-C439-18 Laboratory methods of test for rating the performance of heat/energy-recovery ventilators

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE Standard 51-16 / ANSI/AMCA Standard 210-16 Laboratory Methods Of Testing Fans For Certified Aerodynamic Performance Rating

Reason: Approval of this proposal and coordinating proposals submitted to the IECC-C will improve alignment of the residential fan efficacy table, the commercial fan efficacy table, the ASHRAE 90.1 fan efficacy table, and the ENERGY STAR Ventilating Fans v4.1 specification. It will also incorporate errata that are needed to the 2021 IECC based on final action on proposals RE133-19, RE137-19, and RE178-19, approved in the previous code cycle. The test procedures referenced are those referenced by ASHRAE 90.1 and the IECC-C and are those used by industry for testing and listing.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The only element of this proposal that may affect first costs is the introduction of a fan efficacy requirement for exhaust fans exceeding 200 cfm. This requirement aligns with ENERGY STAR criteria and has already been vetted by ASHRAE 90.1, which has cost effectiveness requirements. Additionally, a small sample of internet retail pricing for units that would be affected by this requirement showed that price was not heavily correlated with efficacy:

Compliant:
Model A: 300 cfm, 7.3 cfm/watt, $185
Model B: 200 cfm, 11.4 cfm/watt, $179

Not Compliant:

Model C: 200 cfm, 3.5 cfm/watt, $159
Model D: 200 cfm, 3.6 cfm/watt, $212
Pricing gathered October 2021 from airxheat, ecomfort, homedepot, and amazon.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: updated testing procedure references

Proposal # 395

REPI-96-21

Proponents: Mike Moore, Stator LLC, representing Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R403.6.3 Testing. Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation airflow rates required by Section R403.6, in accordance with ANSI/RESNET/ICC 380. ~~Testing shall be performed according to the ventilation *equipment* manufacturer's instructions, or by using a flow hood or box, 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.~~ Where required by the code official, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Exceptions: ~~Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger duct and not more than one 90-degree (1.57 rad) elbows or equivalent in the duct run.~~

1. Kitchen range hoods that are ducted to the outside with ducting having a diameter of 6 inches (152 mm) or larger, a length of 10ft (3048 mm) or less, and not more than two 90° elbows or equivalent shall not require testing.
2. A third-party test shall not be required where the ventilation system has an integrated diagnostic tool used for airflow measurement, programmable airflow settings, and a user interface that communicates the installed airflow rate.

Add new text as follows:

403.6.2.1 External airflow testing device. Where an airflow testing device having one or more components that are external to the ventilation equipment is used to determine the airflow, testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood or box, 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. The device shall have an airflow rate accuracy within the greater of 10% or 5 CFM. Where required by the code official, testing shall be conducted by an approved third party.

403.6.2.2 Integrated airflow verification device. Where an airflow verification device that is a component of the ventilation equipment is used to determine the airflow, airflow verification shall be performed according to the ventilation equipment manufacturer's instructions. The device shall be verified to provide the following: programmable and self-modulating airflow rate, airflow rate accuracy within the greater of 10% or 5 CFM, and a user interface that communicates if the selected airflow rate is achieved. Verification of the device shall be supported by data furnished by a laboratory approved for airflow testing by an ISO/IEC 17065 accredited certification body.

Reason: Verification of ventilation system airflow rate is critical to ensuring systems meet minimum code requirements. This modification to the original proposal is in keeping with the objective of verifying airflow rate, but it adds another option for doing so by encouraging innovation of products that are verified to modulate airflow to the user's selected rate and communicate via a user-interface whether the user's selected rate is achieved. To encourage the development and specification of such verified, self-modulating systems, this proposal waives any requirement for third-party field verification of the airflow rate when such a device is used. To verify that the device meets the criteria of Section 403.6.2.2, results from laboratory testing must be provided by a laboratory that is approved by a certification body that is accredited to ISO/IEC 17065, Conformity assessment — Requirements for Bodies Certifying Products, Processes and Services. ISO/IEC 17065 is the cornerstone for certification body accreditation; referencing it clarifies compliance requirements for manufacturers and relieves building officials from the burden of subjective approval.
This proposal also modifies the kitchen range hood testing exception to stipulate a maximum length of duct that can be used to be eligible for the exception while adding more flexibility in terms of the number of elbows. The allowance proposed for length and elbows aligns with the Home Ventilating Institute's new airflow metric for range hoods, Nominal Installed Airflow (see HVI 920 for more information), which is intended to provide a better approximation of real-world airflow than the traditional range hood airflow rating at 0.1" w.c.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposal will not increase the cost of construction. The proposal can help reduce costs by providing additional compliance options.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: adds option to verifying airflow rate and modifies the kitchen range hood testing exception

REPI-99-21

Proponents: David Baylon, representing Northwest Energy Efficiency Alliance (david@davidbaylon.com); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new definition as follows:

ZONAL HEATING. A heating system in which each *zone* or room has a separate heater with a single controller in each *zone*.

Add new text as follows:

R403.7.1 Electric resistance zone heated units. All detached one- and two-family dwellings and townhouses in Climate Zones 4-8 using electric resistance *zonal heating* as the primary heat source shall install one additional heating unit in the largest living zone. The additional unit shall have an HSPF greater than 7.4 (6.3 HSPF2). Building permit drawings shall specify the heating equipment type and location of the heating system.

Exceptions:

1. Total installed heating capacity of 2 kW per dwelling or less.
2. Dwellings that have central ducted or ductless cooling or heating systems.

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7, except Section R403.7.1	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: The use of a split system DHP system (less than 36,000 BTU heating) has shown itself to provide significant savings in the field trials and large-scale market evaluations in the Pacific Northwest. Savings have been demonstrated in all three climate zones in the region (4C, 5B, and 6B). These savings derive from the ability of the heat pump to perform over a wide range of outdoor temperature conditions (down to -10° F) and provide significant heating to the home with C.O.P. greater than 2.5. The unit is meant to displace the electric heat when conditions allow often in swing seasons. The savings largely depend on the unit to fully heat the zone or zones where they are installed. The primary electric heating is sized to meet the design heating requirements in accordance with R403.7 so this additional equipment is designed to provide savings when it is operating. The variable speed compressors can also provide significant cooling to the zone and typically have SEER ratings above 16. In many cases this can be the primary cooling in the dwelling and obviate the need for further zone level cooling using much less efficient equipment.
Detailed metering of about 100 electric resistance zonal homes showed a reduction of about 3000 kwh/yr. Even in homes that used supplemental stoves such as wood or propane fired average savings was almost 2000 kwh/yr in subsequent billing analysis done on almost 4000 homes throughout the region.

While this region had small cooling loads in the few areas where substantial seasonal cooling is required, savings of about 300 kwh/yr were observed. In most cases these savings were the result of replacing window air conditioners that provided zone cooling for the home.

Cost Impact: The code change proposal will increase the cost of construction.
The installation costs of DHP were documented as part of the detailed field and market evaluation in the Pacific Northwest. The cost of a DHP

installation in new construction (townhouses) varied from $2500 to $3500. The installed DHPs were generally 1 nominal 1 ton. The costs for DHPs as a retrofit varied substantially. The retrofit costs were generally between $3500 and $4500 and were sized between 1 ton and 2.5 tons nominal.

Bibliography: Baylon, et al, 2014, *Ductless Heat Pump Impact and Process Evaluation, Billing Analysis Report*, Northwest Energy efficiency Alliance, Portland, OR
https://neea.org/resources/ductless-heat-pump-impact-process-evaluation-billing-analysis-report

Baylon, et al, 2012, *Ductless Heat Pump Impact and Process Analysis, Field Metering Report,* Northwest Energy Efficiency Alliance, Portland, OR.

https://ecotope.com/ecotope-publications-database/

Lubliner, Et al, 2016, Performance and Costs of Ductless Heat Pumps in Marine Climate High-Performance Homes—Habitat for Humanity the Woods, USDOE Building America Program, Golden, CO
http:/www.osti.gov/scitech/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides consensus language that follows what has been used successfully in Washington state.

REPI-101-21

Proponents: Mike Moore, Stator LLC, representing Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

Revise as follows:

R404.1 (N1104.1) Lighting equipment. All permanently installed lighting fixtures~~, excluding kitchen appliance lighting fixtures,~~ shall contain only high-efficacy lighting sources .

Exceptions:

1. kitchen appliance lighting.
2. antimicrobial lighting used for the sole purpose of disinfecting.

Reason: The lighting efficacy requirements of this section were only developed to apply to luminaires that provide lighting for illumination. This exception clarifies the section's intent in regard to lighting that is used for germicidal or antimicrobial purposes and is aligned with the IECC-C Section C405.3.1 exception for antimicrobial lighting.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change will provide clarity to code officials and designers regarding how to apply the requirements of this section to germicidal or antimicrobial lighting. No effect is expected with regard to construction costs.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: language matches the commercial side. new part in article 410, added in group A, interior environments that point to UL standards. Guidance in the IBC and NEC

REPI-102-21 Part I

Proponents: Michael Jouaneh, representing Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

THIS IS A 2 PART PROPOSAL. PART I & II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE.

2021 International Energy Conservation Code

Revise as follows:

~~**HIGH-EFFICACY LIGHT SOURCES.** Any lamp with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.~~

R404.1 Lighting equipment. All permanently installed luminaires ~~lighting fixtures~~, excluding kitchen appliance lighting equipment ~~fixtures~~, shall be capable of operation with an efficacy of not less than 45 lumens per watt or shall contain lamps~~only high-efficacy lighting sources~~ capable of operation at 65 lumens per watt or greater.

Reason: This editorial revision corrects the terminology used to describe lightning equipment and relocates the efficacy criteria from the definition of "high-efficacy light sources" to R404.1 to improve clarity for the user and proper enforcement of the code. By including the lighting efficacy requirements in R404.1, there is no need for the definition. Additionally, color tunable light sources are capable of operation outside of those used for general lighting applications (e.g., red color operation). It's appropriate to ensure tunable sources are capable of providing white light at the efficacies shown above.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
There is no increase or decrease cost in construction as this proposal is primarily editorial. It moves requirements that were in the definitions to the main body of the code. And the proposal adds clarity for new lighting technology (e.g, tunable lighting) so that this technology can also comply with the efficacy thresholds.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: per proponent's reason statement

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REPI-102-21 Part II

Proponents: Michael Jouaneh, representing Lutron Electronics Co., Inc. (mjouaneh@lutron.com)

2021 International Residential Code

Revise as follows:

~~**HIGH-EFFICACY LIGHT SOURCES.** Any lamp with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.~~

N1104.1 Lighting equipment. All permanently installed luminaires ~~lighting fixtures~~, excluding kitchen appliance lighting equipment ~~fixtures~~, shall be capable of operation with an efficacy of not less than 45 lumens per watt or shall contain lamps~~only high-efficacy lighting sources~~ capable of operation at 65 lumens per watt or greater.

Reason: This editorial revision corrects the terminology used to describe lightning equipment and relocates the efficacy criteria from the definition of "high-efficacy light sources" to R404.1 to improve clarity for the user and proper enforcement of the code. By including the lighting efficacy requirements in R404.1, there is no need for the definition. Additionally, color tunable light sources are capable of operation outside of those used for general lighting applications (e.g., red color operation). It's appropriate to ensure tunable sources are capable of providing white light at the efficacies shown above.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
There is no increase or decrease cost in construction as this proposal is primarily editorial. It moves requirements that were in the definitions to the main body of the code. And the proposal adds clarity for new lighting technology (e.g, tunable lighting) so that this technology can also comply with the efficacy thresholds.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: per proponent's reason statement

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REPI-105-21

Proponents: Vladimir Kochkin, NAHB, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Add new text as follows:

TABLE R404.1 (TABLE N1104.1) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

Base site allowance	400 watts
Uncovered parking areas and drives	0.4 W/ft2
Building Grounds	
Walkways and ramps less than 10 feet wide	0.50 W/linear foot
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 W/ft2
Dining areas	0.65 W/ft2
Stairways	0.70 W/ft2
Pedestrian tunnels	0.12 W/ft2
Landscaping	0.04 W/ft2
Building Entrances and Exits	
Pedestrian and vehicular entrances and exits	14 W/linear foot of opening
Entry canopies	0.25 W/ft2

For SI: 1 watt per square foot = 10.76 w/m2, 1 foot = 304.8 mm.

Revise as follows:

R404.1.1 Exterior lighting. Connected exterior lighting for Group R-2, R-3, and R-4 residential buildings shall comply with Section s R404.1.2 through R404.1.5. ~~C405.4.~~

Exceptions:

1. Detached one- and two- family dwellings.
2. Townhouses.
3. Group R-3 buildings that do not contain more than 2 dwelling units.

~~4~~3. Solar-powered lamps not connected to any electrical service.

~~5~~4. Luminaires controlled by a motion sensor.

~~6~~5. Lamps and luminaires that comply with Section R404.1.

Add new text as follows:

R404.1.2 (N1104.1.1) Exterior lighting power requirements. The total exterior connected lighting power shall be not greater than the exterior lighting power allowance calculated in accordance with Section R404.1.3. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting that is powered through the energy service for the building.

Exception: Lighting used for the following applications shall not be included.

1. Lighting approved because of safety considerations.
2. Exit signs.
3. Specialized signal, directional and marker lighting associated with transportation.
4. Temporary lighting.
5. Lighting for water features and swimming pools.
6. Lighting controlled from within dwelling units.

R404.1.3 (N1104.1.2) Exterior Lighting Power Allowance. The total area or length of each area type multiplied by the value for the area type in Table R404.1 shall be the lighting power (watts) allowed for each area type. For area types not listed, the area type that most closely represents the proposed use of the area shall be selected. The total exterior lighting power allowance (watts) shall be the sum of the base site allowance plus the watts from each area type.

R404.1.4 (N1104.1.3) Additional exterior lighting power. Additional exterior lighting power allowance shall be available for the building facades at 0.075 W/ft2 (0.807 w/m^2) of gross above-grade wall area. This additional power allowances shall be used only for the luminaires serving the facade and shall not be used to increase any other lighting power allowance.

R404.1.5 (N1104.1.4) Gas lighting. Gas-fired lighting appliances shall not be equipped with continuously burning pilot ignition systems.

Reason: The 2021 IECC Residential Provisions include a new section for exterior lighting that points the user to the commercial energy code. This format is counter to the framework of residential energy provisions intended to serve as a standalone set of criteria. This proposal extracts the relevant provisions applicable to residential occupancies from the commercial energy provisions and places these requirements directly within the residential provisions. The additional item under exceptions is intended to cover one- and two-unit R-2 buildings that may fall outside of the scope of the IRC for unrelated reasons and will need to be designed using the IBC but effectively are the same as the buildings already exempt under the first two items.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposal copies the relevant requirements from the commercial code.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Discussion on modifying the numbers through public comment. Should consider other zones

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REPI-106-21

Proponents: Megan Hayes, representing NEMA (Megan.Hayes@nema.org)

2021 International Energy Conservation Code

Add new definition as follows:

AUTOMATIC SHUT-OFF CONTROL. A device capable of automatically turning loads off without manual intervention. Automatic shut-off controls include devices such as, but not limited to, occupancy sensors, vacancy sensors, door switches, programmable time switches (i.e., timeclocks), or count-down timers.

Revise as follows:

R404.2 (N1104.2) Interior lighting controls. All permanently installed luminaires ~~lighting fixtures~~ shall be controlled as required in 404.2.1 and 404.2.2. ~~with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.~~

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

1. ~~Bathrooms~~.
2. ~~Hallways.~~
3. ~~Exterior lighting fixtures~~.
4. ~~Lighting designed for safety or security.~~

Add new text as follows:

404.2.1 (N1104.2.1) Habitable spaces. All permanently installed luminaires in habitable spaces shall be controlled with a dimmer or an automatic shut-off control that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a manual control to allow occupants to turn the lights on or off.

404.2.2 (N1104.2.2) Specific locations. All permanently installed luminaires in garages, unfinished basements, laundry rooms, and utility rooms shall be controlled by an *automatic shut-off control* that automatically turns off lights within 20 minutes after all occupants have left the space and shall incorporate a manual control to allow occupants to turn the lights on or off.

Reason: This proposal extensively revises R404.2 to correct terminology and to clarify application of lighting controls in residential occupancies. The revised rule adds a separate lighting control requirement for habitable spaces that includes both automatic and non-automatic control function and adds automatic occupant sensor control only to specific, non-habitable spaces of a residence where lighting tends to remain on when no occupants are using the spaces, thus reducing energy conservation. The revised language also includes provisions to ensure the occupants can manually turn the lighting on and off independently of the occupant sensor control. Approval of this proposal will more closely align R404.2 with C405.2 of the IECC and improve enforceability of the requirement.

Cost Impact: The code change proposal will increase the cost of construction.
The code change proposal will increase the cost of construction by removing the four exempt spaces in the current rule but will also increase the effective use and conservation of energy consumed by lighting in residential occupancies.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: this proposal improves the requirements for interior lighting control by correcting terminology and providing different control allowances in habitable spaces versus other specific locations in residential occupancies.

REPI-108-21

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

2021 International Energy Conservation Code

Revise as follows:

R404.2 (N1104.2) Interior lighting controls. Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture. **Exception:** Lighting controls shall not be required for the following lighting fixtures:

1. Bathroom~~s~~ lighting.
2. Hallway~~s~~ lighting.
3. ~~Exterior lighting fixtures.~~
4. ~~4~~ 3. Lighting designed for safety or security.

Reason: As currently written, the exception in 404.2 appears that exempts lighting controls for exterior lighting fixtures appears to conflict with the requirements for exterior lighting controls in 404.3.
This proposal clarifies that the control requirements of 404.2 only apply to interior lighting fixtures and removes the language about exterior lighting fixtures to prevent any confusion.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This is an editorial correction that will have no impact on the cost of construction.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Aligns language with section title.

REPI-111-21

Proponents: Jeremy Williams, representing U.S. Department of Energy (jeremy.williams@ee.doe.gov)

2021 International Energy Conservation Code

Add new text as follows:

R404.4 (N1104.4) Electric readiness. Systems using fossil fuel: water heaters, household clothes dryers, conventional cooking tops or conventional ovens shall comply with the requirements of Sections R404.4.1 through R404.4.4. All water heating systems shall comply with the space requirements of Section R404.4.5.

R404.4.1 (N1104.4.1) Cooking products. An individual branch circuit outlet with a rating not less than 250-volts, 40-amperes shall be installed, and terminate within three feet of conventional cooking tops, conventional ovens or cooking products combining both.

Exception: Cooking products not installed in an individual dwelling unit.

R404.4.2 (N1104.4.2) Household Clothes Dryers . An individual branch circuit outlet with a rating not less than 240-volts, 30-amperes shall be installed, and terminate within three feet of each household clothes dryer.

Exception: Clothes dryers that serve more than one dwelling unit and are located outside of a dwelling unit.

R404.4.3 (N1104.4.3) Water heaters. An individual branch circuit outlet with a rating not less than either 240-volts, 30-amperes or 120V, 20-amperes shall be installed, and terminate within three feet of each fossil fuel water heater.

Exception: Water heaters in a centralized water heating system serving multiple dwelling units in a R-2 occupancy.

R404.4.4 (N1104.4.4) Electrification-ready circuits. The unused conductors required by Sections R404.4.1 through R404.4.3 shall be labeled with the word “spare.” Space shall be reserved in the electrical panel in which the branch circuit originates for the installation of an overcurrent device. Capacity for the circuits required by Sections R404.4.1 through R404.4.3 shall be included in the load calculations of the original installation.

R404.4.5 (N1104.4.5) Water heater space. An indoor space that is at least 3 feet (0.91 m) by 3 feet (0.91 m) wide by 7 feet (2.13) high shall be available surrounding or within 3 feet (0.91 m) of the installed water heater.

Exceptions:

1. Installed heat pump, electric tankless, or fossil fuel tankless water heaters.
2. Water heaters in a centralized water heating system serving multiple dwelling units in a R-2 occupancy.

Reason: This proposal enhances customer choice by making it easy for homeowners to choose either electric or gas appliances and water heating equipment. By ensuring that a home built with gas or propane can easily accommodate future electric appliances and equipment, this proposal protects homeowners from future costs, should natural gas become less affordable or even unavailable over the life of the building. As the electric grid becomes cleaner, and high-efficiency electric heat pump technology increasingly offers utility bill and pollution reduction benefits over gas, more customers may want to transition from natural gas to electric space and water heating. Federal, state, and local environmental and public health policies may also encourage, or even require the transition in some areas over the life of the building. Electric-ready requirements will protect customers from potential high retrofit costs.

Cost Impact: The code change proposal will increase the cost of construction.
The cost of meeting these electric-ready requirements when the house is being built, walls are open, and the trades are already on-site, is marginal. In comparison, the cost of retrofitting a building for these requirements can be orders of magnitude higher and act as a barrier for the homeowner to choose electric appliances. An electrification engineering study reports that the electrical modifications needed to install a HP heating system and a HPWH is $2,100 as a retrofit compared to $500 as an original install for a single family home (Group-14 2020). Not making new buildings electric-ready would leave homeowners exposed to potentially high retrofit costs in the future and will greatly inhibit customer choice.

Bibliography: Group 14 Engineering. 2020. *Electrification of Commercial and Residential Buildings: An Evaluation of the System Options, Economics, and Strategies to Achieve Electrification of Buildings.* Prepared for Community Energy, Inc.
Franconi, E and V Salcido. 2021. *Electric Readiness in Residential Energy Code*. Pacific Northwest National Laboratory. Richland, Washington. https://www.energycodes.gov/sites/default/files/2021-10/TechBrief_Electric_Readiness.pdf

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: addressed options for outlets and the space provided for equipment

REPI-115-21

Proponents: Joseph Cain, representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

2021 International Energy Conservation Code

Add new definition as follows:

ENERGY STORAGE SYSTEM (ESS) . One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time.

Add new text as follows:

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

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

R404.4 Electrical energy storage system. One- and two-family dwellings, townhouse units, and Group R-3 occupancies shall either comply with R404.4.1 or R404.4.2. Buildings with Group R-2 and R-4 occupancies shall comply with C405.15.

R404.4.1 Electrical energy storage energy capacity. Each building shall have a ESS with a minimum rated energy capacity of 5 kWh with a minimum of four ESS supplied branch circuits.

R404.4.2 Electrical energy storage system ready. Each building shall be energy storage ready area in accordance with Sections R404.4.2.1 through R404.2.2.4.

R404.4.2.1 Energy storage system space. Interior or exterior space with dimensions and locations in accordance with Section R328 of the *International Residential Code* and Section 110.26 of NFPA 70 shall be reserved to allow for the future installation of an *energy storage system*.

R404.4.2.2 System Isolation Equipment Space. Space shall be reserved to allow for the future installation of a transfer switch within 3 feet (305 mm) of the main panelboard. Raceways shall be installed between the panelboard and the transfer switch location to allow the connection of an *ESS*.

R404.4.2.3 Panelboard with backed-up load circuits. A dedicated raceway from the main service to a panelboard that supplies the branch circuits served by the *ESS*. All branch circuits are permitted to be supplied by the main service panel prior to the installation of an *ESS*. The trade size of the raceway shall be not less than one inch. The panelboard that supplies the branch circuits shall be labeled "Subpanel reserved for future battery energy storage system to supply essential loads."

R404.4.2.4 Branch circuits served by ESS. A minimum of four branch circuits shall be identified and have their source of supply collocated at a single panelboard supplied by the *ESS*. The following end uses shall be served by the branch circuits:

1. A refrigerator.
2. One lighting circuit near the primary egress.
3. A sleeping room receptacle outlet.

Revise as follows:

TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Electrical energy storage system

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

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Electrical energy storage
R406.3	Building thermal envelope

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

Reason: As deployment of distributed energy resources such as solar photovoltaic systems increases, so does the need for distributed energy storage resources to minimize grid impacts. Solar PV systems are known to be an intermittent power source, with peak power generation at mid-day and reduced power generation in the late afternoon and into early evening. Energy storage systems such as Battery Energy Storage Systems charge during the peak PV generation hours, and begin to discharge in late afternoon and evening as the sun sets. Considering these energy storage systems reduce the backfeed into the grid, they help with grid management, as well as provide a financial buffer for differing net energy metering policies by states and utilities. In an ideal case, a home with PV and ESS can be nearly "invisible" to the grid.
In recent news we have seen extended grid power outages in multiple regions of the U.S. owing to severe environmental events such as fire, wind, hurricanes, and flooding. Many homeowners in regions with a history of recurring grid power outages have acquired gas-powered generators to serve as their backup power source. People need power to keep food from spoiling in refrigerators and freezers, as well as to refrigerate their medicines. Many people need to power medical devices, which can be as common and simple as CPAP machines. And of course, basic communications means a need for charging cell phones and other electronics.

Solar photovoltaic systems paired with battery storage systems can operate to serve these basic needs indefinitely. Stand-alone battery storage systems can serve short-term needs. Manufacturers of electric vehicles are providing more options for connecting vehicle batteries to home electrical systems.

The cost of battery storage systems is declining. As the market expands, the cost will continue to drop. During the years the 2024 IECC will be in effect, it will help to have storage readiness, to provide for reduced cost of ESS installation, and dedicated circuits to direct backup power where it is needed the most.

This proposal is based on the ESS Ready provisions that will appear in California's 2022 Building Energy Efficiency Standards as a mandatory measure. The specific requirements -- and the cost consideration -- have been prepared by the California Energy Commission.

Cost Impact: The code change proposal will increase the cost of construction.
The proposed requirements are based on mandatory measures in California Energy Commission's 2022 Building Energy Efficiency Standards. The goal of the CEC was an estimated cost for ESS readiness of no more than about $200 to $250 per home, which will vary by location and builder. For any homes that have ESS installed in the future, ESS readiness will save more money at the time of installation than money spent in the cost of readiness.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: This proposal requires readiness for energy storage systems, to reduce future cost of retrofit of ESS, and improves opportunities for resilience by designating minimum required circuits for backup power during grid power outages.

REPI-117-21

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

2021 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. 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 Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

~~Exception~~ Exceptions:

1. 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.
2. The 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 the energy cost for an all-electric building with on-site renewable energy installed.

Reason: A new exception is needed for those buildings that are using 100% renewable energy. When a building is using 100% renewable energy, the source multiplier has the same value for the standard reference design and the proposed design.
Under the "captured energy" approach, the source multiplier for renewable electricity is 1.0. If the standard reference design uses 100 kWh, that is equal to 341,200 site Btu's and 341,200 "source" Btu's. If the proposed design uses 70 kWh, that is equal to 238,840 site Btu's and 238,840 "source" Btu's. There is no difference in the results. Even if another value, such as 1.05 were used, the difference / percentage reduction would still be the same (30%), as the ratio would be (70 * 1.05) / (100 * 1.05) = 70/100.

Under the "infinite energy" approach, the source multiplier for renewable electricity is 0.0. In this scenario, by using the "source" value, the standard reference design uses 0.0 "source" Btu's and the proposed design uses 0.0 "source" Btu's. For this situation, it is analytically necessary to use site energy as the basis of comparison.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposed change only adds an exception for the building performance analysis and has no impact on construction costs.

Bibliography: ASHRAE Standard 105-2021, *Standard Methods for Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emissions*, Appendix J and Appendix K, 2021, Atlanta, GA

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: adds exceptions to allow annualized consideration for renewables.

REPI-118-21

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of *U*-factor times assembly area, shall be less ~~greater~~ 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. ~~levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.~~ The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.$UA_{Proposed\ design} \leq 1.15 \times UA_{Prescriptive\ reference\ design}$ (Equation 4-1)
3. 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 Data System Prices and Expenditures reports. 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 proposal is to improve the mandatory thermal envelope trade-off backstop applicable to the performance compliance path. This proposal improves the efficiency and usability of the *IECC* by combining two successful concepts incorporated into the 2021 *IECC:*

- First, it adds some flexibility to the performance path backstop by changing the thermal envelope backstop from values in the 2009 *IECC* prescriptive tables to a calculation based on a percentage (115%) of the Total UA of the current code's envelope requirements. This would make the performance path backstop consistent with the ERI backstop for projects without on-site generation in Section R406.3.1. The ERI backstop, which was originally based on the 2009 *IECC* in the 2015 and 2018 editions of the *IECC*, was changed to a Total UA-based backstop in the 2021 *IECC* as a result of Proposal No. RE150-19 (as modified by the Committee). We believe that code users would benefit from both trade-off backstops working in the same way.
- Second, this proposal will improve efficiency and streamline future code development by replacing a reference to envelope requirements from an older code edition with a reference to the current code requirements. Basing the calculation on the current code helps ensure that improvements to the code baseline each cycle will be reflected in the backstop without a need for additional code change proposals in the future. This will also simplify compliance and enforcement efforts by reducing the need to refer to other code books.

An effective thermal envelope backstop is crucial to ensure that the home retains reasonable envelope performance (U-factor and SHGC) (similar to the prescriptive path) under alternative compliance paths (such as the performance path, ERI, etc.) and that the envelope is not unduly traded-off for other measures. Trading off envelope and associated occupant comfort can have direct impacts on energy usage. For example, if the occupant responds to discomfort from a "cold" or "hot" room due to an inadequate building envelope by adjusting the thermostat, the additional energy use from the adjusted thermostat can be substantial. Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R6 table pix.png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	**Nat'l Avg**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
+1 Degree Heating	4.1%	0.5%	3.0%	4.2%	4.4%	4.7%	4.5%	4.0%	2.9%
-1 Degree Cooling	3.2%	7.8%	5.3%	3.9%	2.6%	1.8%	1.4%	0.7%	0.4%

An effective envelope trade-off backstop can help improve occupant comfort and can save significant energy and energy cost.

As the *IECC* is improved in 2024 and future cycles to meet the nation's demand for more efficient and resilient buildings and reduced greenhouse gas production, we believe that improved and streamlined trade-off backstops play a very important role. These backstops are critical consumer protections that will maintain a minimum level of building thermal envelope efficiency across all new homes, providing long-term comfort and energy savings for homeowners, and more broadly, reducing peak demand and greenhouse gas production at the state and national level.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not increase the baseline stringency of the *IECC*, and whether the proposal results in increased or decreased costs ultimately depends on compliance choices made by the code user in each case (including the choice of compliance path). The added flexibility of moving to a UA-based backstop will allow builders to use what they conclude is the optimal combination of envelope measures to meet the building thermal envelope UA under the code, which may reduce construction costs as compared with the current backstop in some cases.

COST-EFFECTIVENESS

This proposal does not increase or otherwise affect the stringency of the prescriptive code values or necessarily result in increased costs. Instead, the performance path thermal envelope backstop only places limits on choices under an alternative compliance path (which is optional), so a cost-effectiveness analysis does not apply.

The ICC Board of Directors set the 2021 *IECC* as the baseline for future *IECC* development – and by extension made the 2021 *IECC* the basis for cost-effectiveness analyses. This means for purposes of analyzing code proposals, the existing provisions of the 2021 *IECC* are considered cost-effective and reasonable, since they are the starting point for analyses of code changes and no rollbacks are permitted. It should also be noted that US DOE found the entire 2021 *IECC* cost effective, including section R406. *See* Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC* (June 2021). Changes to trade-off backstops like this code change proposal (which utilizes U-factors and SHGCs less stringent than the prescriptive measures of the 2021 *IECC*) do not increase the stringency of that baseline or impose any additional costs to meet specific measures. In addition, if the prescriptive values are cost-effective, then the backstop values would be cost-effective. These backstops serve only as a consumer protection against excessive trade-offs, but do not require anything more than what would be required for base code compliance. Thus, a cost-effectiveness analysis would be difficult or impossible to apply and would not be informative.

Attached Files

- **R6 table pix.PNG**
  https://energy.cdpaccess.com/proposal/315/1084/files/download/182/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: The only modification is to adjust the equals sign to a less than or equals sign to align with REPI-004-21 previously approved by the full committee.

REPI-120-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R405.2 (TABLE N1105.2) REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.8	Basement Walls
R402.2.8.1	Basment wall insulation installation
R402.2.9.1	Slab-on-grade floor insulation installation
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.4.2	Fireplaces
R402.4.3	Fenestration air leakage
R402.4.4	Rooms containing fuel burning appliances
R402.4.5	Recessed Lighting
R402.4.6	Electrical and communication outlet boxes(air sealed boxes)
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.2	Hot Water boiler temperature reset
R403.3, ~~including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.6~~	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

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

TABLE R406.2 (TABLE N1106.2) REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.8	Basement walls
R402.2.8.1	Basement wall insulation installation
R402.2.9.1	Slab-on-grade floor insulation installation
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.4.2	Fireplaces
R402.4.3	Fenetration air leakage
R402.4.4	Rooms containing fuel burning appliances
R402.4.5	Recessed lighting
R402.4.6	Electrical and communication outlet boxes (air sealed boxes)
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3 ~~except Sections R403.3.2, R403.3.3 and R403.3.6~~	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Reason: Performance paths R405 and R406 really are the same in terms of how the energy model compares the as built home is modeled against a reference home. One's metric of compliance is energy cost and one is an ERI score but both have to be better than.
The objective of the different compliance paths is to offer flexibility to trade off components of the building thermal envelope. Primarily R-values and U-values. Section R405 and R406 allow some greater trade off opportunities which increases flexibility in choosing building assemblies and R-values and U-values primarily.

The intent how ever is that how the IECC calls out for things to be installed is consistent throughout the compliance path options. The pre 2021 IECC prescriptive and mandatory approach did not make this clear enough so the word requirements was adopted and these tables were created to

demonstrate that the requirements pertained to all compliance approach choices.

This proposal fills out the table to better ensure parity between the different compliance approaches. Eave baffles was the main example used in the 2021 code development cycle. Just because one can trade off the R-value if attic insulation does not mean that you don't have to install attic eave baffles in a ventilated attic assembly. In the same way the requirements added to the tables in this proposal all have to do with an installation requirement not an R-value or U-value that can be traded. These types of requirements need to be the same regardless of the compliance path chosen.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not increase cost but rather ensures that requirements of the IECC are equally required regardless of the compliance path option chosen.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Proposal initially included changes to R402.2.8 in both portions. After discussion motion was as modified with removal of R402.2.8 in both portions, and correction of missing 'e' in recessed lighting for both tables.

REPI-121-21

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

2021 International Energy Conservation Code

Revise as follows:

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.
3. 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 Data System Prices and Expenditures reports. 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 s for ~~electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1~~ all energy sources shall be obtained from ASHRAE Standard 105 (Tables K2, K4, or K8) or from another data source *approved* by the *code official.*

CHAPTER 6 [RE]
REFERENCED STANDARDS

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE - 2021	ASHRAE 105 - 2021 Standard Methods for Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emissions

Staff Note: Proponent unable to provide required copies prior to printing of monograph.

Reason: The current values in the code are not correct, as they have not been updated and do not account for regional or international differences and different key inputs. ASHRAE has updated these estimates on a regular basis, with explanations of how the estimates were derived. This proposal provides the locations of the updated estimates without reprinting the large tables into the IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This only affects estimates of source energy used for total building performance analysis, and does not have any impact on construction costs.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Proposal initially offered 2 reference points for source energy factors: IGCC and ASHRAE, after discussion motion was as modified with IGCC reference stricken

REPI-122-21

Proponents: Vladimir Kochkin, NAHB, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

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

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

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

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

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

~~3.~~ 2. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.

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

R405.2 (N1105.2) Performance-based compliance. Compliance based on total building performance requires that a *proposed design* meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The proposed total building thermal envelope UA, which is the sum of the U-factor times assembly area, shall be less ~~greater~~ 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.~~levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code*.~~ The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.

   Equation 4-1: $UA_{proposed\ design} <= 1.15 \times UA_{prescriptive\ reference}$ design.
3. For buildings without a fuel burning appliance for space heating or water heating, ~~An~~ the annual energy cost of the *proposed design* that is less than or equal to 85% of the annual energy cost of the *standard reference design*. For buildings with a fuel burning appliance for space heating or water heating, the annual energy cost of the *proposed design* that is less than or equal to 80% of 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 Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

<table>
<tr><th>BUILDING COMPONENT</th><th>STANDARD REFERENCE DESIGN</th><th>PROPOSED DESIGN</th></tr>
<tr><td rowspan="7">Heating systems[d, e, j, k]</td><td>~~For other than electric heating without a heat pump: as proposed.
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.~~</td><td>~~As proposed~~</td></tr>
<tr><td>Fuel Type/Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Product class: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies:</td><td>As proposed</td></tr>
<tr><td>Heat pump: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Non-electric furnaces: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Non-electric boilers: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td rowspan="2">Cooling systems[d, f, k]</td><td>~~As proposed.
Capacity: sized in accordance with Section R403.7.~~</td><td>~~As proposed~~</td></tr>
<tr><td>Fuel Type: Electric

Capacity: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies: Complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td rowspan="7">Service water heating[d, g, k]</td><td rowspan="7">~~As proposed.~~
Use, in units of gal/day = 25.5 + (8.5 × N_{br})
where: N_{br} = number of bedrooms.</td><td>~~As proposed~~
Use, in units of gal/day = 25.5 + (8.5 × N_{br}) × (1 – HWDS)
where:
N_{br} = number of bedrooms.
HWDS = factor for the compactness of the hot water distribution system.
<table>
<tr><th colspan="2">Compactness ratio[i] factor</th><th>HWDS</th></tr>
<tr><td>1 story</td><td>2 or more stories</td><td></td></tr>
<tr><td>> 60%</td><td>> 30%</td><td>0</td></tr>
<tr><td>> 30% to ≤ 60%</td><td>> 15% to ≤ 30%</td><td>0.05</td></tr>
<tr><td>> 15% to ≤ 30%</td><td>> 7.5% to ≤ 15%</td><td>0.10</td></tr>
<tr><td>< 15%</td><td>< 7.5%</td><td>0.15</td></tr>
</table></td></tr>
<tr><td>Fuel Type: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Rated Storage Volume: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Draw Pattern: Same as proposed design</td><td>As proposed</td></tr>
<tr><td>Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32</td><td>As proposed</td></tr>
<tr><td>Tank Temperature: 120° F (48.9° C)</td><td>Same as standard reference design</td></tr>
<tr><td>Thermal distribution systems</td><td>Duct insulation: in accordance with Section R403.3.1.

Duct location: ~~same as proposed design~~
<table>
<tr><th>Foundation Type</th><th>Slab on grade</th><th>Unconditioned crawlspace</th><th>Basement or conditioned crawlspace</th></tr>
<tr><td>Duct location (supply and return)</td><td>One-story building: 100% in unconditioned attic

All other: 75% in unconditioned attic and 25% inside</td><td>One-story building: 100% in unconditioned crawlspace

All other: 75% in unconditioned crawlspace and 25%</td><td>50% inside conditioned space

50% unconditioned attic</td></tr>
</table></td><td>Duct insulation: as proposed.

Duct location: as proposed.

Duct System Leakage to Outside:

The measured total duct system leakage rate shall be entered into the software as the duct system leakage to outside rate.

Exceptions:</td></tr>
</table>

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
	~~and 25% inside *conditioned space*~~ ~~crawlspace and 25% inside *conditioned space* attic~~	1. When duct system leakage to outside is tested in accordance with RESNET/ICC 380 or ASTM E1554, the measured value shall be permitted to be entered. 2. When total duct system leakage is measured without the air handler installed, the simulation value shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floor area*.
	Duct system leakage to outside: For duct systems serving > 1,000ft^2 of *conditioned floor area*, the duct leakage to outside rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floor area*. For duct systems serving ≤ 1,000ft^2 of *conditioned floor area*, the duct leakage to outside rate shall be 40 cfm (1132.7 L/min).	
	~~For all systems other than tested duct systems. a~~ For hydronic systems and ductless systems.a~~ A~~ 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.~~ **Exception:** ~~For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1.~~ ~~For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of *conditioned floorarea* at a pressure of differential of 0.1 inch w.g. (25 Pa).~~	~~As tested or, where not tested,~~ For hydronic systems and ductless systems, DSE shall be as specified in Table R405.4.2(2).

g. For a proposed design ~~with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design~~ without a proposed water heater, ~~a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed~~ the following assumptions shall be made for both the proposed design and standard reference design.
Fuel Type: Same as the predominant heating fuel type
Rated Storage Volume: 40 Gallons
Draw Pattern: Medium
Efficiency: Uniform Energy Factor complying with 10 CFR §130.32

j. For a proposed design with electric resistance heating, a split system heat pump complying with 10 CFR §430.32 (2021) shall be assumed modeled in the standard reference design.

k. For heating systems, cooling systems, or water heating systems not included in Table R405.4.2(1), the standard reference design shall be the same as proposed design.

TABLE R405.4.2(2) DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	NA	0.95
~~Untested d~~ Distribution system~~s~~ components entirely located in conditioned space[c]	~~0.88~~ NA	1
"Ductless" systems[d]	1	NA

a. Default values in this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in conditioned space shall mean that no component of the distribution system, including the air-handler unit, is located outside of the conditioned space.

d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air-handler enclosure.

Add new standard(s) as follows:

DOE

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

10 CFR, Part 430-2021 — Energy Conservation Program for Consumer Products: Energy and Water Conservation Standards and their compliance dates.

Reason: The 2021 IECC introduced equipment with efficiencies above federal minimums as prescriptive compliance options (Section R408) for use with both performance and prescriptive paths. This proposed change improves the usability and consistency of the performance paths by including energy neutral equipment trade-offs directly within the performance path. The change will provide energy modelers the option to demonstrate code compliance fully through Section 405 (Performance Path) without the burden of combining performance design with a limited choice of prescriptive packages in Section R408, which in many respects defeats the purpose of the performance design.
There is a major inconsistency in Section R401.2.5 (Item 2) of 2021 IECC for the performance compliance path: Item 2.1 allows the use of high efficiency equipment for compliance through Section 408, whereas the parallel option - Item 2.2 - does not allow the use of higher efficiency equipment for compliance. There is no basis for this disparity and is a significant oversight.

Furthermore, the goals set out in the new IECC framework cannot be reasonably achieved without the option to use higher efficiency mechanical systems. Building envelope requirements are already at the levels that exceed rational cost effectiveness criteria, even on a life-cycle basis. Therefore, equipment efficiency must be a design choice in the performance path.

This proposal provide a balanced approach to energy neutral trade-offs by including an additional thermal envelope backstop via a UA calculation. (We leave it to the judgment of the committee whether the current backstop to 2009 IECC is already sufficient or if both backstops are needed.) 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) and a similar calculation is done for windows. Energy neutral equipment trade-offs had been in the IECC residential section in the past. 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

EnergyStar

RESNET 301

Cost Impact: The code change proposal will decrease the cost of construction.
This change will help achieve higher performing dwellings while adding flexibility. It will provide an option to optimize performance and increase cost-

effectiveness.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: changes the envelope backstop and increases trade-offs for mechanical equipment in return for modifying the % of energy savings required in R405. The proponent also agreed to support a further modification to include HRV/ERV requirements in the performance path where required in the prescriptive path.

REPI-124-21

Proponents: Mike Moore, Stator LLC, representing Broan-NuTone (mmoore@statorllc.com)

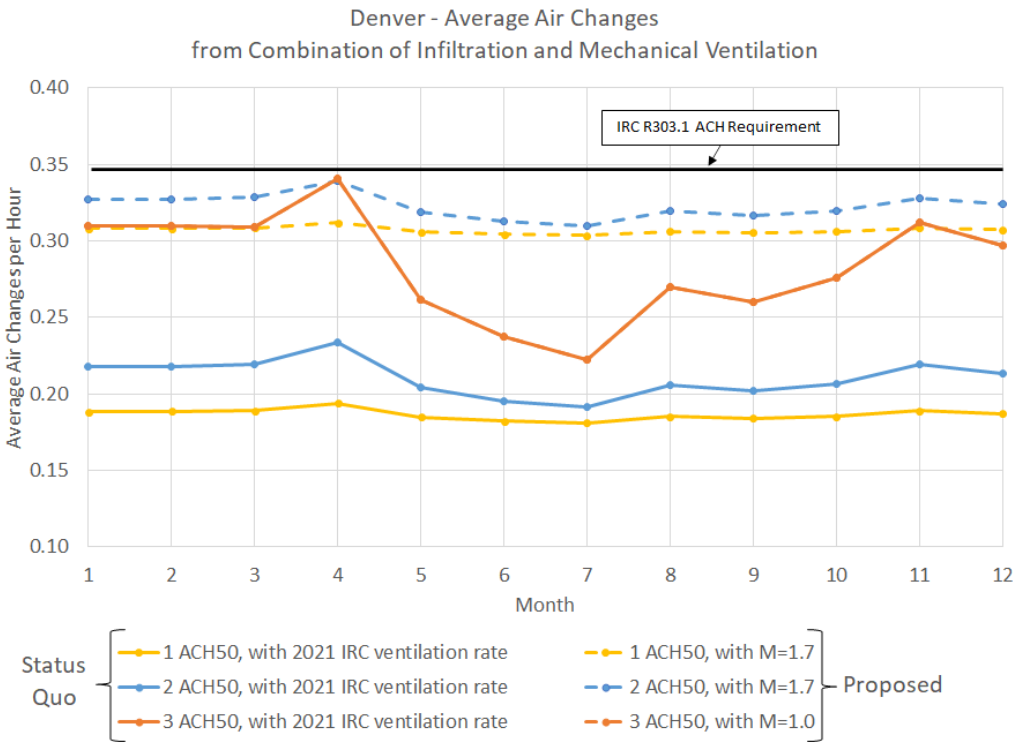
2021 International Energy Conservation Code

Revise as follows:

TABLE R405.4.2(1) (TABLE N1105.4.2(1)) SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS
Portions of table not shown remain unchanged.

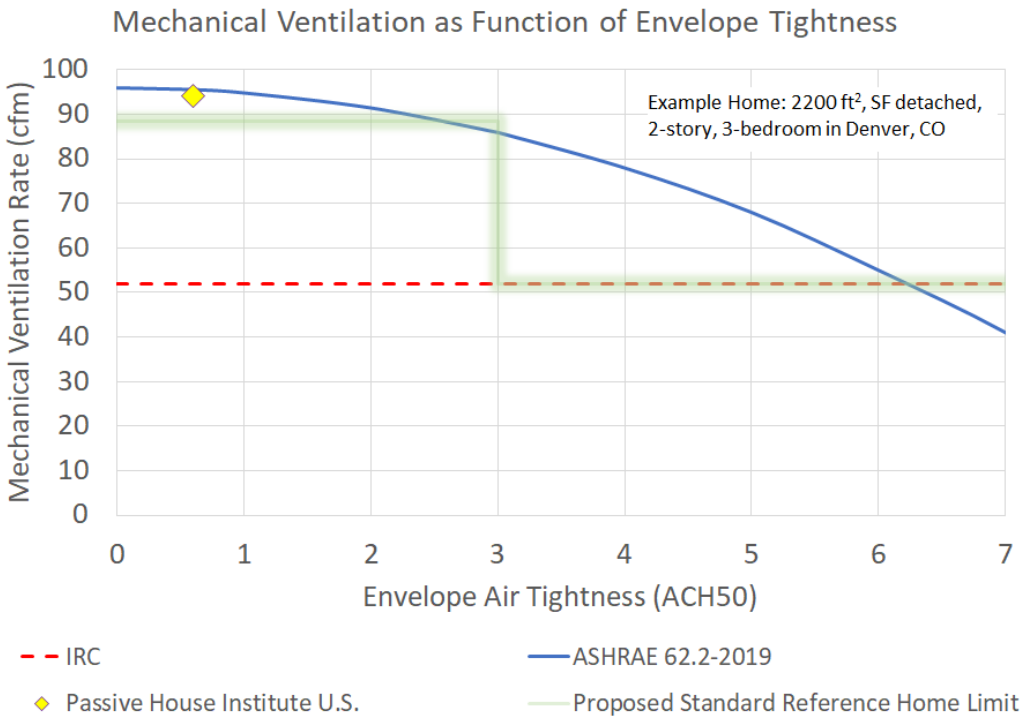
BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 0 through 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour.	The measured air exchange rate.[a]
	The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than B x M~~0.01 × *CFA* + 7.5 × (N_{br} + 1)~~ where: B = 0.01 × *CFA* + 7.5 × (N_{br} + 1), cfm. *M = 1.0 where the measured air exchange rate is > = 3.0 air changes per hour at 50 Pascals, and otherwise, M = minimum (1.7, Q/B)* *Q = the proposed mechanical ventilation rate, cfm.* *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms. The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	The mechanical ventilation rate[b], Q, shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal ~~(1/e_f) × [0.0876 × *CFA* + 65.7 × (N_{br} + 1)]~~ (8.76 × B × M)/e_f where: B and M are determined in accordance with the Air Exchange Rate row of this table. e_f = the minimum fan efficacy, as specified in Table 403.6.2, corresponding to the system type at a flow rate of B × M(~~0.01 × *CFA* + 7.5 × (N_{br} + 1)~~) . *CFA* = conditioned floor area, ft^2. N_{br} = number of bedrooms.	As proposed

Reason: Within very tight homes, this proposal would permit builders and homeowners to increase mechanical ventilation rates to a more reasonable level without imposing an IECC performance path penalty. The IECC incentivizes builders to build as tightly as possible, which is good. However, the IECC penalizes builders for providing mechanical ventilation at rates that are minimally compliant with consensus standards (ASHRAE 62.2-2019), minimally compliant with IRC R303.1, and that are above the minimum required by IRC M1505.4.3; this is bad. Because the IRC M1505.4.3 mechanical ventilation rate is not calculated as a function of the building envelope air tightness, the combination of the IECC and IRC requirements encourages builders to build homes with air changes that can be ~50% lower than the 0.35 air changes per hour (ACH) that has traditionally been the target for minimum acceptable indoor air quality (see IRC Section R303.1).
The following graph shows monthly average air changes rates (i.e., total air changes resulting from mechanical ventilation combined with infiltration from building envelope leakage) in Denver, CO for a typical 2200 ft^2 single-family dwelling unit, calculated using the ASHRAE Handbook of Fundamentals.[1] The solid lines show the monthly average air changes resulting from a builder tightening a home without increasing the minimum IRC M1505.4.3 mechanical ventilation rate. At 3.0 ACH50, the home is expected to have an annual average air change rate of 0.28 ACH, which is 20% lower than the 0.35 ACH target. However, if the same home is tightened to 1.0 ACH50 without increasing the mechanical ventilation rate, the annual average air change rate decreases to 0.18 ACH, which is almost 50% lower than the 0.35 ACH target! To incentivize builders to build tight without penalizing them for providing reasonable number of air changes, the performance path's standard reference mechanical ventilation rate should permit higher ventilation rates for very tight construction (i.e., < 3.0 ACH50). In the example chart below, the dashed lines show the maximum air change rate (combined infiltration and mechanical ventilation rate) for the standard reference home that would be permitted by this proposal. These rates are still lower than the traditional 0.35 ACH target and strike a more reasonable balance between health and energy concerns than Table R405.4.2(1)'s current language.



Why did the ASHRAE Ventilation Rates and IRC Ventilation Rates Diverge?

The IRC M1505.4.3 ventilation rate was developed based on the ASHRAE 62.2-2010 ventilation rate equation, which was built around the assumption of the ventilation system being installed in a fairly leaky building that was typical practice at the time (i.e., ~6 - 7 ACH50). In 2012, the IECC required building air sealing to be verified by a blower door test for the first time. In 2013, ASHRAE 62.2 responded to the IECC building air sealing requirements by changing the ventilation rate equation to be a function of the building envelope air tightness level. This change by ASHRAE was intended to provide an occupant with the same amount of fresh air (on an annual basis), regardless of how tightly the occupant's home is constructed. Unfortunately, the IRC M1505.4.3 ventilation rates have not kept pace with improvements in building air sealing. The chart below illustrates how ASHRAE 62.2-2019 rates change as a function of envelope air tightness, which results in comparable fresh air regardless of building tightness. This proposal would permit tight homes (i.e., those with an air tightness below 3 ACH50) to step up their mechanical ventilation rate to a rate comparable to the ASHRAE 62.2-2019 and the IRC R303.1 minimum ventilation rate without penalty.



Why is it Important to have the OPTION to Specify Higher, Reasonable Ventilation Rates without Penalty?

The total ventilation rates promulgated by ASHRAE 62.2-2019 and IRC R303.1 have long been referenced as rates needed to provide minimum acceptable indoor air quality. It is expected that occupants seeking improved IAQ may elect to use these rates that are higher than the IRC M1505.4.3 minimum to reduce pollutant concentration and support better productivity and health outcomes, which have also been linked to increases in wages. Studies that have shown better health outcomes or improved performance for building occupants as a function of higher ventilation rates include:

- Sundell[2]: Sick building syndrome declines as ventilation rate increases.
- Milton[3]: Sick leave decreases as ventilation rate increases.
- Bornehag[4]: Risk of asthma for children increases with decreasing ventilation rate in homes.
- Seppänen[5] : Productivity decreases with decreasing ventilation rate.
- Tejsen[6]: Productivity increases with increasing residential ventilation rate.

While some of these studies were conducted in commercial buildings, LBNL's[7] analysis of residential studies concluded that, "Just over half of (residential) studies report one or more statistically significant health benefits of increased ventilation rates." LBNL noted that, "The findings of research on how ventilation rates in homes affect health are mixed," but that "overall… the number of reported statistically significant improvements in health with increased ventilation rates far exceeded the anticipated chance improvements in health."

Additional Q&A

Q1: What happens if the proposed building envelope is 3 ACH50 or greater?

A1: There is no change to current requirements.

Q2: What happens if the builder doesn't increase the proposed design mechanical ventilation rate beyond the IRC Section M1505.4.3 minimum?

A2: In this case, Q/B = 1, M = 1 (i.e., minimum(1.7, Q/B) = 1), BxM = B, and there is no change to the current requirements.

Q3: What if the builder triples the proposed design mechanical ventilation rate beyond the IRC Section M1505.4.3 minimum?

A3: In this case, Q/B = 3, M = 1.7 (i.e., minimum(1.7, Q/B), and BxM = 1.7B, meaning the mechanical ventilation rate of the standard reference home increases to 1.7 times the IRC Section M1505.4.3 minimum. The builder would be penalized for the energy use associated with the difference between the proposed design mechanical ventilation rate of 3B and the standard reference home's ventilation rate of 1.7B.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
In some cases, this proposal could increase the estimated savings associated with mechanical ventilation systems in very tight construction. This could help to reduce construction costs.

Bibliography:

1. ASHRAE Handbook of Fundamentals. 2017. Chapter 17 Enhanced Model.
2. Sundell et al. 1994. Sick Building Syndrome (SBS) in Office Workers and Facial Skin Symptoms among VDT-Workers in Relation to Building and Room Characteristics: Two Case-Referent Studies. Indoor Air, 4: 83-94.
3. Milton et al. 2000. Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification, and Occupant Complaints. Indoor Air, 10:212-221.
4. Bornehag, C & Sundell, Jan & Hägerhed, Linda. (2003). Asthma and allergy among children and the association to ventilation rate at home, a case control study. Epidemiology. 14. 10.1097/00001648-200309001-00224.
5. Seppänen, O. A., and W. Fisk. 2006. Some quantitative relations between indoor environmental quality and work performance or health. HVAC&R Research 12 (4):957–73. doi:10.1080/10789669.2006.10391446.
6. Tejsen et al. 2016. The effects of bedroom air quality on sleep and next-day performance. Indoor Air, 26:679-686.
7. LBNL. Indoor Air Quality Scientific Findings Resource Bank. Building Ventilation. Accessed May 6, 2021. https://iaqscience.lbl.gov/ventsummary#:~:text=Just%20over%20half%20of%20studies,improve%20with%20increased%20ventilation%20rates.

Attached Files

- **Denver Average Air Changes.png**
  https://energy.cdpaccess.com/proposal/272/912/files/download/201/
- **Mechanical Ventilation as Function of Envelope Tightness.png**
  https://energy.cdpaccess.com/proposal/272/912/files/download/200/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: this proposal would permit builders and homeowners to increase mechanical ventilation rates to a more reasonable level without imposing an IECC performance path penalty.

REPI-126-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing BUILDTank, Inc. (robby@btankinc.com)

2021 International Energy Conservation Code

Revise as follows:

R406.2 (N1106.2) ERI compliance. Compliance based on the Energy Rating Index (ERI) requires that the rated design meets all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum ERI values indicated in ~~of~~ Table R406.5.

TABLE R406.2 (TABLE N1106.2) REQUIREMENTS FOR ENERGY RATING INDEX

SECTION[a]	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.8	Basement walls
R402.8.1	Basement wall insulation installation
R402.2.9.1	Slab-on-grade floor insulation installation
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.4.2	Fireplaces
R402.4.3	Fenetration air leakage
R402.4.4	Rooms Containing fuel burning appliances
R402.4.5	Recessed Lighting
R402.4.6	Electrical and Communication outlet boxes (air sealed boxes)
Mechanical	
R403.1	Controls
R403.2	Hot water boiler temperature reset
R403.3 ~~except Sections R403.3.2, R403.3.3 and R403.3.6~~	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

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

Delete without substitution:

~~**R406.3 Building thermal envelope.** Building and portions thereof shall comply with Section R406.3.1 or R406.3.2.~~

~~**R406.3.1 On-site renewables are not included.** Where on-site renewable energy is not included for compliance using the ERI analysis of Section R406.4, 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 0 through 3 shall be 0.30.~~

~~$UA_{Proposed\ design} = 1.15 \times UA_{Prescriptive\ reference\ design}$ (Equation 4-1)~~

~~**R406.3.2 On-site renewables are included.** Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the *building thermal envelope* shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2018 *International Energy Conservation Code.*~~

Revise as follows:

R406.3 ~~**R406.4 (N1106.4)**~~ **Energy Rating Index.** The Energy Rating Index (ERI) shall be determined in accordance with ANSI/RESNET/ICC 301. ~~except for buildings covered by the *International Residential Code* , the ERI reference design ventilation rate shall be in accordance with Equation 4-2.~~

~~**(Equation 4-2)**~~

Delete equation that is an image

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the *ERI reference design* or the *rated design.* ~~For compliance purposes, any reduction in energy use of the rated design associated with on-site renewable energy shall not exceed 5 percent of the total energy use.~~

R406.4 ~~**R406.5 (N1106.5)**~~ **ERI-based compliance.** Compliance based on an ERI analysis requires that the *rated proposed design* and confirmed built dwelling be shown to have an ERI less than or equal to the appropriate value indicated in Table R406. 4 ~~5~~ when compared to the *ERI reference design*, as follows: ~~.~~

1. Where on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP applies.
2. Where on-site renewables are installed, the maximum ENERGY RATING INDEX INCLUDING OPP applies.

Exception: Where the ERI analysis excludes OPP, the maximum ENERGY RATING INDEX NOT INCLUDING OPP shall be permitted.

TABLE R406.4 ~~R406.5 (TABLE N1106.5)~~ MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX with OPP
0- 1	~~52~~ 51	40
2	~~52~~ 51	40
3	~~51~~ 50	40
4	~~54~~ 53	40
5	~~55~~ 54	40
6	~~54~~ 53	40
7	~~53~~ 52	40
8	~~53~~ 52	40

R406.5 ~~R406.6 (N1106.6)~~ Verification by approved agency. Verification of compliance with Section R406 as outlined in Sections R406.3 ~~R406.4~~ and R406.5 ~~R406.6~~ shall be completed by an *approved* third party. Verification of compliance with Section R406.2 shall be completed by the authority having jurisdiction or an *approved* third-party inspection agency in accordance with Section R105.4.

R406.6 ~~R406.7 (N1106.7)~~ 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 ~~R406.7.1~~ through ~~R406.7.4~~ R406.6.4.

R406.6.1 ~~R406.7.1 (N1106.7.1)~~ Compliance software tools. Software tools used for determining ERI shall be *Approved* Software Rating Tools in accordance with ANSI/RESNET/ICC 301.

R406.6.2 ~~R406.7.2 (N1106.7.2)~~ Compliance report. Compliance software tools shall generate a report that documents that the home and the ERI score of the *rated design* complies with Sections R406.2, R406.3 and R406.4 . Compliance documentation shall be created for the proposed design and shall be submitted with the application for the building permit. Confirmed compliance documents of the built *dwelling unit* shall be created and submitted to the code official for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R406.6 .2.1 ~~R406.7.2.1~~ and R406.6 .2.2 ~~R406.7.2.2~~.

R406.6.2.1 ~~R406.7.2.1 (N1106.7.2.1)~~ Proposed compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other *building site* identification.
2. Declare ERI on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table R406.5 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R*-values or *U*-factors; assumed duct system and building envelope air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R406.6.2.2 ~~R406.7.2.2 (N1106.7.2.2)~~ Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.

6. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections R406.2 and R406.4. The certificate shall report the energy features that were confirmed to be in the home, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.

R406.6.3 ~~R406.7.3 (N1106.7.3)~~ Renewable energy certificate (REC) documentation. Where on-site renewable energy is included in the calculation of an ERI, one of the following forms of documentation shall be provided to the code official:

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

R406.6.4 ~~R406.7.4 (N1106.7.4)~~ Additional documentation. The *code official* shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *ERI reference design*.
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*.

R406.6.5 ~~R406.7.5 (N1106.7.5)~~ Specific approval. Performance analysis tools meeting the applicable subsections of Section R406 shall be *approved*. Documentation demonstrating the approval of performance analysis tools in accordance with Section R406.7.1 shall be provided.

R406.6.6 ~~R406.7.6 (N1106.7.6)~~ Input values. Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from RESNET/ICC 301.

Reason: The current ERI compliance alternative is overly complicated due to a lack of understanding of the energy modeling that produces an ERI index score. Because of this the Code ERI score is significantly different than other ERI system generated score which creates a lack of confidence in the compliance path, energy modeling in general, and ERI scores specifically.
Let's being with backstops. This proposal requires an ERI compliance score without onsite renewables/ onsite power production (OPP) and with OPP. It should be noted that ERI scores can only account for renewable energy that is generated on side. Offsite utility solar or wind energy, community solar gardens, and the like cannot be incorporated into the generation of an ERI score at this time.

Backstops in the current ERI compliance path complicate use of an ERI score, making the ERI compliance path the most restrictive path that is far from equal to the energy performance achieved by the other available compliance options. The objective of the current incorporated backstops is to ensure that one cannot build a poorly performing thermal envelope and then install either good mechanical systems or OPP to drive the ERI score down to a specific compliant level. This is a valid concern but one that can be handled in a much simpler way.

This proposal uses an energy modeled ERI score without OPP installed to be the backstop that protects the quality of the installed R-values and U-values of the building thermal envelope. In addition, it uses the requirement table to ensure installation of energy components in the home follow the IECC. Additions have been added to the requirement table ensuring parity of requirements across compliance paths.

An ERI score set in the 50's and calculated before OPP is installed requires that the builder install R-values and U-values in the envelope that are better than the current 2021 IECC requirements. In fact, the modeling shows that the builder is also required to install mechanical equipment that is better than federal minimums to obtain an ERI score without OPP to meet the ERI score requirements of the past and of this proposal. Therefore, it makes sense to simplify the compliance path, allow for flexibility in developing energy specifications for the house, while at the same time ensuring that the building thermal envelope cannot be less efficient than that required by the prescriptive compliance options. This is all done by setting an ERI compliance score in the 50's before OPP is installed on the home.

This proposal also requires that a score be developed with OPP. Currently the score has been set to be the same as the score without OPP meaning that the code is not mandating that renewables be installed on the home. However, a simple amendment by a progressive jurisdiction could change the two required scores to achieve climate action or other community goals they may have. For example, if the ERI score was set at 40 without OPP it would be at a about the tipping point where you can't get lower after maximizing the thermal envelope and mechanical system performance and before renewables would have to be added. So, a jurisdiction could also amend the ERI score with OPP to be zero and mandate zero energy homes. This mandate, however, allows the builder to determine what works best for them for how to achieve the ERI score of 40 without OPP.

As the Building thermal envelope is protected in this proposal by having an ERI score before OPP requirement, I am proposing that the ERI score remain the same per climate zone because they are all in the 50's. There is not a requirement to install OPP but a requirement if it is installed that the score with OPP be equal to or better than the score requirement without OPP.

Next Ventilation: The ventilation debate has been politicized in the current R406 ERI compliance option. I am not here to say that a few more or less cubic feet of air to ventilate a house is good or bad. All I know is that the primary reason for the diversion of the IECC ERI score and the true ANSI/RESNET/ICC standard 301 ERI score is the amended ventilation rate that has been implemented in the IECC adoption of the ERI compliance path. Although the average difference in ERI score is around 10 points, I have seen them differ by as much as 16. This divergence impacts not only the credibility of the ERI compliance process but of Energy Modeling as well. Since the IECC has accepted the ANSI/RESNET/ICC 301 standard as the standard by which to develop an ERI score I propose that the standard be used rather than be significantly amended. The biggest issue we need to keep at the forefront is that all IECC compliant homes are built tight to a specific IECC requirement and are ventilated. This proposal does not change that. All homes will be mechanically ventilated. The upside is more use of a compliance path.

Continuous maintenance standards vs. IECC code development. I know that it is not the norm, but this proposal seeks to use the most recent version of the ANSI/RESNET/ICC 301 standard starting with the 2024 IECC and moving forward. The reason is that the ANSI standards are under continual maintenance and significant changes for the better are made and adopted on a regular basis. The ANSI standards are phased in with compliance dates set based on the permit date of the house, usually six months into the future. So, for example, if an updated version of ANSI 301 is release on January 1st, 2022, the implementation date for that standard would be for houses permitted on June 1st, 2022. This gives time for energy modelers and builders to coordinate any changes in construction practices that may be needed to maintain compliance while allowing homes that permitted prior to June 1st, 2022, to complete using the standard that was in place at the time of the original building permit.

This change will make the ERI compliance path dynamic based on the effective dates of the ANSI 301 standard which will also allows all ERI scores based on the ANSI 301 standard to progress in unison rather than continually being out of sync. As the public, builders, jurisdictions, and the ICC do not truly understand all these nuances and do not realize that currently Section R406 ERI is a snapshot in time where the sole audience should be local code officials only, this break from the norm makes sense in this case.

As an example of this issue is put forth in a RESNET paper that states, “homes with permits in the fall of 2020 and seeking a HERS Rating will be using ANSI/RESNET/ICC Standard 301-2019. If their state has adopted 2018 IECC, their code-compliance ERI will still be based on the much older 2014 version of Standard 301 with Addendum A and B. The result is different index scores, since the older version of Standard 301 with only Addendum A and B was before amendments like the Index Adjustment Factor or the allowance of credit for LED lighting.” Link provided in Bibliography

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not change cost implications of using the ERI compliance option. Because the ERI score without OPP have not changed the path is still not as flexible as other compliance options. However, it is easier to use and is more likely to be used without significant amendments.

Bibliography: https://www.resnet.us/articles/the-iecc-energy-rating-index-and-hers-index-whats-the-difference/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Proponent modified proposal based on prior meeting input. Changes allow for modest solar trade-off while maintaining envelope UA backstop, and modest change to reduce ERI values

Proposal # 477

REPI-129-21

Proponents: William Fay, representing Energy Efficient Codes Coalition; Amy Boyce, representing Energy Efficient Codes Coalition (amy.boyce@imt.org); Amber Wood, representing Energy Efficient Codes Coalition (awood@aceee.org); Jason Reott, representing Energy Efficient Codes Coalition

2021 International Energy Conservation Code

Revise as follows:

R406.3.2 (N1106.3.2) On-site renewables are included. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the proposed total *building thermal envelope* UA, which is the sum of *U*-factor times assembly area, shall be ~~greater~~ less than or equal to the ~~levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2018 *International Energy Conservation Code*~~ building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2. The area-weighted maximum fenestration SHGC permitted shall be 0.25 in Climate Zones 0 through 3 and 0.40 in Climate Zones 4 through 5.

Reason: The purpose of this code change proposal is to improve the Energy Rating Index ('ERI") compliance path in the *IECC* by updating and adding flexibility to the mandatory thermal envelope backstop for projects with on-site generation by incorporating a UA trade-off and basing the requirements on the current *IECC*. This proposal will serve to make the two ERI backstops more consistent in approach.
These backstops are crucial to ensure that the home retains reasonable thermal envelope performance (U-factor and SHGC) under alternative compliance paths (in this case, the ERI) and that the prescriptive envelope is not unduly traded-off for other measures. Trading off envelope and associated occupant comfort can have direct impacts on energy usage. For example, if the occupant responds to discomfort from a "cold" or "hot" room due to an inadequate building envelope by adjusting the thermostat, the additional energy use from the adjusted thermostat can be substantial. Below is a summary of estimated energy use increases associated with adjusting a thermostat 1 degree higher or lower, broken out by climate zone.

[R5 table pix,png]

Increased Energy Use Resulting from Thermostat Adjustment									
Measure	**Nat'l Avg**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
+1 Degree Heating	**4.1%**	**0.5%**	**3.0%**	**4.2%**	**4.4%**	**4.7%**	**4.5%**	**4.0%**	**2.9%**
-1 Degree Cooling	**3.2%**	**7.8%**	**5.3%**	**3.9%**	**2.6%**	**1.8%**	**1.4%**	**0.7%**	**0.4%**

An effective envelope trade-off backstop can help improve occupant comfort and can save significant energy and energy cost.

In the development of the 2021 *IECC*, the EECC supported Proposal No. RE150-19 (as modified), which was submitted by the National Association of Homebuilders. RE150-19 improved the ERI thermal envelope backstop for projects without on-site generation by changing it from being based on the 2009 *IECC* prescriptive tables to a calculation based on a percentage of the Total UA of the envelope, using the current code requirements. This solution provided several benefits:

- A Total UA-based calculation provides more flexibility by allowing reasonable trade-offs among the efficiency (U-factors) of thermal envelope components to achieve an overall efficiency target;
- Basing the calculation on the current code helps ensure that improvements to the code baseline over time will be reflected in the ERI backstop without a need for additional code change proposals in the future; and
- Referencing the current code will simplify compliance by avoiding references to older versions of the code.

However, unlike the ERI envelope backstop for projects without onsite generation, similar improvements were not adopted last cycle for projects complying under ERI using on-site generation. As a result, the backstop for projects with on-site generation currently references the prescriptive values of the 2018 *IECC* (reflecting the need for a more rigorous backstop for ERI compliance using on-site generation) and does not include a UA trade-off approach. A similar backstop could also be applied to ERI calculations that incorporate on-site renewable energy, so long as the backstop is more rigorous, protecting against direct trade-offs between energy generation and the thermal envelope. The changes in this proposal provide the best solution for the two ERI thermal envelope backstops:

- It uses a Total UA-based calculation both for ERI projects with and without on-site power, improving consistency, code compliance and enforcement;
- It provides more flexibility for code users, allowing reasonable trade-offs among the efficiency (U-factor) of thermal envelope components;
- It sets the UA calculation baseline for projects with on-site renewable generation based on the level of the prescriptive envelope requirements of the current IECC to avoid rolling back the efficiency of the code and to help ensure that envelope efficiency is not traded away for additional

on-site generation; and
- It removes a reference to a previous code edition, allowing the backstop to automatically update in future editions of the code without the need for additional code change proposals.

We agree with the ICC's recent call for each new edition of the *IECC* to provide "increased energy savings over the prior edition." (*See* proposed Section R101.3 Intent.) Implicit in this call is protection of current energy savings and other *IECC* benefits, such as provided by the backstops applicable to alternative code compliance paths. Code proposals should not only seek improvement for top-performing homes on the leading edge of energy efficiency, but also for homes simply built to the code minimums. Effective thermal envelope trade-off backstops will help to maintain a reasonable level of efficiency for all homes built to the 2024 *IECC*.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal does not increase the baseline stringency of the 2021 *IECC*, and whether the proposal results in increased or decreased costs ultimately depends on compliance choices made by the code user in each case. The added flexibility of moving to a UA-based backstop will allow builders to use what they conclude is the optimal combination of envelope measures to meet the building thermal envelope UA under the code, which may reduce construction costs as compared with the current backstop in some cases.

COST-EFFECTIVENESS

This proposal does not increase or otherwise affect the stringency of the prescriptive code values or result in increased costs. Instead, the ERI thermal envelope backstop only places limits on choices under an alternative compliance path (which is optional), so a cost-effectiveness analysis does not apply.

The ICC Board of Directors set the 2021 *IECC* as the baseline for future *IECC* development – and by extension made the 2021 *IECC* the basis for cost-effectiveness analyses. This means for purposes of analyzing code proposals, the existing provisions of the 2021 *IECC* are considered cost-effective and reasonable (since they are the starting point for analyses of code changes and no rollbacks are permitted). It should also be noted that US DOE found the entire 2021 *IECC* cost effective, including section R406. *See* Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC* (June 2021). Changes to trade-off backstops like this code change proposal (which utilizes U-factors and SHGCs no more stringent than the prescriptive measures of the 2021 *IECC*) do not increase the stringency of that baseline or impose any additional costs to meet specific measures. In addition, if the prescriptive values are cost-effective, then the backstop values would be cost-effective. These backstops serve only as a consumer protection against excessive trade-offs, but do not require anything more than what would be required for base code prescriptive compliance. Thus, a cost-effectiveness analysis would be difficult or impossible to apply and would not be informative.

Bibliography: Pacific Northwest National Laboratory, *National Cost Effectiveness of the Residential Provisions of the 2021 IECC* (June 2021)

Attached Files

- **R5 table pix.PNG**
  https://energy.cdpaccess.com/proposal/313/932/files/download/180/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Considered alongside REPI-128-21 – competing backstop approaches for R406.

REPI-131-21

Proponents: Vladimir Kochkin, NAHB, representing NAHB (vkochkin@nahb.org)

2021 International Energy Conservation Code

Revise as follows:

R406.4 (N1106.4) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301. ~~except for buildings covered by the *International Residential Code* , the ERI reference design ventilation rate shall be in accordance with Equation 4-2.~~

~~Ventilation rate, CFM = (0.01 × total square foot area of house) + [7.5 × (number of bedrooms + 1)]~~ **~~(Equation 4-2)~~**

The mechanical ventilation rates used for the purpose of determining the ERI shall not be construed to establish minimum ventilation requirements for compliance with this code.

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the *ERI reference design* or the *rated design*. For compliance purposes, any reduction in energy use of the rated design associated with on-site renewable energy shall not exceed 5 percent of the total energy use.

Reason: The purpose of this proposal is to fix an inadvertent error that was introduced in the 2018 IECC during an effort to coordinate the ERI calculation procedure with the residential ventilation rates. The change in 2018 IECC resulted in a significant increase in the ERI scores. That was never the intent of the change as was confirmed by the original proponent, and it was the result of using terms that were not fully coordinated with the specific terms in Standard 301. Proposals and public comments attempted to fix this issue in 2021 IECC, but in the end none of them were approved. The proposed amendment resolves the issues in accordance with the original intent by requiring the calculation of air exchange rate in Standard 301 be aligned with IECC Table R405.4.2(1) used in the performance path calculations. This amendment will coordinate the ERI procedure with the residential mechanical code provisions on this subject. The proposed amendment also makes it clear that IECC buildings rated using the ERI are not required to meet the Standard 301 air exchange and ventilation rates -- this is added because Standard 301 uses the terms "**required** dwelling unit total exchange rate" and "total **required** ventilation rate." It's noted that the coordination between Standard 301 and this code should be done such that there is a single ERI index for buildings complying with the IECC.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal fixes an error. There is no impact on construction practices. The change will allow designers to calculate correct ERI scores.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: This proposal better aligns the R406 ERI path with the ICC/RESNET standard 301 and HERS ratings

Proposal # 293

REPI-136-21

Proponents: Ryohei Hinokuma, Daikin U.S. Corporation, representing Daikin U.S. Corporation (ryohei.hinokuma@daikinus.com)

2021 International Energy Conservation Code

Revise as follows:

R408.2 (N1108.2) Additional efficiency package options. Buildings meeting the requirements ~~Additional efficiency package options~~ for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.

R408.2.2 (N1108.2.2) More efficient HVAC equipment performance option. Heating and cooling *equipment* shall meet one of the following efficiencies:

Centrally Ducted Systems

1. Greater than or equal to 95 AFUE natural gas furnace and ~~16 SEER~~ 15.2 SEER2 in Climate Zones 5, 6, and 7 and 16.0 SEER2 in the other Climate Zones for air conditioner.
2. Greater than or equal to 95 AFUE natural gas furnace and 8.5 HSPF2/16.0 SEER2 air source heat pump.
2. ~~.~~ 3. Greater than or equal to ~~10 HSPF/16 SEER~~ 8.5 HSPF2/16.0 SEER2 air source heat pump.
3. ~~.~~ 4. Greater than or equal to 3.5 COP ground source heat pump.

Ductless Systems

1. Single Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump
2. Multi Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump (Non-Ducted Indoor Units)
3. Multi Zone: 8.5 HSPF2/15.2 SEER2 variable speed air source heat pump (Ducted or Mixed Indoor Units)

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

Reason: The 2021 IECC has implemented a new section, R408 Additional Efficiency Package Options, which defines requirements to achieve additional energy efficiency to be selected from one of the following five options: 1. Enhanced envelope performance option., 2. More efficient HVAC equipment performance option., 3. Reduced energy use in servicing water-heating option., 4. More efficient duct thermal distribution system option., and 5. Improved air sealing and efficient ventilation system option. Daikin requests that the 2024 version of IECC retains the section to continue effectively driving builders and users to optimize the energy performance of their homes.
As mentioned in our Introduction (see attached letter), variable speed heat pumps provide superior energy performance over single and two-stage equipment due to their higher efficiency attained during partial load operation. Also, ductless systems with variable speed compressors provide~~s~~ homeowners opportunities to further save energy consumption by turning off individual indoor units in unoccupied zones. For the 2024 IECC, Daikin proposes changes to R408.2 and R408.2.2 to accurately capture the energy performance superiority of variable speed air source heat pumps in both centrally ducted and ductless systems.

The metrics of HSPF and SEER are being updated to the new metrics of HSPF2 and SEER2 that will be in effect when the 2024 IECC is adopted by jurisdictions (see 10 CFR 430.32).

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October 12, 2021

The International Code Council
500 New Jersey Ave NW 6th Floor
Washington, DC 20001
Re: 2024 International Energy Conservation Code (IECC) Code Change Proposal

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Daikin U.S. Corporation ("Daikin") hereby submits the following code change proposal in response to the development process of 2024 International Energy Conservation Code (IECC). Daikin U.S. Corporation is a subsidiary of Daikin Industries, Ltd., the world's largest air conditioning equipment manufacturer. The Daikin Group includes Daikin Applied, Daikin North America LLC, and Goodman Manufacturing Company, L.P.

I. Introduction

Buildings account for 40 percent of all US energy consumption and 24 percent of its greenhouse gas (GHG) emissions[1]. Out of those, 22 percent of the consumption and 12 percent of the emissions come from residential buildings[2]. Under the Biden Administration, the United States targets to reduce its GHG emission by 50-52 percent by 2030. To achieve the decarbonization goal, energy efficiency as well as building electrification will need to play a critical role.

Replacement of lower efficiency or carbon intensive HVAC equipment with heat pumps are an effective solution to drive energy efficiency and building electrification and thus building decarbonization. Within heat pumps, variable speed heat pumps have demonstrated superior energy performance over single and two-stage equipment. For instance, the United States Environmental Protection Agency (U.S. EPA) notes that variable speed equipment and modulating systems specifically provide additional customer comfort advantages by following load, provide

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[1] Use of energy in explained - U.S. Energy Information Administration, https://www.eia.gov/energyexplained/use-of-energy/

[2] Fast Facts on Transportation Greenhouse Gas Emissions | US EPA, https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

capacities (i.e., less than 100% capacity). When operating at part-load, it can be significantly more efficient. As shown in Figure 1, variable speed equipment's efficiency increases significantly as its load reduces below 100%. This exceeds the performance of both single and two-stage equipment as load reduces. According to computer simulations, validated by the Electric Power Research Institute (EPRI), when variable speed HVAC equipment reduces its cooling capacity by 25% it results in a 43% reduction in power consumption while for single-speed equipment it would yield only a 25% reduction in power consumption[4]. However, according to National Resource Defense Council (NRDC), "current test procedures do not adequately capture the impact of a variable [speed] unit's control logic, which can have a large impact on efficiency[5]." Lastly, Daikin would like to point out that ductless systems can further improve energy performance of HVAC systems by allowing homeowners to turn off indoor units in unoccupied zones.

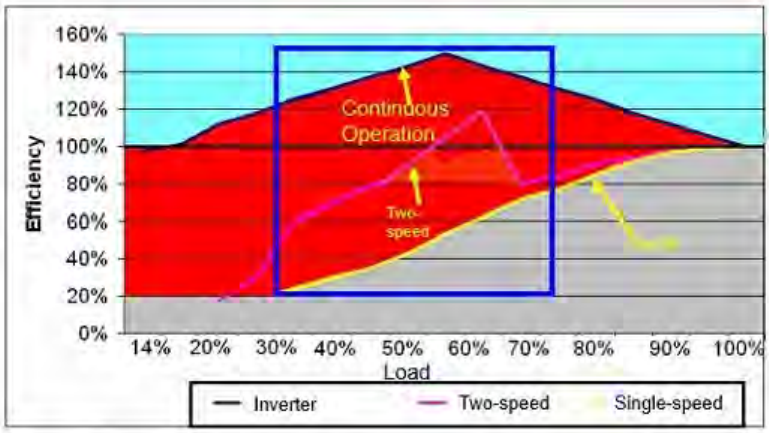

Figure 1: HVAC Equipment Efficiency at Various Part-Loads

[3] U.S. EPA, ENERGY STAR Residential Air Source Heat Pump and Central Air Conditioning Equipment Version 6.0 Discussion Guide dated August 3, 2018, https://www.energystar.gov/sites/default/files/

[4] HRAI and AHRI, Letter to U.S. EPA Regarding ENERGY STAR Residential Air Source Heat Pump and Central Air Conditioning Equipment Version 6.0 Discussion Guide dated September 21, 2018, https://www.energystar.gov/sites/default/files/AHRI_HRAI_Comments_CAC_ASHP_Discussion%20Guide_09%2021%202018.pdf

[5] NRDC, NRDC Comments on ENERGY STAR Program Requirements for Air Source Heat Pump and Central Air Conditioner Equipment Version 6.0, Draft 1 dated May 23, 2019, https://www.energystar.gov/sites/default/files/NRDC%20Comments%20on%20CACASHP%20Draft%201%20V6.0.pdf

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However, heat pumps currently account for only 12 percent of the space heating install base in the United States, whilst a significant portion of space heating installed consists of combustion equipment such as furnaces and boilers (76 percent of total)[6]. To significantly boost the proportion of heat pumps, especially variable speed heat pumps including the ones in ductless configuration, effective and aggressive market transformation will be required. Daikin believes that building codes should play a critical role in accelerating the adoption of such technologies in the United States.

Hereby, to execute the forementioned market transformation, Daikin would like to make the following code change proposals for the development process of 2024 IECC:

II. Code Change Proposal to R403.1.2 Heat Pump Supplementary Heat

The use of electric resistance heaters as backup heating devices can significantly increase winter energy consumption, and air source heat pumps can effectively provide heating without such devices including the cold climate regions in the United States. Also, Daikin has observed that it's common for heat pumps to be installed with electric resistance heaters configured to operate in conditions where sufficient heating capacity is available from the heat pump alone. This results in reducing the operation hours of heat pumps and increasing the operation hours of electric heaters. Such setting of heat pump systems will fail to yield expected reduction of GHG emissions and result in higher energy consumption and longer peak demand events. Therefore, Daikin proposes to revise R403.1.2, which defines the use of electric resistance heaters as supplementary heat for heat pumps, to prevent such practice as following:

> **R403.1.2 Heat pump supplementary heat (Mandatory).**
> Heat pumps having supplementary electric-resistance heat shall have controls that, ~~except during defrost,~~ prevent supplemental heat operation when the capacity of the heat pump ~~compressor~~ can meet the heating load. The controls shall permit supplemental heat operation only during heat pump capacity shortage, defrost operation, or for emergency use when heat pump is not operational. To ensure the use

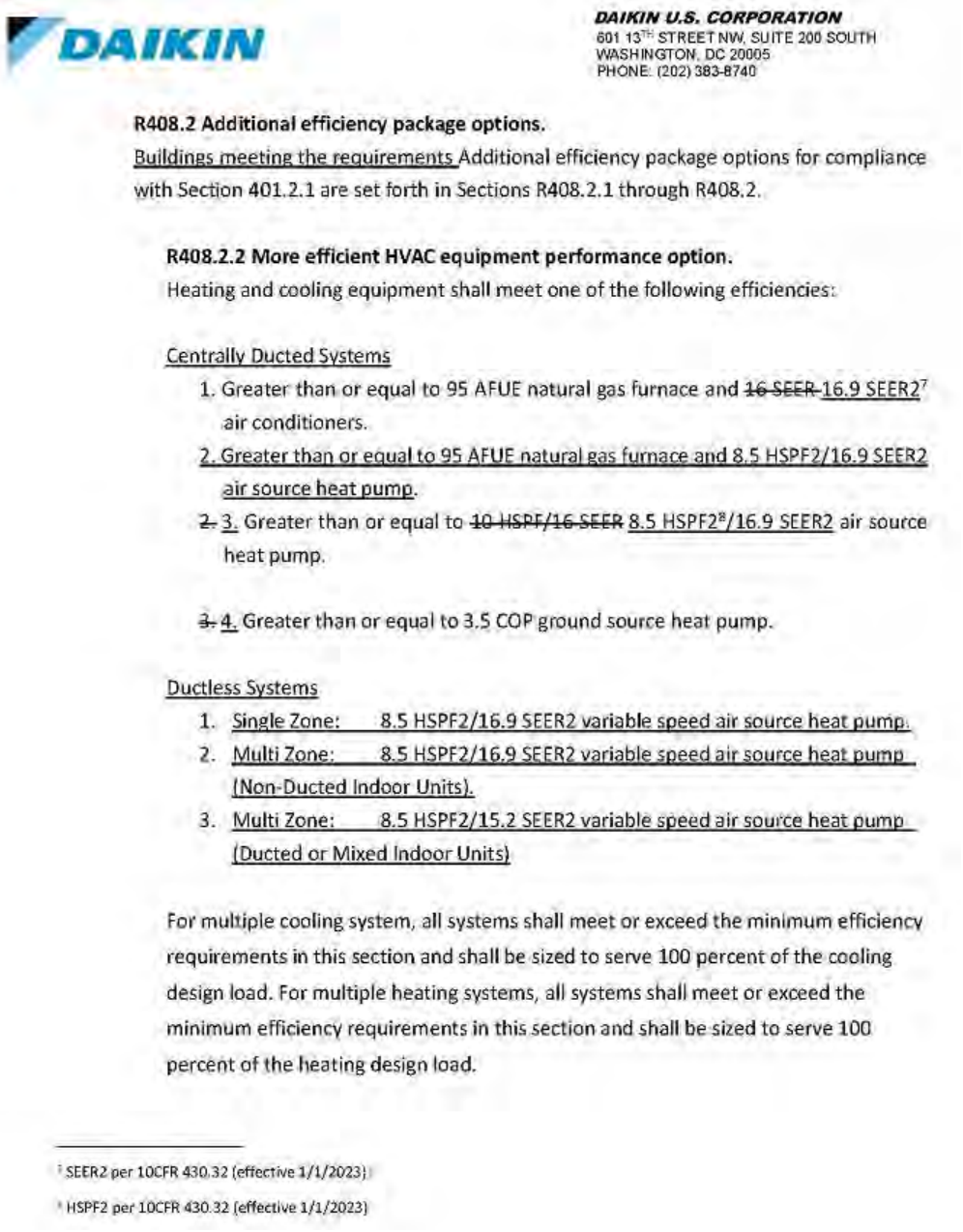
[6] Statistics Office

of electric-resistance heat for supplementary use only, the space heating design ambient temperature shall be used to switch operation from heat pumps to the resistance heat.

III. Code Change Proposal to R408.2 Additional Efficiency Package Options

The 2021 IECC has implemented a new section, R408 Additional Efficiency Package Options, which defines requirements to achieve additional energy efficiency to be selected from one of the following five options: 1. Enhanced envelope performance option., 2. More efficient HVAC equipment performance option., 3. Reduced energy use in servicing water-heating option., 4. More efficient duct thermal distribution system option., and 5. Improved air sealing and efficient ventilation system option. Daikin requests that the 2024 version of IECC retains the section to continue effectively driving builders and users to optimize the energy performance of their homes.

As mentioned in our Introduction, variable speed heat pumps provide superior energy performance over single and two-stage equipment due to their higher efficiency attained during partial load operation. Also, ductless systems with variable speed compressors provide~~s~~ homeowners opportunities to further save energy consumption by turning off individual indoor units in unoccupied zones. For the 2024 IECC, Daikin proposes the following changes to R408.2 to accurately capture the energy performance superiority of variable speed air source heat pumps in both centrally ducted and ductless systems.



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R408.2 Additional efficiency package options.

Buildings meeting the requirements Additional efficiency package options for compliance with Section 401.2.1 are set forth in Sections R408.2.1 through R408.2.

R408.2.2 More efficient HVAC equipment performance option.

Heating and cooling equipment shall meet one of the following efficiencies:

Centrally Ducted Systems

1. Greater than or equal to 95 AFUE natural gas furnace and ~~16 SEER~~ 16.9 SEER2[7] air conditioners.
2. Greater than or equal to 95 AFUE natural gas furnace and 8.5 HSPF2/16.9 SEER2 air source heat pump.

~~2.~~ 3. Greater than or equal to ~~10 HSPF/16 SEER~~ 8.5 HSPF2[8]/16.9 SEER2 air source heat pump.

~~3.~~ 4. Greater than or equal to 3.5 COP ground source heat pump.

Ductless Systems

1. Single Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump.
2. Multi Zone: 8.5 HSPF2/16.9 SEER2 variable speed air source heat pump (Non-Ducted Indoor Units).
3. Multi Zone: 8.5 HSPF2/15.2 SEER2 variable speed air source heat pump (Ducted or Mixed Indoor Units)

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

[7] SEER2 per 10CFR 430.32 (effective 1/1/2023)

[8] HSPF2 per 10CFR 430.32 (effective 1/1/2023)

Cost Impact: The code change proposal will increase the cost of construction.
This proposal may increase the cost of construction when utilizing variable speed air source heat pumps, but it will result in energy savings and lower utility costs for the end-user.

Attached Files

- **2021.10.12_Daikin Comments - 2024 IECC_Final.pdf**
  https://energy.cdpaccess.com/proposal/538/1203/files/download/207/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: proponent worked with industry to provide a proposal that is clear and provides cost benefit.

REPI-140-21

Proponents: Mike Moore, Stator LLC, representing Broan-NuTone (mmoore@statorllc.com)

2021 International Energy Conservation Code

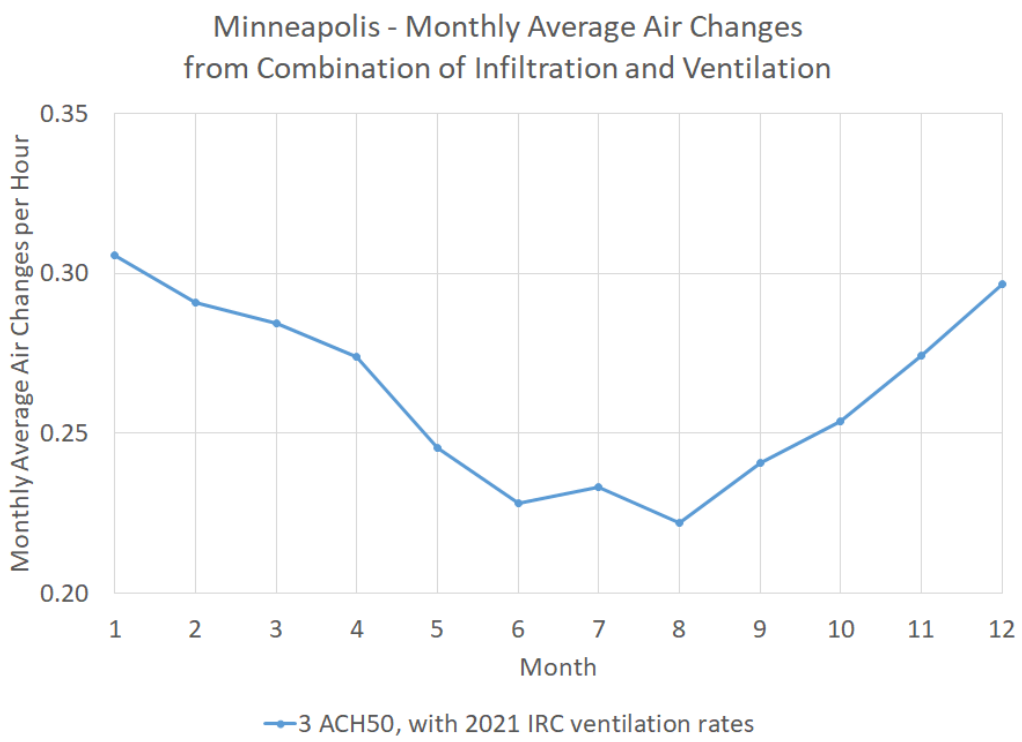
Revise as follows:

R408.2.5 (N1108.2.5) Improved air sealing and efficient ventilation system option. The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. ~~Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent~~ HRV and ERV Sensible Recovery Efficiency (SRE)~~,~~ shall be no less than 75 percent at 32°F (0°C), at the lowest listed net airflow~~less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent~~ ERV Latent Recovery/Moisture Transfer (LRMT) shall be no less than 50 percent, at the lowest listed net airflow. In Climate Zone 8, recirculation shall not be used as a defrost strategy.

Reason: This proposal removes a conflict between the H/ERV fan efficacy of this section and that of Table R403.6.2 (removing the requirement here to ensure that the higher fan efficacy of R403.6.2 takes precedent), clarifies that performance values should be *listed* values (and for SRE, uses the same reference temperature as is required in Section R403.6.1), permits recirculation defrost to be used in all climate zones but Climate Zone 8, and improves readability of the section.
Recirculation defrost draws a fraction of the electrical load of an H/ERV that uses electric resistance defrost, which is a strategy that designers may specify to meet the current Section R408.2.5 requirements. In fact, electric resistance defrost can draw over 900 Watts in a typical unit. A common criticism of recirculation defrost is that it reduces air exchange when installed in cold climates that require frequent operation of the defrost cycle – leaving occupants without access to fresh air. However, by overlaying a typical recirculation defrost control strategy on a TMY3 weather data for each climate zone, we can see that recirculation defrost cycles are very limited on an annual basis, even in cold climates:

Climate Zone	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Annual Recirc Defrost Run Time (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	3%	2%	4%	7%

In all but climate zone 8, a typical reduction in annual run time is less than 5%. Also, that reduction happens during the coldest time of the year, when infiltration of outdoor air through leaks within the building envelope is at its peak and is offsetting the reduction in mechanical ventilation (see the chart below for an illustration of total ventilation rates for a typical code compliant home). For these reasons, permitting recirculation defrost in all but climate zone 8 strikes a good balance between IAQ and energy demand.



Cost Impact: The code change proposal will decrease the cost of construction.
The proposal can help reduce costs by providing additional, energy efficient compliance options.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: proposal removes a conflict between the H/ERV fan efficacy of this section and Table R403.6.2.

Proposal # 420

REPI-142-21

Proponents: Dan Wildenhaus, representing Northwest Energy Efficiency Alliance (dwildenhaus@trccompanies.com); Kevin Rose, representing Northwest Energy Efficiency Alliance (NEEA) (krose@neea.org)

2021 International Energy Conservation Code

Add new text as follows:

408.2.6 Compact hot water distribution. For Compact Hot Water Distribution system credit, the volume shall store not more than 16 ounces of water between the nearest source of heated water and the termination of the fixture supply pipe where calculated using section R403.5.4 *Construction documents* shall indicate the ounces of water in piping between the hot water source and the termination of the fixture supply.

Reason: Inefficient hot water distribution systems have been recognized as a problem for many years as they result in energy and water waste, and result in long hot water delay times that are the cause of a significant number of complaints by new home buyers. Recirculation systems are a solution to two of the three problems (water and wait time), but the thermal energy impact of different recirculation system options has already been addressed in section **R403.5.1.1 Circulation system**.[1]
In all non-recirculation distribution options, water heater energy consumption and hot water waste are correlated. A decrease in water heater energy consumption follows a reduction in wasted water; therefore, improving insulation and reducing the piping length and/or pipe diameter have equal benefits for energy and water waste. In recirculation systems, water heater energy consumption and wasted hot water are independent, and often have an inverse effect (when recirculation is not demand based).[2]

This distribution system problem exists for a variety of factors including:

- An outdated pipe sizing methodology in the plumbing code that results in oversized hot water distribution systems since the assumed fixture flow rates are much higher than current requirements.
- Municipalities with design recommendations that force plumbers and designers to assume low supply water pressure, resulting in larger distribution piping, which waste more water and energy.
- Increasing efforts to conserve water has resulted in the realization of water savings due to improvements in showerhead and lavatory maximum flow rates; however, reduced flow rates often result in increased wait times if the hot water distribution system is not designed to accommodate lower flows.
- Increasing popularity of gas instantaneous water heaters, which offer improved operating efficiency, but can result in increased water waste when starting from a “cold start up” situation.
- Inefficient plumbing installations that are not focused on minimizing pipe length or pipe diameters.

The IECC has already addressed pipe insulation and Circulation systems in the 2021 IECC Residential provisions.

[1]*Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility*

Farhad Farahmand, TRC Companies and Yanda Zhang, ZYD Energy

[2]*Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models* E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation

Savings:

The following savings have been calculated for compact domestic hot water distribution only, as Drain Water Heat Recovery has already been included in the 2021 IECC. The California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing[3] performed savings analysis using 16 California climate zones. This analysis focused on Therm and Water Savings as it’s estimated that over 75% of Residential New Construction Water Heaters installed are gas tankless systems. Nationally, ~68% of Residential New Construction Domestic Hot Water systems are gas fueled, according to the *Home Innovation Research Lab’s Annual Builder Practices Survey, 2021*[4]. California’s climate zones correlate approximately to IECC Climate Zones 2, 3b, 3c, 4c, 5b, and 6. Savings estimated should be conservative for climate zones 4c and higher as ground temperatures and therefore incoming water temperatures in California homes may be 1 to 3ºF higher than in these cooler climates.

Energy Savings Compact Hot Water Distribution Design:In climate zones 3b and lower, first year weighted average residential energy savings (translated from Therms/yr to Mmbtu/yr) are estimated to be per Single Family Home: Climate ZoneSavings in ThermsSavings in Mmbtu2 and 3b4.480.4483c and higher5.570.557 These estimates come from assumption of a 2,430 sq ft home with 3.5 bedrooms.

[3]

California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing

[4]Home Innovation Research Labs Annual Builder Practices Survey, 2021

Water Savings

:

Estimated impacts on water use are presented in the table below. Water use savings estimates are challenging given that hot water usage behaviors among individuals and households are highly variable and can depend strongly on the demographics of the household (Parker, D.; Fairey, P.; and Lutz, J.; 2015). In addition, the proposed compliance option approach ensures that compliant hot water distribution systems will be smaller than a conventional non-compact system but cannot precisely specify the design and configuration and hence the impacts on water waste. To provide a best approximation of water savings impacts, the Statewide CASE Team relied on detailed distribution simulation study completed under the U.S. Department of Energy's Building America program (Weitzel, E.; Hoeschele, M. 2014). In these estimates, it was assumed that all water savings occur indoors.

Impacts on Water Use Table On-Site Indoor Water Savings (gal/yr) Per Dwelling Unit Impacts (single family) 962

Per Dwelling Unit Impacts (multifamily) 321

Drain Water Heat Recovery Savings:

Using the most conservative Department of Energy savings estimates of 800kWh per year, with an U.S. Energy Information Agency hybrid electricity rate for the nation of 13.5 cents per kWh show an annual savings estimate for electric water heating at: $108/yr

https://energy.cdpaccess.com/proposal/446/975/files/download/139/
https://energy.cdpaccess.com/proposal/446/975/files/download/138/
https://energy.cdpaccess.com/proposal/446/975/files/download/137/
https://energy.cdpaccess.com/proposal/446/975/files/download/136/
https://energy.cdpaccess.com/proposal/446/975/files/download/135/

Cost Impact: The code change proposal will increase the cost of construction.
Incremental first costs to builders, designers, and plumbers are design based and each builder will need to determine potential cost impacts based on existing designs and measures in use. Depending on current practices and paths taken for IECC compliance this measure may result in small incremental cost increases or decreases. These potential cost differences relative to standard practices are likely to be:

- Reduced cost of PEX or copper tubing due to less material installed.
- Reduced cost to pipe insulation due to smaller plumbing layout.
- Reduced or neutral cost in labor hours for plumber.
- Increased water heating venting costs, if a gas water heater or electric heat pump water heater is centrally located.
- Increased venting labor costs, if a gas water heater or electric heat pump water heater is located is centrally located and not on a garage wall.

This measure should not have maintenance costs associated with it compared to standard practices.

Energy Savings and Cost Impact for Drain Water Heat Recovery: Using the most conservative Department of Energy savings estimates of 800kWh per year savings, with an U.S. Energy Information Agency hybrid electricity rate for the nation of 13.5 cents per kWh, and an increased cost of $1,000 per unit due to increase copper prices; these systems provide an 11 year simple payback.

Bibliography:

- *Residential Compact Domestic Hot Water Distribution Design: Balancing Energy Savings, Water Savings, and Architectural Flexibility* Farhad Farahmand, TRC Companie;Yanda Zhang, ZYD Energy
- *Evaluating Domestic Hot Water Distribution System Options With Validated Analysis Models* E. Weitzel and M. Hoeschele Alliance for Residential Building Innovation
- California Energy Codes & Standards Case Report for *Compact Hot Water Distribution*; Measure Number: 2019-RES-DHW1-F, Residential Plumbing

- Home Innovation Research Labs Annual Builder Practices Survey, 2021
- Department of Energy Zero Energy Ready Home National Program Requirements (Rev. 07) [footnote 15]
- Efficient hot water distribution system – USBGC LEED BD+C: Homes v4 – LEED v4
- Residential Hot Water Distribution Systems: Roundtable Session; JD Lutz, Lawrence Berkely National Laboratory; G Klein, California Energy Commission; D Springer, Davis Energy Group; BD Howard, Building Environmental Science & Technology

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: based on the proponent's reason statement and will need to coordinate with REPI-18-21.

Proposal # 446

REPI-143-21

Proponents: Robby Schwarz, BUILDTank, Inc., representing Colorado Chapter of the ICC (robby@btankinc.com)

2021 International Energy Conservation Code

Add new text as follows:

R501.7 Change in space conditioning. Any unconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.

Revise as follows:

R502.1 General. *Additions* to an existing *building*, *building* system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction. ~~without requiring the unaltered portion of the existing *building* or *building* system to comply with this code.~~ *Additions* shall not create an unsafe or hazardous condition or overload existing *building* systems. ~~An *addition* shall be deemed to comply with this code where the *addition* alone complies, where the existing *building* and *addition* comply with this code as a single building, or where the *building* with the *addition* does not use more energy than the existing *building*. *Additions* shall be in accordance with Section R502.2 or R502.3.~~

~~**R502.2 (N1110.2) Change in space conditioning. Any unconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.**~~

~~**Exceptions:**~~

1. ~~**Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the *proposed design* is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.2.**~~
2. ~~**Where the Total UA, as determined in Section R402.1.5, of the existing building and the *addition*, and any *alterations* that are part of the project, is less than or equal to the Total UA generated for the existing *building*.**~~
3. ~~**Where complying in accordance with Section R405 and the annual energy cost or energy use of the *addition* and the existing *building*, and any *alterations* that are part of the project, is less than or equal to the annual energy cost of the existing *building*. The *addition* and any *alterations* that are part of the project shall comply with Section R405 in its entirety.**~~

R502.~~3~~ 2.1 Building envelope. New *building* envelope assemblies that are part of the *addition* shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: New envelope assemblies are exempt from the requirements of Section R402.4.1.2.

R502.2 ~~3~~.2 Heating and cooling systems. HVAC ducts newly installed as part of an *addition* shall comply with Section R403.

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

R502.2 ~~3~~.3 Service hot water systems. New service hot water systems that are part of the *addition* shall comply with Section R403.5.

R502.2 ~~3~~.4 Lighting. New lighting systems that are part of the *addition* shall comply with Section R404.1.

R502.~~3~~ 2 Prescriptive compliance. *Additions* shall comply with Sections R502.3.1 through R502.3.4.

Reason: The existing Section **R502.2 Change in space conditioning** in the additions chapter 5 Existing homes has not reference to additions. Is speaks to a general condition of changing a low energy space during an alteration to become a conditioned space. This is not an addition, so it was moved to a new section in R501 General as an overarching general requirement rather than one specific to additions.
The additions section R502 struggle with how to determine compliance with the requirements of the IECC as they relate to existing home additions. The existing section R502.1 general spoke loosely to demonstrating compliance but it is not specific enough to guide enforcement well. We therefore stuck language from this section and created a true compliance section for additions on Section R502.2. This new section leverages an existing compliance option and states that the *addition* shall be deemed to comply with this code where the existing building with the addition complies prescriptively (using Total UA) or does not use more energy than the existing building and demonstrates compliance using either Building Performance energy cost, or Energy Rating Index compliance option listed below. In this way a prescriptive nonenergy compliance base compliance path can be used, and two energy-based compliance paths are options. All of the compliance paths require that the building plus the addition be compared to the building before the addition to quantify that the building plus the addition is equal to or better than the building before the addition was added.

This approach requires benchmarking the existing structure before construction begins so a comparison can be made using one of the three compliance approaches. ANSI/RESNET/ICC 301-2019 or ANSI/BPI 1200-S-2017 standards have been referenced as guidelines for how to evaluate insulation levels and other energy features needed to benchmark an existing building through computer modeling.

All compliance approaches compare the building plus addition to itself without the addition, so parity is achieved. The two performance approaches should be more flexible as they are whole house approaches meaning, for example, that a leaky house before an addition, is compared with a leaky house plus a tighter addition with more volume which can offset (trade) to be equal to or better than. In addition, the existing house could add LED lighting or do other low hanging, low cost, energy upgrades to ensure compliance.

This approach is new and forces us to consider and offer opportunity to upgrade existing homes at the time that an addition is added to the structure. New Homes become existing homes and they last a really long time. Jurisdictions around the country are struggling with how to encourage energy upgrades to help meet climate action and other goals they may have for their housing stock. This proposal offers a starting point by which a community grow from. It requires a look at the existing structure to consider if some level of upgrade must happen when an addition is added. Communities could go further and require that the existing structure plus the addition be x percentage better than the existing structure was before. This is the direction that communities are looking to go. If we want jurisdictions to continue to use the IECC this proposal needs to be considered. Otherwise community goals will outpace the what the IECC can offer to meet their climate goals.

Cost Impact: The code change proposal will increase the cost of construction.
Cost of construction will increase with this proposal primarily due to the cost of demonstrating compliance. However, there was no true means developed in the past existing home additions section to demonstrate compliance other than a vague visual inspection. This approach truly quantifies compliance while offering an opportunity to address issues with the existing structure.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Changes in space conditioning was confusing in the additions section. As additions are new construction would be required to comply with the code. The original language remains with exceptions 2 and 3 removed.

Proposal # 441

REPI-144-21

Proponents: Sean Denniston, representing New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

EXTERIOR WALL ENVELOPE. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

WORK AREA . That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code.

Revise as follows:

R502.3 (N1110.3) Prescriptive compliance. *Additions* shall comply with Sections R502.3.1 through ~~R502.3.4~~ R502.3.5.

Add new text as follows:

R502.3.5 (N1110.3.5) Additional Efficiency Packages. *Additions* shall comply with Section R506. *Alterations* to the existing building that are not part of the *addition*, but permitted with the *addition*, shall be permitted to be used to achieve this requirement.

Exceptions:

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

Revise as follows:

R503.1 (N1111.1) General. *Alterations* to any building or structure shall comply with the requirements of the code for new construction, without requiring the unaltered portions of the existing building or building system to comply with this code. *Alterations* shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing *building* or structure was prior to the *alteration.Alterations* shall not create an unsafe or hazardous condition or overload *existing* building systems. *Alterations* shall be such that the existing *building* or structure does not use more energy than the existing building or structure prior to the *alteration*. *Alterations* to existing *buildings* shall comply with Sections R503.1.1 through ~~R503.1.4~~ R503.1.5.

Add new text as follows:

R503.1.5 (N1111.1.5) Additional Efficiency Packages. *Alterations* shall comply with Section R506 where the *alteration* contains replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the *work area* of the *alteration*.
2. Water heating equipment serving the *work area* of the *alteration*.
3. 50% or more of the lighting fixtures in the *work area* of the *alteration*.
4. 50% or more of the area of interior surfaces of the *thermal envelope* in the *work area* of the *alteration*.
5. 50% or more the area of the *building's exterior wall envelope*.

Exceptions:

1. *Alterations* that are permitted with an addition complying with section R502.3.5.
3. *Alterations* that comply with Section R405 or R406.

SECTION R506 (N1114)
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

R506.1 (N1114.1) General. Where required in Section R502 or R503, the *building* shall comply with one or more additional efficiency package

options in accordance with the following:

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

Reason:
Section R408 was added to the IECC in 2021. R408 requires homes to include an additional efficiency option to achieve greater efficiency. R408 was a residential version of section C406 that had been in the commercial code since 2012. This allowed the IECC to achieve additional efficiency in a highly flexible way. However, there is one significant gap in R408, it does not apply to additions or alterations. R502 and R503 do not reference R408 in the sections with which additions and alterations must comply. The exclusion from R408 is a significant loophole. Additions and substantial alterations are prime opportunities for achieving greater energy efficiency utilizing R408.This proposal creates a framework to apply R408 to additions and substantial alterations. It creates a new Section R506 that provides guidance for how to utilize R408 for existing buildings. R506.1 takes the place of the charging language in R401.2.5, R408.1 and R408.2 for existing buildings. This section R506 is referenced by new sections in R502 and R503 that set which additions and alterations need to meet the additional efficiency option requirement in R506.The new Section R502.3.5 establishes which additions must comply with C506. It also allows alterations and additions that are part of the same permit to meet C506 together. The section includes certain exemptions in order to ensure that C506 is only getting triggered by larger additions that have enough new systems included to enable flexible application of the package options:

1. Smaller additions that add less than 25% conditioned area
2. Additions that don't include new water heating or space conditioning systems
3. Additions that don't include conditioned space
4. Additions that will comply with R405 or R406.

The new section C503.3.5 requires that large alterations comply with the new R506. The section includes important exceptions:

1. The first exception ensures that the requirements only apply to substantial additions with significant scope. The exemption is worded to address small alterations that only impact one of the main buildings systems: envelope (R402), HVAC (R403.5) and water heating (C403.7). Alterations that impact two or more of these systems – and must therefore comply with two or more of these sections – will have a larger scope with more opportunities to choose from among the available package options.
2. An exception that reflects the allowance for alterations and additions to comply together under C502.
3. An exception for buildings that comply with R405 or R406.By limiting requirement to substantial alterations, the proposal ensures that projects will likely have sufficient package options within the existing scope of the project. The project team will be able to pick a package option that applies to building elements that are already within the project scope.

The savings for this proposal will vary based on which project is chosen. However, the savings should be higher for alterations in particular since the baselines for alterations include many below-code existing building features. Depending on how inefficient the rest of the building is, the impact of this proposal could be substantially higher without any greater cost than new construction R408 measures.

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

This proposal is crafted so that it will only impact major renovations / large-scope alterations that are already impacting the major systems that serve as the basis for packages under R408. This means that these projects are already undertaking the cost of bringing two or more of these major systems up to current code requirements, and the incremental cost is therefore only the cost from code rather than the cost of a standalone retrofit. Therefore, the costs for this proposal are the same as the costs for R408 requirements for new construction. However, savings for each package will generally be much higher since the rest of the building will nearly always have specifications that fall short of the latest energy code and each package will deliver greater savings. As a result, any package that is cost effective for new construction will be even more cost effective for major alterations.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: a good step forward ultimately to provide a foundation to go forward and grow from in the existing building space.

REPI-145-21

Proponents: Sean Denniston, representing New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

R502.3.2 (N1110.3.2) Heating and cooling systems. HVAC ducts newly installed as part of an *addition* shall comply with Section R403.

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Exception: Where ducts from an existing heating and cooling system are extended ~~to~~ into an addition Sections R403.3.5 and R403.3.6 shall not be required.

R503.1.2 (N1111.1.2) Heating and cooling systems. New heating and cooling and duct systems ~~HVAC ducts newly~~ installed as part of an alteration shall comply with Section R403. Alterations to heating, cooling and duct systems shall comply with this section.

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

Add new text as follows:

R503.1.2.1 (N1111.1.2.1) Duct Leakage. Where an *alteration* includes any of the following, ducts shall be tested in accordance with Section R403.3.5 and shall have a total leakage less than or equal to 12.0 cubic feet per minute (339.9 L/min) per 100 square feet (9.29 m^2) of conditioned floor area:

1. Where 25% or more of the registers that are part of the duct system are relocated.
2. Where 25% or more of the total length of all ducts in the system are relocated.
3. Where the total length of all ducts in the system is increased by 25% or more.

Exception: Duct systems located entirely inside a *conditioned space* in accordance with R403.3.2.

Reason: This proposal requires that existing ductwork serving new equipment in additions and alterations is tested. In an alteration, all ductwork serving new equipment will need to be tested. In additions, the ductwork serving the addition, both existing and new ductwork, will need to be tested if it increases the total volume of the ductwork serving the addition by more than 20%. The proposal does not include a performance criterion for the testing; the testing is informational.

The requirements for duct construction and sealing in the IECC have developed substantially over recent code cycles. Fiberboard materials, cloth tape, un-sealed duct joints, cavity plenum returns and other materials and approaches that can lead to very leaky ducts were once commonplace but are not now allowed by the IECC. The result is that the ductwork in many existing buildings fall far below modern standards.

Duct tightening can be a very cost-effective energy retrofit. The replacement of equipment or substantial expansion of existing ductwork present prime opportunities to undertake this testing and will provide project teams and building owners important information about the relative need and savings opportunity that could come from duct tightening projects. It will also give project teams important information for configuring new equipment and ductwork to ensure the whole system performs effectively.

Cost Impact: The code change proposal will increase the cost of construction.
The cost will depend on the size of the duct system serving the alteration or addition.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: this helps clarify when duct testing is needed and not needed in existing homes and duct installation remains important no matter when it was installed.

REPI-150-21

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

2021 International Energy Conservation Code

Revise as follows:

R503.1.1 (N1111.1.1) Building thermal envelope. Alterations of existing *building thermal envelope* assemblies shall comply with this section. New ~~*B building thermal envelope*~~ assemblies that are part of the *alteration* shall comply with Section R402 ~~R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.3 and R402.4.5~~. In no case shall the *R*-value of insulation be reduced or the *U*-factor of a *building thermal envelope* assembly be increased as part of a *building thermal envelope* alteration.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. ~~Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.~~
3. ~~Construction where the existing roof, wall or floor cavity is not exposed.~~
2.~~4.~~ Roof recover.
5. ~~Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.~~
3.~~6.~~ Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.
4. An existing building undergoing alterations that is demonstrated to be in compliance with Section R405 or Section R406.

R503.1.1.1 (N1111.1.1.1) ~~Replacement f~~ Fenestration alterations. Where new fenestration area is added to an existing building, the new fenestration shall comply with Section R402.3. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC as specified in Table R402.1.3. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the *U*-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance.

Add new text as follows:

R503.1.1.2 (N1111.1.1.2) Roof alterations. Roof insulation complying with Section R402.1 or an *approved* design shall be provided for the following roof alteration conditions as applicable:

1. An *alteration* to roof-ceiling construction where there is no insulation above *conditioned space*.
2. *Roof replacements* for roofs with insulation entirely above deck,

   Exception: Where compliance with Section R402.1 cannot be met due to limiting conditions on an existing roof, the following shall be permitted to demonstrate compliance with the insulation requirements:

   1. *Construction documents* that include a report by a registered design professional or other *approved source* documenting details of the limiting conditions affecting compliance with the insulation requirements.
   2. *Construction documents* that include a roof design by a registered design professional or other *approved source* that minimize deviation from the insulation requirements.

3. Conversion of an unconditioned attic space into *conditioned space*, and
4. Replacement of ceiling finishes exposing cavities or surfaces of the roof-ceiling construction to which insulation can be applied.

503.1.1.3 (N1111.1.1.3) Above-grade wall alterations. *Above-grade wall* alterations shall comply with the following requirements as applicable:

1. Where interior finishes are removed exposing wall cavities, the existing cavity shall be filled with existing or new insulation complying with Section R303.1.4;
2. Where exterior wall coverings and fenestration are removed and replaced for the full extent of any exterior wall assembly, *continuous insulation* shall be provided where required in accordance with Section R402.1 or an *approved* design;

3. Where Items 1 and 2 apply, the entire wall assembly shall be insulated in accordance with Section R402.1; and,
4. Where new interior finishes or exterior wall coverings are applied to the full extent of any exterior wall assembly of mass construction, insulation shall be provided where required in accordance with Section R402.1 or an *approved* design.

Where any of the above requirements are applicable, the a*bove-grade wall* alteration shall comply with the insulation and water vapor retarder requirements of Section R702.7 of the *International Residential Code*. Where the exterior wall coverings are removed and replaced, the *above-grade wall* alteration shall comply with the water and wind resistance requirements of Section R703.1.1 of the *International Residential Code*.

R503.1.1.4 (N1111.1.1.4) Floor alterations. Where an alteration to a floor or floor overhang exposes cavities or surfaces to which insulation can be applied and the floor or floor overhang is part of the building thermal envelope, the floor or floor overhang shall be brought into compliance with Section R402.1 or an *approved* design. This requirement shall apply to floor alterations where the floor cavities or surfaces are exposed and accessible prior to construction.

R503.1.1.5 (N1111.1.1.5) Below-grade wall alterations. Where a blow-grade space is changed to *conditioned space*, the *below-grade walls* shall be insulated where required in accordance with Section R402.1. Where the below-grade space is *conditioned space* and a *below-grade wall* is altered by removing or adding interior finishes, it shall be insulated where required in accordance with Section R402.1.

R503.1.1.6 (N1111.1.1.6) Air barrier. *Building thermal envelope* assemblies altered in accordance with Section R503.1.1 shall be provided with an *air barrier* in accordance with Section R402.4. The *air barrier* shall not be required to be made continuous with unaltered portions of the *building thermal envelope*. Testing requirements of Section R402.4.1.2 shall not be required.

Add new definition as follows:

APPROVED SOURCE. An independent person, firm or corporation, approved by the *code official*, who is competent and experienced in the application of engineering principles to materials, methods or system analyses.

CONSTRUCTION DOCUMENTS. Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building *permit*.

Revise as follows:

ROOF REPLACEMENT. ~~The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.~~ An alteration that includes the removal of all existing layers of roof assembly materials down to the roof deck and installing replacement materials above the existing roof deck.

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	FENESTRATION *U*-FACTOR[f]	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SHGC[d, e]	CEILING *U*-FACTOR[g]	WOOD FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
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	0.026	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.30	0.55	0.40	0.024	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.024	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.024	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

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

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

d. The SHGC column applies to all glazed fenestration.

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

f. A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

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

g. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the "Group R" *U-factors* of Table C402.1.4.

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

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b, i]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE[i]	WOOD FRAME WALL *R*-VALUE[g]	MASS WALL *R*-VALUE[h]	FLOOR *R*-VALUE	BASEMENT[c,g] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c,g] WALL *R*-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	49	13 or 0 & 10ci	4/6	13	0	0	0
3	.30	0.55	0.25	49	20 or 13 & 5ci[h] or 0 & 15ci[h]	8/13	19	5ci or 13[f]	10ci, 2 ft	5ci or 13[f]
4 except Marine	.30	0.55	0.40	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
5 and Marine 4	0.30[i]	0.55	0.40	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	13/17	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
6	0.30[i]	0.55	NR	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci
7 and 8	0.30[i]	0.55	NR	60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4 ft	15ci or 19 or 13 & 5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.
ci = continuous insulation.

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

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

   Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

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

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

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

g. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13 & 5” means R-13 cavity insulation plus R-5 continuous insulation.

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

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

   1. Above 4,000 feet in elevation, or
   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

j. Roofs with insulation entirely above deck shall comply with Section C402.2.1 and the "Group R" *R-values* of Table C402.1.3.

Reason: Existing building alterations are perhaps one of the primary opportunities to reduce national energy consumption, yet Chapter 5 does little to address this need. There are many opportunities to cost-effectively improve energy efficiency of the existing building stock by use of reasonable criteria to trigger (or avoid) requirements with flexibility in the manner or extent of compliance where needed. This proposal attempts to strike that balance in a practical and cost-effective manner for building envelope assemblies of existing buildings that are undergoing specific types of alterations. Consequently, this proposal will help to address the 40% of national energy use that is attributed to the existing building stock and will only apply where alterations are proposed that provide opportunity to improve the performance of the existing building stock. A similar coordinated proposal was also submitted for the IECC-C committee.
Key changes made in this proposal are summarized as follows:

1. The revisions to charging language in Section R503.1.1 are made to be consistent with commercial building provisions in C503.2.

2. A clause is added to Section R503.1.1 to prevent reduction in existing building thermal envelope insulation levels as is included in the IECC provisions.

3. Exceptions 2 and 3 of Section R503.1.1 are deleted as they are now addressed and preserved within requirements in new subsections for above-grade walls, floors, and roofs.

4. Existing exception 5 of Section R503.1.1 is deleted because it is a requirement (not an exception) that is now moved to new Section R503.1.1.2 for roof alterations.

5. New exception 4 is added to Section R503.1.1 to provide the flexibility of a “whole” existing building compliance path using the existing total building performance and ERI paths in Sections R405 and R406. This would be most applicable to extensive or multiple alterations as may occur in a building renovation.

6. Section 503.1.1.1 for fenestration replacements is modified to address fenestration alterations including both added fenestration and fenestration replacements as both are also addressed in the IECC-C provisions for existing buildings and are relevant to existing residential building alterations.

7. A new Section R503.1.1.2 is provided to address multiple types of roof alterations to identify conditions where it is appropriate to provide insulation (if not already present).

8. A new Section R503.1.1.3 is provided for above-grade wall alterations which identifies conditions where it is appropriate and practical to provide insulation (if not already present). Language is also provided to ensure coordination with building code moisture control requirements which require integration with and can influence the method of complying with the insulation requirements.

9. A new Section R503.1.1.4 is provided for floor alterations and takes an approach similar to that done for above-grade walls (although with fewer conditional requirements).

10. A new Section R503.1.1.5 is provided for below-grade wall alterations. This captures the cases where a below-grade space (e.g., basement) is being converted to conditioned space and where basement walls are altered and the basement is already conditioned.

11. Finally, new Section R503.1.1.6 is provided to address air barrier installations in altered building thermal envelope assemblies. However, it is made clear that continuity of the air barrier is not required with unaltered portions of the building thermal envelope as that would cause the alteration to extend beyond its intended scope. It also is made clear that whole building air leakage testing is not required.

Cost Impact: The code change proposal will increase the cost of construction.
Where requirements are triggered and where upgrades in energy efficiency were not already planned for an alteration, this proposal will increase cost for a limited set of envelope alteration activities for existing buildings. Some existing requirements such as roof replacements and filling of exposed stud cavities remain unchanged. For those existing buildings with deficient insulation levels (or no insulation) and where planned alterations allow that deficiency to be addressed efficiently, the cost-benefits are expected to closely align with that for new buildings. However, it is not possible to conduct a simple cost-benefit analysis for existing buildings because of the multitude of variables involved and the flexibility provided in this proposal that make it nearly impossible to quantify with any reasonable level of certainty. Thus, we consider these proposed provisions to be cost-effective by judgment as these types of existing building thermal envelope upgrades are currently being used in the existing building/remodeling/renovation market, although not consistently or in an enforceable manner. In addition, the current charging language in Section R503.1.1 requires compliance with insulation requirements for new buildings for all alterations, barring only those few excepted. Now, this proposal provides requirements that also provide flexibility in means of compliance for the many alterations that are currently not included in exceptions to Section 503.1.1. For these cases, this proposal could be considered to reduce cost.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Existing building alterations are perhaps one of the primary opportunities to reduce national energy consumption, yet Chapter 5 does little to address this need. There are many opportunities to cost-effectively improve energy efficiency of the existing building stock by use of reasonable criteria to trigger (or avoid) requirements with flexibility in the manner or extent of compliance where needed. This proposal attempts to strike that balance in a practical and cost-effective manner for building envelope assemblies of existing buildings that are undergoing specific types of alterations. Consequently, this proposal will help to address the 40% of national energy use that is attributed to the existing building stock and will only apply where alterations are proposed that provide opportunity to improve the performance of the existing building stock. A similar coordinated proposal was also submitted for the IECC-C committee

REPI-151-21

Proponents: Sean Denniston, representing New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

R503.1.2 (N1111.1.2) Heating and cooling systems. ~~HVAC ducts newly installed as part of an alteration shall comply with section R403~~ New heating and cooling and duct systems that are part of the alteration shall comply with Section R403 and this section.

Add new text as follows:

R503.1.2.2 (N1111.1.2.2) System Sizing. New heating and cooling equipment that is part of an *alteration* shall be sized in accordance with Section R403.7 based on the existing *building* features as modified by the *alteration*.

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

R503.1.2.1 (N1111.1.2.1) Ducts. HVAC ducts newly installed as part of an *alteration* shall comply with Section R403.

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

Reason:
Historically, HVAC equipment has been routinely oversized. Studies have found very high rates of equipment oversizing; for example, 60% of RTU units in CA were found to be oversized.[1] Oversized equipment results in increased energy use, decreased occupant comfort and increased wear-and-tear on equipment.[2] Oversized equipment is also less effective at dehumidification. Like-for-like equipment replacement are particularly vulnerable to oversizing. The original equipment may have been installed when code requirements for "right-sizing" equipment did not exist or was not enforced. The materials markups that are common practice among contractors disincentivize them to install smaller, right-sized equipment. Changes to building use could have occurred since the original equipment was installed, creating a mismatch between current design loads and the original equipment. The building may have modified, particularly by energy efficiency programs, altering the design loads of the building. Lighting especially stands out here. Fluorescent and LED lighting is ubiquitous, but many HVAC systems were designed to account for incandescent lamps that convert over 75% of the energy they consume into heat.

With all of these considerations, it is reasonable to assume that the existing equipment sizing is more likely to be wrong than right, yet many equipment replacements use existing system sizing to size new equipment. This proposal explicitly requires that new equipment installed as part of an alteration be sized based on current building characteristics and loads, using current sizing standards. The resulting installations will be more efficient and more effective and many will be less costly to install as owners stop paying for more equipment than they need.

Savings will vary based on the amount that existing equipment is oversized. "Right-sizing" has been found to result in about 0.2% energy savings for every 1% reduction in oversizing.[3]

[1] D.R. Felts, P. Bailey, The State of Affairs – Packaged Cooling Equipment in California, 2000.

[2] Ery Djunaedy, Kevin van den Wymelenberg, Brad Acker, Harshana Thimmana, *Oversizing of HVAC system: Signatures and penalties.* "Energy and Buildings," Volume 43, Issues 2–3, 2011,

[3] H.McLain,D.Goldberg. "Benefits of Replacing Residential Central Air Conditioning Systems." American Council for an Energy-Efficient Economy, WashingtonDC, USA, 1984.

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

As "wrong-sized" equipment is generally oversized, this proposal will generally decrease the cost of installation. Smaller, right-sized equipment will generally be less costly to install.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Committee generally agreed that oversizing of heating and cooling appliances in existing homes was an issue. The proposed exception does allow the HVAC contractor to evaluate the existing system and propose an appliance that is compatible with the existing system components.

REPI-152-21

Proponents: Sean Denniston, representing New Buildings Institute (sean@newbuildings.org)

2021 International Energy Conservation Code

Add new text as follows:

R503.1.2.1(N1111.1.2.1) Controls. New heating and cooling equipment that are part of the *alteration* shall be provided with controls that comply with Section R403.1.

Reason: The IECC only requires that new portions of HVAC systems comply with the requirements for new construction. This leaves unaltered portions of the HVAC system unaffected, including controls. Controls are a vital component of effective and efficient operation of heating and cooling systems and older controls that do not meet current code requirements significantly hamper efficiency in buildings. Obsolete controls also increase the operational costs for building owners and tenants. The IECC has relied on HVAC controls as a cost-effective means of delivering energy efficiency in buildings, so this is a significant missed opportunity. Equipment replacement is an ideal time to also upgrade controls. Contractors are onsite, operation of the HVAC system is already disrupted, and the cost of controls would generally be a small line-item cost in the project.
This proposal requires that thermostats be brought into compliance with current control requirements when equipment is replaced. The proposal does not require the installation of new controls, so if the existing controls already meet current code requirements, they would already be in compliance with this new section.

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

Cost will vary depending on the type of control and how obsolete existing controls are. In most systems subject to this requirement, compliance would require replacing one thermostat with another. Modern, wireless thermostats can be used to control costs when existing control wiring is insufficient to support modern controls. Utilities have consistently found thermostat retrofits to be cost effective efficiency incentive measures.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: Change title of Section to Thermostat also added reference to R403.2.

Proposal # 407

REPI-153-21

Proponents: Patricia Chawla, representing Austin Energy (patricia.chawla@austinenergy.com)

2021 International Energy Conservation Code

Revise as follows:

SECTION RC101(AX101)
~~COMPLIANCE~~ GENERAL

RC101.1(AX101.1) ~~Compliance~~ Scope. ~~Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RC102.~~ This appendix applies to new *residential buildings*.

Reason: This proposal seeks to simplify the scope statement of this appendix.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed code change deletes redundant text from the existing code language and will not affect the cost of construction.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: proposal simplifies the scope statement of the appendix

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REPI-154-21

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

2021 International Energy Conservation Code

Revise as follows:

APPENDIX RC (APPENDIX AX)
ZERO NET ENERGY RESIDENTIAL BUILDING PROVISIONS

SECTION RC102 (AX102)
ZERO NET ENERGY RESIDENTIAL BUILDINGS

RC102.2 (AX102.2) Energy Rating Index zero net energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

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

$$\text{Adjusted OPP} = \text{OPP} + \text{CREF} + \text{REPC} \quad \textbf{(Equation RC-1)}$$

where:

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

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

Reason: The term "zero energy" is more suited for a marketing brochure, rather than an IECC Appendix or an ICC code. All buildings use energy, and the use of a term like "zero energy", while appealing, is not accurate and will mislead and misinform consumers and businesses and policy makers.
The term that should be used is "zero net energy", which is the technically correct way to describe such buildings.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Using the more accurate term will have no impact on the cost of construction.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: This adds the word “net” to the term “zero energy”. Zero Net Energy (ZNE) is the term most commonly used and is more accurate. All building use energy – there are no “zero energy” buildings.

REPI-155-21

Proponents: Kim Cheslak, NBI, representing NBI (kim@newbuildings.org); Ben Rabe, representing Fresh Energy (rabe@fresh-energy.org); Bryan Bomer, representing Department of Permitting Services (bryan.bomer@montgomerycountymd.gov); Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org); Howard Wiig, representing Hawaii State Energy Office (howard.c.wiig@hawaii.gov); Kim Burke, representing Colorado Energy Office (kim.burke@state.co.us); Chris Castro, representing City of Orlando (chris.castro@orlando.gov); Brad Smith, representing City of Fort Collins (brsmith@fcgov.com)

2021 International Energy Conservation Code

Add new text as follows:

RC102 (AX102)
GENERAL DEFINITIONS

Add new definition as follows:

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

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

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

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

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

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

Add new text as follows:

Appendix RX requires the installation of all-electric equipment and appliances in new construction in order to reduce carbon emissions and improve the safety and health of residential buildings. Where adopted as a requirement, Section RX102.1 is intended to replace R401.2. RX
ALL-ELECTIC RESIDENTIAL BUILDINGS

Section RX101
GENERAL

RX101.1 Intent. The intent of this Appendix is to amend the *International Energy Conservation Code* to reduce greenhouse gas emissions and improve the safety and health of buildings by not permitting *combustion equipment* in buildings.

RX101.2 Scope. This appendix applies to new residential buildings.

Section RX102
ALL-ELECTRIC RESIDENTIAL BUILDINGS

RX102.1 Application. Residential buildings shall be *all-electric buildings* and comply with Section R401.2.5 and either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

Reason: The adoption of the Zero Home Appendix into the 2021 IECC has garnered a lot of attention and questions from cities and states looking to understand its energy impact and alignment with energy reduction and climate goals. The 2021 IECC version of the appendix does not address onsite carbon emissions, a request that has been made by jurisdictions seeking to set carbon targets in addition to energy reductions via energy code and stretch codes. This amendment would place the Appendix in line with the ICC's stated goals on carbon and energy reductions by requiring buildings be all-electric in addition to energy efficient. Since the Appendix is structured to be used as an optional stretch code, it presents opportunities for jurisdictions to begin to move residential construction toward full decarbonization in line with climate goals.
In order to meet President Biden's 2050 goal of reducing greenhouse gas emissions in half by 2030 and achieving net zero carbon emissions by 2050, the United States must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also

transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. In 2020, combustion equipment in commercial and residential buildings accounted for 36% of the United States energy-related greenhouse gas emissions. To meet President Biden's goal, it is crucial that new homes built today are all-electric so that emissions from these buildings are not "locked-in" by gas-dependent building infrastructure. Reduced carbon emissions was also recently cited as a priority of energy code development by the ICC in their Leading the Way to Energy Efficiency: A Path Forward on Energy and Sustainability to Confront a Changing Climate in 2021.

Fortunately, heat pump technology has dramatically improved over the last few decades, giving contractors and building owners access to highly efficient electric heating and cooling, and water heating technologies. An Ecotope study of the 2017 Oregon Residential code found that homes heated by electric heat pumps use 40 percent less energy than homes heated with gas (including water heating). Even accounting for reduced efficiency in extreme cold weather, according to a study by RMI, modern air source heat pumps are more than twice as efficient as gas furnaces and can save families up to 9 percent on their utility bills in Climate Zone 6. This is one reason why the U.S. EPA just announced that standards for the most efficient appliances in 2022 certified under the ENERGY STAR program will be all-electric.

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

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

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

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

NBI also analyzed the cost effectiveness of an all-electric home in New York City (Climate Zone 4A) that met the requirements in NBI's Decarbonization code compared to a code compliant mixed-fuel home that met the requirements of the 2021 IECC. NBI's decarbonization code all-electric home analyzed was solar-ready, EV-ready, utilized a heat pump water heater, demand responsive controls and minimum code compliant HVAC system. These features resulted in reduced cost of $8,357 for a single-family home. Utilizing local time-of-use rates, the all-electric home resulted in equivalent utility costs as the baseline mixed fuel home and positive life cycle cost savings of $14,828 for the consumer over a 30-year analysis period. Life cycle cost savings doubled to $23,934 if the social cost of carbon is included in the analysis.

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

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: provides optional appendix for jurisdictions wanting to put this regulation in place and provides consistent language.

Proposal # 187

REPI-156-21

Proponents: Patricia Chawla, representing Austin Energy (patricia.chawla@austinenergy.com)

2021 International Energy Conservation Code

Revise as follows:

SECTION RC102 (AX102)
~~ZERO ENERGY RESIDENTIAL BUILDINGS~~
GENERAL DEFINITIONS

Add new definition as follows:

COMMUNITY RENEWABLE ENERGY FACILITY (CREF)POWER PRODUCTION. The yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.

RENEWABLE ENERGY PURCHASE CONTRACT (REPC)POWER PRODUCTION. The yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

Add new text as follows:

SECTION RC103 (AX103)
ZERO ENERGY RESIDENTIAL BUILDINGS

Revise as follows:

~~**RC102.1**~~ **RC103.1 (AX103.1) General.** New *residential buildings* shall comply with Section ~~RC102.2~~ RC103.2.

~~**RC102.2**~~ **RC103.2 (AX103.2) Energy Rating Index zero energy score.** Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table ~~RC102.2~~ RC103.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

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

$$\text{Adjusted OPP} = \text{OPP} + \text{CREF} + \text{REPC} \qquad \textbf{(Equation RC-1)}$$

~~where:~~

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

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

TABLE ~~RC102.2~~ RC103.2 (TABLE AX103.2) MAXIMUM ENERGY RATING INDEX[a]

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

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.

Reason: This proposal seeks to improve readability and structure of the language by moving defined words to a definitions portion of the Appendix. No changes were made to the content of the definitions. All other changes are renumbering changes.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The proposed code reorganizes and restructures the existing code only and will not affect the cost of construction. No changes were made to the content of the definitions. The reorganization and restructuring increase the flexibility of the code for future code proposals.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: proposal simplifies the scope statement of the appendix

Proposal # 533

REPI-157-21

Proponents: Emily Toto, representing ASHRAE (etoto@ashrae.org)

2021 International Energy Conservation Code

Add new text as follows:

RC102.2 (AX102.2) Requirements. New residential buildings shall comply with one of the following:

1. The Energy Rating Index (ERI) not including OPP calculated in accordance with RESNET/ICC 301 for the rated design shall be not more than the values listed in Table RC102.2 and the requirements of Sections R406.3, R406.6 and R406.7 and Table R406.2 shall be met, or
2. The requirements of ASHRAE/IES Standard 90.2, including the ERI requirements of ASHRAE/IES 90.2 Table 6-1 without the use of on-site power production (OPP), and the requirements of Sections R402.4.1.1, R402.4.1.2, R406.3, R404.4 (Electric Readiness), and R404.4 (Electric Vehicle Power Transfer Infrastructure) shall be met.

Revise as follows:

TABLE RC102.2 (TABLE AX102.2) MAXIMUM ENERGY RATING INDEX[a]

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

~~a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.~~

Add new text as follows:

RC102.2.1 (AX102.2.1) On-site power production. New residential buildings shall achieve an Energy Rating Index (ERI) value including onsite power production not more than the values in Table RC 102.2. The ERI shall be calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

Adjusted OPP = OPP + CREF + REPC **(Equation RC-1)**
where:

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

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

Add new standard(s) as follows:

ASHRAE

ASHRAE
180 Technology Parkway NW
Peachtree Corners, GA 30092

ASHRAE/IES 90.2-2018: Energy-Efficient Design of Low-Rise Residential Buildings

Reason: The modifications in this proposal aim to standardize the method of achieving Net Zero for residential buildings. The modifications do not change the ERI values or the fact that you must meet the requirements of Table R406.2. By adding a reference to ASHRAE 90.2 users, software developers, and code officials will have the added guidance of a well vetted ASHRAE standard. The previously referenced standard RESNET 301 does not set ERI targets like that of ASHRAE 90.2. The targets in the existing appendix were taken from ASHRAE 90.2. At the time 90.2 was just being finalized and therefore was not referenced in the existing appendix. Modifications include:

- Adding the word “Net” Zero. Although there is some debate over the inclusion of the word “Net” in the industry to describe buildings achieving this degree of efficiency and reliance on renewable energy sources it is widely accepted and adequately describes the intent of this section.
- Replacing then text of RC102.2 with a new “Requirements” section that clearly outlines the requirements of this section:
- #1 points users to the “mandatory requirements” of the code. This is consistent with the current appendix.
- #2 points users to the newly referenced ASHRAE 90.2 standard vs. RESNET 301.
- #3 lets users know they must comply with Table 6-1 of 90.1 without using renewable energy in the calculation. This is consistent with the existing appendix language.
- #4 makes it clear that users must also achieve and ERI of 0 and that they can use renewable energy to achieve this calculation. This is also consistent with the current appendix.
- Section RC102.2.1 is added to address the existing allowance to use Community Renewable Energy Facility power production and Renewable Energy Purchase Contract power production in OPP calculations in a way that is more meaningful in light of the reference to ASHRAE 90.2.
- Table RC102.2 is deleted as it is no longer needed because these exact ERI values are contained in the ASHRAE 90.2 standard.
- Added ASHRAE/IES 90.2 to Chapter 6 Referenced Standards.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change does not impact the cost of construction. Modifications do not change the stringency of this voluntary appendix.

Bibliography: ASHRAE/IES 90.2-2018: Energy-Efficient Design of Low-Rise Residential Buildings

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Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: adds a reference to ASHRAE 90.2 to the appendix as an additional reference standard.

Proposal # 37

REPI-158-21

Proponents: Diana Burk, representing New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Revise as follows:

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

SECTION R404 (N1104)
ELECTRICAL POWER~~,~~ ~~AND~~ LIGHTING, AND RENEWABLE ENERGY SYSTEMS

Add new text as follows:

R404.4 (N1104.4) Renewable energy certificate (REC) documentation. Where renewable energy generation is used to comply with this code, the documentation shall be provided to the *code official* by the property owner or owner's authorized agent which demonstrates that where RECs or EACs are associated with that portion of renewable energy used to comply with this code, the RECs or EACs shall be retained, or retired, on behalf of the property owner.

Revise as follows:

R406.7.3 (N1106.7.3) Renewable energy certificate (REC) documentation. Where ~~on-site~~ renewable energy power production is included in the calculation of an ERI, documentation shall comply with Section R404.5. ~~one of the following forms of documentation shall be provided to the code official:~~

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

Add new text as follows:

RC102.3 (AX102.3) Renewable energy certificate (REC) documentation. Where *RECs* are associated with *renewable energy* power production included in the calculation of ERI zero energy score, documentation shall comply with Section R404.5.

Reason: During the 2021 IECC process the original proposal was revised during the public comment period. Because of the rules of the public comment hearings, the original proposal and not the public comment was put up for the online vote. This proposal brings back the public comment language for consideration into the 2024 IECC.
The revised language clarifies and simplifies the original proposal. The Solar Energy Industry Association (SEIA) assisted NBI in drafting these revisions. The Comment clarifies that the owner or the owner's agent shall show that the ownership or retirement of RECs have been properly tracked to the owner. This information about the treatment of RECs is found in typical leases, contracts and incentive agreements for installed solar energy systems. A reference to the contractual provision is all that is needed to satisfy the requirements of this proposal – and this reference to the RECs provision in the plans set is all that the code official would need to examine.

As an example, the following language from Austin Energy's solar program states (emphasis added): "*Customers receiving service under either Non-Demand or Demand Value-Of-Solar Riders cannot combine services with the Load Shifting Voltage Discount Rider. Renewable Energy Credits (RECs) and all other renewable energy attributes for generation receiving Value-of-Solar credits are aggregated by Austin Energy. All RECs for energy consumed onsite* ***will be retired on behalf of the solar customer****. "*

This is a sample bilateral contract involving the Solano (CA) Community College District: "***Environmental Attributes and Energy Credits.*** *District shall own all right, title, and interest associated with or resulting from the development, construction, installation and ownership of any facilities installed on the Project ("Generating Facilities")"*

This proposal also seeks to clarify the term renewable energy certificate. The proposal more closely aligns the definition with language under consideration both in ASHRAE Standard 228P, The Standard Method of Evaluating Zero Energy Building Performance, and in ASHRAE Standard 189.1, which will be the basis of the IgCC.

Finally, the proposal adds the term "renewable energy" in the title of Section R404 and documentation for REC requirements in this section to ensure REC documentation requirements apply if renewable energy requirements are added to this section.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal simply clarifies requirements and thus will result in no additional cost for compliance with the standard.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: addresses committee concerns regarding the potential use of off site renewables and indicates that only the portion or RECs required for compliance shall be counted.

REPI-160-21

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

2021 International Energy Conservation Code

Revise as follows:

RC102.2 (AX102.2) Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

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

$$\text{Adjusted OPP} = \text{OPP} + \text{CREF} + \text{REPC} \qquad \textbf{(Equation RC-1)}$$

where:

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

REPC = Renewable Energy Purchase Contract power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with *renewable energy resources* ~~photovoltaic, solar thermal, geothermal energy or wind systems~~, and that is demonstrated by an energy purchase contract or lease with a duration of not less than ~~15~~ 10 years.

Reason: This proposal aligns the text of RC102.2 with the definition of renewable energy resources located on page R2-3. By taking out the list and using the definition, it will prevent conflicts with state or local laws that have a longer list of eligible renewable energy resources.
In addition, it modifies the contract period to be more consistent with the typical length of time that people are in a residence.

https://ipropertymanagement.com/research/average-length-of-homeownership (data shows that the average length of home ownership is 8.17 years, and only 37% of Americans have lived in their homes for 10+ years)

https://www.nar.realtor/blogs/economists-outlook/how-long-do-homeowners-stay-in-their-homes (median length of home ownership is 13 years, with significant regional variations).

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
These proposed changes will not affect the cost of construction.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: This proposal adds the more inclusive term “renewable energy resources” instead of spelling out various types of renewable energy. It would also change the terms of an energy purchase contract or lease from not less than 15 years to not less than 10 years.

REPI-161-21

Proponents: Diana Burk, representing New Buildings Institute (diana@newbuildings.org)

2021 International Energy Conservation Code

Add new definition as follows:

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

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

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

Revise as follows:

RC102.2 (AX102.2) Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

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

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

where:

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

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

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

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal simply clarifies requirements and thus will result in no additional cost for compliance with the standard.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: There was discussion regarding definitions as well as interaction with other proposals in front of the EPLS SC and how their action would affect this proposal. It was agreed by the Econ SC that this proposal should be moved out of SC as submitted for action by the full committee.

REPI-163-21

Proponents: Kim Cheslak, NBI, representing NBI (kim@newbuildings.org); Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org)

2021 International Energy Conservation Code

Revise as follows:

TABLE RC102.2 (TABLE AX102.2) MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
0	42	0
1	~~43~~ 42	0
2	~~45~~ 42	0
3	~~47~~ 42	0
4	~~47~~ 42	0
5	~~47~~ 42	0
6	~~46~~ 42	0
7	~~46~~ 42	0
8	~~46~~ 42	0

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3 of the *2015 International Energy Conservation Code*.

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

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
Because the proposal is based on a performance path, the strategies to achieve the targets are able to be optimized by the design teams to incur the smallest upfront incremental costs and the largest month over month energy, cost, and carbon savings for the life of the building.

Workgroup Recommendation

Residential Energy Committee Committee Action: As Modified

Residential Energy Committee Reason: After discussion it was determined the PHIUS values submitted by Climate Zone were overly stringent. The subcommittee felt a more realistic value to set the ERI values across all Climate Zones at 42.

Proposal # 186

REPI-165-21

Proponents: Jay Crandell, P.E., ABTG/ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz); Joel Martell, representing North American Insulation Manufacturers Association (NAIMA) (joel.e.martell@gmail.com)

2021 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 MAXIMUM ASSEMBLY U-FACTORS[a] AND FENESTRATION REQUIREMENTS

Portions of table not shown remain unchanged.

For SI: 1 foot = 304.8 mm.

a. Nonfenestration *U*-factors shall be obtained from Appendix RD or by *approved* test data ~~measurement~~, *approved* calculation, or an *approved* source.

R402.1.3 R-value alternative. Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U*-factor in Table R402.1.2. *R*-values of insulation materials for the assemblies specified in Appendix RD that have a *U*-factor less than or equal to the *U*-factor required by Table R402.1.2 shall be permitted.

Add new text as follows:

APPENDIX RD
ALTERNATIVE BUILDING THERMAL ENVELOPE INSULATION R-VALUE OPTIONS

RD101
ABOVE-GRADE WALL ASSEMBLIES

RD101.1 Wood frame walls. Wood frame *above-grade wall* assemblies shall comply with both the *cavity insulation* and *continuous insulation R*-values and framing conditions specified by Table RD101.1 where the tabulated *U*-factors are less than or equal to those needed for compliance with Section R402.1.2. For assemblies not addressed by the conditions of Table RD101.1, *U*-factors shall be determined by using accepted engineering practice or by testing in accordance with ASTM C1363 and shall be subject to approval by the *code official* in accordance with Section R102.1. Use of a lesser framing fraction than the indicated maximums in Table RD101.1 shall require wall framing layout details for each *above-grade wall* elevation to be included on *approved* construction documents and shall be inspected for compliance

TABLE RD101.1 ASSEMBLY U-FACTORS FOR WOOD FRAME WALLS[a,b,c,d,e,]

Wood Stud Size & Spacing	Cavity Insulation Installed R-value	Continuous Insulation R-value																	
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30
2x4 (12" oc)	0	0.324	0.239	0.190	0.158	0.136	0.119	0.106	0.096	0.087	0.080	0.074	0.069	0.064	0.060	0.057	0.054	0.042	0.035	0.030
	11	0.094	0.085	0.078	0.072	0.067	0.062	0.059	0.055	0.052	0.050	0.047	0.045	0.043	0.041	0.040	0.038	0.032	0.027	0.024
	12	0.090	0.082	0.075	0.069	0.064	0.060	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.039	0.037	0.031	0.027	0.024
	13	0.087	0.079	0.072	0.067	0.063	0.059	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.031	0.027	0.023
	14	0.084	0.076	0.070	0.065	0.061	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.030	0.026	0.023
	15	0.082	0.074	0.068	0.063	0.059	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.030	0.026	0.023
	16	0.079	0.072	0.066	0.062	0.058	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.034	0.029	0.025	0.022
	17	0.077	0.070	0.065	0.060	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.029	0.025	0.022
	18	0.076	0.069	0.063	0.059	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.034	0.033	0.028	0.025	0.022
	19	0.074	0.067	0.062	0.058	0.054	0.051	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.032	0.028	0.024	0.022
	20	0.072	0.066	0.061	0.056	0.053	0.050	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.027	0.024	0.021
2x6 (12" oc)	0	0.313	0.230	0.183	0.153	0.131	0.115	0.102	0.093	0.084	0.078	0.072	0.067	0.063	0.059	0.055	0.053	0.041	0.034	0.029
	18	0.065	0.060	0.056	0.053	0.050	0.048	0.045	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.027	0.024	0.021
	19	0.063	0.059	0.055	0.052	0.049	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.027	0.024	0.021
	20	0.062	0.057	0.054	0.051	0.048	0.046	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.026	0.023	0.021
	21	0.060	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.026	0.023	0.021
	22	0.059	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.026	0.023	0.020
	23	0.058	0.054	0.051	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020

	24	0.057	0.053	0.050	0.047	0.044	0.042	0.040	0.039	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	25	0.056	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.036	0.035	0.034	0.032	0.031	0.030	0.029	0.028	0.025	0.022	0.020
	30	0.052	0.048	0.045	0.043	0.041	0.039	0.037	0.035	0.034	0.033	0.031	0.030	0.029	0.028	0.027	0.027	0.023	0.021	0.019
	35	0.049	0.046	0.043	0.040	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.022	0.020	0.018
2x8 (12" oc)	0	0.308	0.226	0.179	0.149	0.128	0.112	0.100	0.091	0.083	0.076	0.070	0.066	0.061	0.058	0.054	0.052	0.041	0.034	0.029
	20	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.026	0.023	0.020
	21	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	22	0.053	0.050	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	23	0.052	0.049	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.025	0.022	0.020
	24	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.024	0.022	0.019
	25	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.024	0.021	0.019
	30	0.046	0.044	0.041	0.039	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.026	0.023	0.020	0.018
	35	0.043	0.041	0.039	0.037	0.035	0.034	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.026	0.025	0.024	0.021	0.019	0.017
	40	0.041	0.039	0.037	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.024	0.024	0.023	0.020	0.018	0.017
2x4 (16" oc)	0	0.331	0.243	0.193	0.161	0.138	0.120	0.107	0.097	0.088	0.081	0.075	0.069	0.065	0.061	0.057	0.054	0.043	0.035	0.030
	11	0.092	0.083	0.076	0.071	0.066	0.061	0.058	0.054	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.032	0.027	0.024
	12	0.088	0.080	0.073	0.068	0.063	0.059	0.056	0.053	0.050	0.048	0.045	0.043	0.041	0.040	0.038	0.037	0.031	0.027	0.024
	13	0.084	0.077	0.071	0.066	0.061	0.057	0.054	0.051	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.030	0.026	0.023
	14	0.081	0.074	0.068	0.064	0.059	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.038	0.037	0.035	0.030	0.026	0.023
	15	0.079	0.072	0.066	0.062	0.058	0.054	0.051	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.029	0.025	0.023
	16	0.077	0.070	0.065	0.060	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.029	0.025	0.022

	17	0.075	0.068	0.063	0.058	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.028	0.025	0.022
	18	0.073	0.066	0.061	0.057	0.053	0.050	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.033	0.028	0.024	0.022
	19	0.071	0.065	0.060	0.056	0.052	0.049	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.027	0.024	0.021
	20	0.069	0.063	0.059	0.055	0.051	0.048	0.046	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.032	0.031	0.027	0.024	0.021
2x6	0	0.322	0.236	0.187	0.156	0.133	0.117	0.104	0.094	0.086	0.079	0.073	0.068	0.063	0.059	0.056	0.053	0.042	0.034	0.029
(16" oc)	18	0.063	0.059	0.055	0.052	0.049	0.047	0.044	0.042	0.041	0.039	0.037	0.036	0.035	0.034	0.032	0.031	0.027	0.024	0.021
	19	0.061	0.057	0.054	0.051	0.048	0.046	0.043	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.027	0.023	0.021
	20	0.060	0.056	0.052	0.050	0.047	0.045	0.042	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.026	0.023	0.021
	21	0.058	0.055	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.026	0.023	0.020
	22	0.057	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	23	0.056	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	24	0.055	0.051	0.048	0.046	0.043	0.041	0.039	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.025	0.022	0.020
	25	0.054	0.050	0.047	0.045	0.042	0.040	0.039	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.024	0.022	0.019
	30	0.050	0.046	0.044	0.041	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.029	0.029	0.028	0.027	0.026	0.023	0.020	0.018
	35	0.047	0.043	0.041	0.039	0.037	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.025	0.022	0.019	0.017
2x8	0	0.317	0.232	0.184	0.152	0.131	0.115	0.102	0.092	0.084	0.077	0.071	0.066	0.062	0.058	0.055	0.052	0.041	0.034	0.029
(16" oc)	20	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.026	0.023	0.020
	21	0.053	0.050	0.048	0.045	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	22	0.052	0.049	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.025	0.022	0.020
	23	0.051	0.048	0.046	0.043	0.041	0.040	0.038	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.024	0.022	0.020
	24	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.024	0.021	0.019

	25	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.024	0.021	0.019
	30	0.045	0.042	0.040	0.038	0.037	0.035	0.034	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026	0.025	0.022	0.020	0.018
	35	0.042	0.039	0.037	0.036	0.034	0.033	0.031	0.030	0.029	0.028	0.027	0.027	0.026	0.025	0.024	0.024	0.021	0.019	0.017
	40	0.039	0.037	0.035	0.034	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.024	0.024	0.023	0.022	0.020	0.018	0.016
2x4 (24" oc)	0	0.339	0.248	0.196	0.163	0.139	0.122	0.108	0.098	0.089	0.081	0.075	0.070	0.065	0.061	0.058	0.055	0.043	0.035	0.030
	11	0.089	0.081	0.075	0.069	0.065	0.061	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.039	0.037	0.031	0.027	0.024
	12	0.085	0.078	0.072	0.067	0.062	0.058	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.031	0.027	0.023
	13	0.082	0.075	0.069	0.064	0.060	0.056	0.053	0.050	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.030	0.026	0.023
	14	0.079	0.072	0.067	0.062	0.058	0.055	0.052	0.049	0.047	0.044	0.042	0.041	0.039	0.037	0.036	0.035	0.030	0.026	0.023
	15	0.076	0.070	0.065	0.060	0.056	0.053	0.050	0.048	0.045	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.029	0.025	0.022
	16	0.074	0.068	0.063	0.058	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.028	0.025	0.022
	17	0.072	0.066	0.061	0.057	0.053	0.050	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.033	0.028	0.024	0.022
	18	0.070	0.064	0.059	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.027	0.024	0.021
	19	0.068	0.062	0.058	0.054	0.051	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.032	0.031	0.027	0.024	0.021
	20	0.066	0.061	0.056	0.053	0.050	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.027	0.023	0.021
2x6 (24" oc)	0	0.330	0.241	0.191	0.159	0.136	0.119	0.106	0.095	0.087	0.080	0.074	0.068	0.064	0.060	0.057	0.053	0.042	0.035	0.030
	18	0.061	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.034	0.033	0.032	0.031	0.027	0.024	0.021
	19	0.060	0.056	0.052	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.034	0.032	0.031	0.030	0.026	0.023	0.021
	20	0.058	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.026	0.023	0.020
	21	0.057	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	22	0.055	0.052	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020

	23	0.054	0.051	0.048	0.045	0.043	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.025	0.022	0.020
	24	0.053	0.049	0.047	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.024	0.022	0.019
	25	0.052	0.048	0.046	0.043	0.041	0.039	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.024	0.021	0.019
	30	0.047	0.044	0.042	0.040	0.038	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.022	0.020	0.018
	35	0.044	0.041	0.039	0.037	0.035	0.034	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.025	0.024	0.021	0.019	0.017
2x8	0	0.326	0.238	0.188	0.156	0.133	0.117	0.104	0.094	0.085	0.078	0.072	0.067	0.063	0.059	0.056	0.053	0.042	0.034	0.029
(24" oc)	20	0.054	0.051	0.048	0.046	0.043	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.025	0.022	0.020
	21	0.052	0.049	0.047	0.044	0.042	0.041	0.039	0.037	0.036	0.035	0.033	0.032	0.031	0.030	0.029	0.029	0.025	0.022	0.020
	22	0.051	0.048	0.046	0.043	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.024	0.022	0.020
	23	0.050	0.047	0.044	0.042	0.041	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.028	0.024	0.021	0.019
	24	0.048	0.046	0.044	0.041	0.040	0.038	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.024	0.021	0.019
	25	0.047	0.045	0.043	0.041	0.039	0.037	0.036	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.023	0.021	0.019
	30	0.043	0.041	0.039	0.037	0.035	0.034	0.033	0.032	0.030	0.029	0.029	0.028	0.027	0.026	0.025	0.025	0.022	0.020	0.018
	35	0.040	0.038	0.036	0.034	0.033	0.032	0.030	0.029	0.028	0.027	0.027	0.026	0.025	0.024	0.024	0.023	0.021	0.018	0.017
	40	0.037	0.035	0.034	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.024	0.024	0.023	0.022	0.022	0.019	0.018	0.016

For SI: 1 W/m2-K = 0.176 Btu/hr-ft2-F

a. Linear interpolation of U-factors shall be permitted between continuous insulation and cavity insulation R-values. For non-standard stud spacing, use the next lesser stud spacing shown in the table.

b. Table values are based on the parallel path calculation procedure as applicable to wood-frame assemblies and requires compliance with the following assembly conditions:

1. Maximum framing fractions of 28% (assumed for 12"oc studs), 25% (assumed for 16"oc studs), and 22% (assumed for 24"oc studs) with 4% attributed to headers in all cases. The framing fraction is the percentage of overall opaque wall area occupied by framing members.
2. Wood framing materials or species with a minimum thermal resistivity of R-1.25 per inch.
3. Exterior sheathing with a minimum R-value of R-0.62 as based on wood structural panel. For walls having no exterior sheathing or sheathing of lesser R-value, footnote d shall be used to adjust the tabulated U-factor.
4. Siding of a minimum R-0.62 as based on the assumption of vinyl siding. For walls with siding having a lower R-value, footnote d shall be used to adjust the tabulated U-factor.
5. Interior finish of a minimum R-0.45 based on 1/2" gypsum. For walls having no interior finish or a finish of lesser R-value, footnote d shall be used to adjust the tabulated U-factor.
6. Cavity insulation with a rated R-value installed as required by the manufacturer's installation instructions to satisfy the indicated installed R-value, considering a reduced R-value for compression in an enclosed cavity where applicable.
7. Continuous insulation specified in accordance with the indicated rated R-value and installed continuously over all exterior wood framing, including studs, plates, headers, and rim joists.
8. Indoor air film R-value of 0.68 and outdoor air-film R-value of 0.17.

c. Where any of the building materials that are continuous over the interior or exterior wall surface vary from those stated in footnote b, it is permissible to adjust the U-factor as follows: Uadj = 1/ [1/U + Rd] where U is the U-factor from the table and Rd is the increase (positive) or decrease (negative) in the cumulative R-value of building material layers on the outside and inside faces of the wall, excluding the continuous insulation R-value if present.

d. For a specific continuous insulation R-value not addressed in this table, the U-factor of the assembly shall be permitted to be determined as follows: Uadj = 1/[1/Unci + Rci] where Unci is the U-factor from the table for no continuous insulation (0 R-value column) and Rci is the specific rated R-value of continuous insulation added to the assembly.

e. For double wall framing, the U-factor shall be permitted to be determined by combining the U-factors for single wall framing from the table as follows: Ucombined = 1/[1/U1 + 1/U2] where U1 and U2 are the U-factors from the table for each of the adjacent parallel walls in the double wall assembly.

f. The use of insulation in accordance with this table does not supersede requirements in Section R702.7 of the International Residential Code for use of insulation and water vapor retarders to control water vapor.

RD101.2 Mass walls. *Reserved.*

RD101.3 Cold-formed steel frame walls. *Reserved.*

RD102 Roof and Ceiling Assemblies. *Reserved.*

RD103 Floor Assemblies. Reserved.

RD104 Basement Walls. *Reserved.*

RD105 Crawlspace Walls. *Reserved.*

RD106 Slabs-on-Grade. *Reserved.*

Reason: The purpose of this proposal is to provide expanded R-value options for determining compliance with the U-factor criteria prescribed in Section R402.1.2 of the IECC residential provisions. It also supplements the limited selection of common insulation conditions addressed in the R-value approach of Table R402.1.3 of the IECC. This proposal is intended to cover common wood-framed assemblies and not intended to address all assemblies at this time, but rather provides a framework for that to occur over time and address many different assembly types and options. Therefore, assembly types that are not addressed are labeled as “reserved” and those with interest in those “reserved” portions can bring forth future improvements or additions consistent with that done for Section RD101.1 for wood frame walls.
The proposal is focused on U-factor compliance options for wood frame above-grade walls (Section RD101.1) at this time because that is considered the most immediate need in the 2021 IECC residential prescriptive provisions due to the many market-available insulation methods and materials as well as different techniques to frame walls that can provide useful means to comply with the U-factors (and as supplemental alternatives to prescribed R-values). This proposal will also help to ensure that a wide-range of possible solutions are achieved in an equivalent and transparent manner. Thus, it will give support to the use of Section R102.1 by code officials often tasked with reviewing and approving alternative assemblies.

The calculations for proposed Table RD101.1 follow the same basis as used to justify the existing R-value options in Table R402.1.3. Calculations supporting this proposal can be made available to the committee upon request. However, the complete basis of the calculations are documented in footnotes to proposed Table RD101.1. Having calculations and assumptions documented in this manner will serve to make the code more transparent and compliance more consistent.

PLEASE SEE ATTACHED WORD FILE FOR PROPER FORMAT AND TABLES FOR THIS PROPOSAL.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This proposal provides additional pre-calculated options for flexibility in prescriptive compliance. In that regard, it may actually reduce cost.

Attached Files

- **211012 IECC-R, U-factor appendix for Alternative R-values (448).docx**
  https://energy.cdpaccess.com/proposal/448/973/files/download/172/

Workgroup Recommendation

Residential Energy Committee Committee Action: As Submitted

Residential Energy Committee Reason: Improves and adds flexibility in the code